THE EDIBLE DESERT:
An inventory of land suitable for urban agriculture & its economic potential in lower Washoe County, Nevada

A thesis submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN LAND USE PLANNING POLICY

By

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Abstract

This study utilized geographic information systems (GIS) software to identify and map vacant parcels of land where the establishment of urban market gardens and small-scale farms would most likely be viable, and then estimated potential crop yields and gross sales based on available land resources. Of the 100,618 parcels (62,098 acres) within the study area, 14 percent (4,603 parcels, 8,612 acres) were water-metered, vacant, and met the study's minimum suitability requirements. Based on average yields for fourteen regionally appropriate crops and local produce prices for organic goods in 2012, gross yields and sales were calculated. The findings suggest that urban growers in the Reno-Sparks-Washoe County study area could generate between $88,000 and $272,000 per acre, a range based on conventional and biointensive crop management methods, respectively. If 10 percent (861 acres) of all suitable vacant lands were cultivated, an estimated $76 million to $234 million could be generated through sales of an estimated yield of 29 to 86 million pounds of produce.

These figures were based on the assumptions that land would be at least 60 percent cultivated; that season extension infrastructure such as row covers, polyethylene-film covered hoop-house structures, or traditional greenhouses would be utilized to ensure three full growing seasons if necessary; and that 60 percent of all produce would be sold directly to consumers at organic retail prices. Costs of labor, establishment, and production were not considered due to extreme variability of site requirements and growing methods. The results highlight the importance of urban agriculture to our community's economy and food security, and its needs for greater public awareness and political and programmatic support.
Dedication

For Eelke and Marla
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Chapter 1: Introduction

1.1 Objectives

The purpose of this study was twofold. The first was to identify, quantify, and classify land capacity for agriculture within the urban, water-metered areas of Reno, Sparks, and Washoe County. The second purpose was to determine if the region has the economic potential to justify community investment in enabling, growing, and promoting the local food industry through urban agriculture. In addition, the study aims to educate local policy makers and entrepreneurs in the Truckee Meadows on the economic potential of urban agriculture as an alternative land use, and to serve as one tool of many that may help guide policy setting agendas with regard to important land use decisions.

1.2 Definitions

Urban agriculture (urban agriculture), refers to activities within urban growth boundaries which involve the growing, raising, processing, and distribution of foods and non-food (such as cut flowers) products for local sales and consumption (Mougeot 2000). This can include the raising of animals for meat and by-products, keeping of bees, horticulture, and agroforestry (fruit bearing trees and bushes), hops for beer, grapes for wine, honey for mead, and even garden compost, compost tea, worms, and worm-casting related products for sale to other gardeners or farmers. Other activities were not included in the study due to regionally inconsistent land use restrictions, although some urban farmers might engage in one or more of these practices informally, regardless of regulation. This study was restricted to vegetables and melons, as other crops and products either take more than one year to produce yields, lack yield and price
data, or fall into a grey area with local planning agencies as to which land uses are allowed, and
where.

Urban agriculture primarily differs from conventional agriculture in that it is much smaller in
scale. An urban farm urban agriculture can be as small as a few hundred square feet or be a
small or medium sized farm on tens of acres (Hodgson, Campbell, & Bailkey, 2011). For small-
scale production, biointensive growing methods are often utilized so that soil productivity and
profitability can be maximized without the use of chemical fertilizers, pesticides, and herbicides
—an important factor to consider due to the close proximity of urban agriculture to residents'
daily activities. Urban agriculture produces goods specifically targeted for local consumption,
while conventional agriculture is typically sold in large quantities to national or global
distributors. Locally produced food items are primarily sold to restaurants, food distributors,
institutional users such as schools and hospitals, nearby grocery stores, and member-based food
 cooperatives, with the majority being sold directly to consumers on-site, through CSA
(community supported agriculture) subscriptions, and at farmers’ markets (personal
communication with Nevada Small Business Development Center).

Suitable land, respective to this analysis only, refers to the absence of (1) development and
active plans for development, (2) dense vegetation, and (3) impervious surfaces -- all in areas
large enough to accommodate profitable food production (0.2 acres of aggregate parcel size
minimum). Land that is publicly owned but being leased was assumed to have a planned use,
and removed accordingly. Also excluded were planned developments that were either under
construction or approved for construction.
Commercial viability relies on many factors, such as cultural influences (i.e. market competition, distance to markets, permitting processes and costs) and parcel-specific or grower-specific improvements (i.e. soil amendment, fencing/security, site design, irrigation, grading, crop selection, and season extension). The costs of production are highly variable and unique to each parcel's location, size, perimeter, slope, exposure to wind and snow conditions, type of production, and even producers' preferences for crop management. For these reasons, the overhead costs of site improvements and production were not included in the study, and only gross yields and sales were looked at.
Chapter 2: Background

Urban agriculture helps meet local consumer demand and promotes health, food security, community engagement, and the environment, all while creating opportunities for average people to enter an otherwise capital-intensive industry (Hodgson et al., 2011). Urban agriculture has been around in North America for more than a hundred years, with planners having restricted and promoted it alternately. Agriculture was once a way of life for half of Americans, but as technology made it more efficient to farm at larger scales, all but two percent of farmers have since embraced outside job opportunities and left farming behind (Dimitri, Effland, & Conklin, 2005). Wartime labor shortages during the world wars, and the need to ship food to soldiers overseas, helped to reintroduce agriculture to cities until soldiers returned home to farm again. Small farmers were largely unable to compete with industrial farmers until recently, with today's consumers willing to pay more for locally and sustainably produced goods—and purchasing greater quantities of them each year (Dimitri & Greene, 2002). As a result, planning agencies across the country have been responding to an increased number of requests for approval to produce and sell foods on urban parcels, but in many places, land use regulations omit language addressing urban agriculture and oftentimes prohibit mixed land uses, such as residential with commercial (like living, farming, and selling directly to consumers on one parcel).

A number of factors, such as climate change, increasing fuel and food prices, poor air quality, loss of soil and prime farmland, cultural preferences, and rising healthcare costs associated with poor dietary intake may lead to increased popularity and necessity of urban agriculture (Hodgson et al., 2011). Similar to how some cities have started land banks to purchase open space and restrict urban growth to within green belts, it is possible that future cities may be
buffered by "food belts" to maintain constant supplies of local foods. With 80 percent of Americans living in urban areas today, city dwellers may one day find it difficult to afford food unless land is preserved for food production within or near cities. High-priced real estate in cities, due to urban infill from increasing urbanization, and rising fuel costs may make both urban and rural food prices skyrocket (US Census Bureau, 2010). Between the years of 2002 and 2007, more than four million acres of active agricultural land were developed in the United States, or more than an acre per minute (National Resources Conservation Service, 2007).

Specialty crop (i.e. non-commodity foods) production occurs largely in areas likely to be developed, with 91 percent of fruits and 78 percent of vegetables produced in "urban influenced" areas, putting our nation's food supply at risk for future shortages should development trends continue (NRI - FIC, 2007). Urban agriculture and food belt land banks could be set up before urbanization and infill results in pricey real estate, but planning for long-term food security is not likely to happen anytime soon with so many cities finding themselves cash-strapped already. In the meantime, new urban farmers are testing out intensive and closed-system crop production methods in cities that have enabled urban agriculture, and are trying to find models that can be both environmentally and economically sustainable. Though little statistical data exists for the specialty crops that are being produced on these urban farms, by whom, or for whom, the New American Food Culture and the romanticized urban farmer has been increasingly visible in popular culture and online social mediums.

2.1 The New American Food Culture & the New American Farmer

The New American Food Culture has been recognized by scholars, reporters, bloggers, and book authors alike. Countless documentaries tackle today's growing and evolving counter-food culture that shuns industrial food production and genetically modified foods for one that seeks
the sweetest tomatoes at the farmers market and grass fed beef. Some trace the movement's origins to the formative days of California Cuisine, which focused on using only the freshest vegetables (Starr & Adams, 2010). During this time, canned and frozen food was what the majority of families ate, with so-called "I hate to cook" books which required as little effort and few ingredients as possible (Roell & Reichl, 2013). Restaurants such as Berkeley' revolutionary Chez: Panisse which opened in 1971, have been credited with contributing to helping change the perception of food as an inconvenience. Alice Waters, the founder of Chez: Panissse, observed that people who were protesting the Vietnam War were also protesting companies (such as Dow and Monsanto) that were simultaneously making chemical weapons and pesticides for crops, yet they were eating processed foods that were produced with these companies' chemicals. She wanted to make food that had fresh ingredients and intense flavors and aromas, but wasn't satisfied with what was available in grocery stores. She found that locally grown organic produce had the characteristics that were missing in conventionally grown foods. She and her fellow chef Jeremiah Tower created seasonal menus using locally sourced items. The popularity of their recipes and non-traditional ingredients spread, and the demand for locally produced organic foods were sought after by both restaurants and at-home cooks wishing to recreate them (Taylor, 2008).

The California Cuisine sparked a food culture that has evolved into a much larger movement – one that is still political, yet speaks to more people now than ever before. While a degree of polarization exists among consumers in our food system, it is not one that falls cleanly between conservative and liberal ideologies as one might expect. Politics and policies aside, what one chooses to eat or eschew has become a reflection of our moral, ethical, and even religious values, giving new meaning to the old adage that "you are what you eat" (Ikerd, n.d.). Some
view local and organic foods as elitist and consider GMOs safe, while others view conventionally
grown foods as environmentally irresponsible, unsafe, and inferior in taste and quality (Oz,
2012).

On one hand, commodity-based foods made from mainly corn, soy, and wheat have resulted in
the cheapest food in the world in proportion to household income, freeing up household
income for other expenses. With inflation factored in, prices have been steadily decreasing
since peak prices during the 1989 energy crisis (Mendes, 2012; USDA, 2013). United States farm
policies were successful in generating cheap and abundant food, but several unintended
consequences occurred as well, such as increased farm sizes and fewer farms overall (Dimitri et
al., 2005). The USDA’s motto of "get big or get out" has made it difficult for new farmers to
enter the workforce, as middle class Americans lack the substantial capital necessary to
purchase land and equipment. Even small farming can be difficult to be successful in, as
subsidies are primarily given to large commodity crop growers.

According to the Census of Agriculture, new farms tend to be smaller and provide only
supplemental income, with 2/3rds of operators holding outside employment. Of the new farms
that started between 2002 and 2007, operators were nine years younger on average (NASS,
2007). Urban farming is especially attractive to young people, as it makes it possible to have a
day job and remain financially secure until farming becomes financially sustainable. Agricultural
marketing statistics are unable to capture and illustrate the cultural shift that is taking place in
America, but one would not need to look far in every day culture to see it for oneself. In
documentaries, blogs, and films, the urban farmer has been depicted as hippies, foodies,
hipsters, women, immigrants, young people, and retirees following their dream – a far cry from
the stereotypical rural cowboy farmers of our past, as advertised in the 2013 Dodge Super Bowl
ad, "So God Made a Farmer" (Haglund, 2013). A magazine and online site called *Modern Farmer* aims to speak to today's younger farmers with visually enticing articles on aquaculture and cultivation of interesting new crops.

The *New York Times* described it as a "farmer-foodie culture, which demands grass-fed and pasture-raised meats," (Raferty, 2011) a culture willing to make sacrifices in order to reconnect with food after a generation of factory farming. The *Times* mentions that there is a knowledge gap between the very old farmers, who grew diverse crops by hand, and today's young farmers who are trying to return to such practices, because of "the lost generation – people [the current generation's] parents' age [that] may farm but do not know how to grow food" (Raferty, 2011).

Urban agriculture has long been a practice that appeared when needed and only lasted as long as viable, such with the Victory Gardens of both World War I and II. Its health, environmental, social, and economic benefits are recognized in planning as an important part of a larger strategy for addressing the most pressing challenges of the twenty-first century – from climate change to obesity (Brinkley, 2012). Today, it has become increasingly incorporated into the vernacular landscape. Evidence of the New American Food Culture's stronghold can be found in the growing number of farmers' markets, community supported agriculture (CSA) subscriptions, restaurants advertising locally grown ingredients. The impact that community-based decisions have on food systems, and consequentially on the environment, economy, and peoples' health, were once just afterthoughts. Today, with farmland disappearing at an alarming rate and access to healthy fresh food for cities’ socioeconomically disadvantaged populations, local jurisdictions all across the US have begun to recognize the need for farmland preservation and other measures, and consequentially have begun to incorporate farmland preservation and food security earlier on in decision-making processes (Hodgson et al., 2011).
2.2 Geographical Context

Organic produce sales more than doubled from 2004 to 2011 nationally, shooting from 11 to 25 billion dollars in that time (Dimitri & Greene, 2002), and it's likely that the nation's actual appetite for organic produce is much higher, as many organic farmers may not be officially certified. Locally produced food was found to fetch a higher price than organic food by one study in Colorado (Loureiro & Hine, 2002), and the same price as imported organic foods by another study (Yue & Tong, 2009). These studies may indicate that incentives may be lacking for small farmers to invest in certification, even if their local produce would meet or exceed official standards. Organic certification requires a three year transition period of inspected organic production and meticulous record keeping, which may require more time, money, and labor than a part-time small farmer can afford.

A number of local efforts to assess and improve aspects of our food system suggest that the community would support the inclusion of food related goals into regional and city planning documents. Washoe County’s Division of Health Washoe County Health District (WCHD) has already taken a number of steps to promote healthier eating and greater food security. After reviewing the largest health threats to Washoe County residents, the WCHD reviewed all county plans and policies to see if they promoted or prevented those threats. They discovered that plans and policies were lacking around food security and healthy eating, possibly contributing to the county's 40 percent of adults that are overweight or obese, and 34% of children. Nearly 50,000 school-aged children received emergency food assistance in 2010 and 40% were eligible for free or reduced school lunches.

With a grant, the County developed a framework for how to improve policies that impact access, security, and acceptance of healthy, fresh foods (Washoe County Health District, 2011).
One of the outcomes of this framework was the creation of the Washoe County Food Policy Council, which is charged with advising local policy makers on the importance of planning for better health, and where to start.

Local producers and food advocates also meet quarterly as the Local Food Network to discuss challenges and solutions to the production of food here. Urban Roots is a local non-profit that was started in an attempt to fill the gap in education, as few school gardens existed when they started. Other organizations, both non-profit and at the state government level, exist to promote local agriculture and the support of local businesses in general. Despite all of these efforts, policy makers have not shown a clear stance on the value of building and maintaining a healthy food system. In September of 2012, the Reno City Council made the progressive move, at the request of two agricultural entrepreneurs wishing to start a farm on downtown commercial property, to define and regulate urban agriculture and on-site produce sales, including hens and bees, in all areas of the city (Hennefer, 2013). Yet in March of 2013, this same Council approved a planned unit development on active farmland along the Truckee River, outraging many local food advocates and residents concerned about flooding impacts (Duggan, 2013; Powers, 2013). Politics and policy outcomes aside, the community's active engagement in the political process is indicative of a strong bottom-up local food movement in Washoe County that mirrors those found across the other urban areas.

The Washoe County region has the advantage of having an established food hub which features a food storage facility and specialized website for connecting producers with buyers. The Distributors of Regional Organic Produce and Products (DROPP) in Reno allows restaurants, schools, and other bulk users to learn more about producers, see what is fresh and seasonal, and make purchases. A large walk-in freezer stores meat and other products available for
DROPP sales. The site collects and distributes food waste back to farmers as well, but on a small scale. The Great Basin Community Food Cooperative (GBCFC) hosts DROPP at its store and sells over one million dollars in retail annually. As local demand has not been completely met by local supply, the GBFC has been importing the next best thing – foods from northern California. Based on DROPP records for crops suited to growing in Northern Nevada, sales of products imported from California were more than twice that of locally sourced produce.

In the fall of 2011, County Commissioners Kitty Jung and Bonnie Weber requested that their Community Development Department review Washoe County's development ordinances to identify barriers to urban agriculture, discuss recent requests regarding food production as a land use, and to recommend amendments to the Washoe County Regional Plan (personal communication with W.C. planning staff). Senior Planner Chad Geisinger conducted this research and reported back to the Commission, leading to a number of code changes. Aquaculture was included in the definition of animal production, and mobile animal slaughtering was included as a new use. Land use zones were changed to allow agricultural sales on site, and to allow temporary produce sales in all zones.

In Reno, the Building Enterprise Fund Advisory Committee (BEFAC) has been consulting with the Washoe County Food Policy Council (WCFPC) on ways to make hoop-house construction requirements clearer, more practical, and more accessible to average residents who are not well versed with regard to building codes and permits. At a public BEFAC meeting in July, 2013, the WCFPC suggested the streamlining of building codes and permits, the provision of training to city staff so that all related questions will be accurately answered, and possibly the online hosting of an illustrated guide on how to safely and legally build a hoop-house. It is anticipated that the economic opportunities that exist for meeting local food demands could soon instigate
a broader regional discussion on how to incorporate not just agriculture, but food systems planning as a whole into regional and city master plans and policies.

2.3 Urban Agriculture in Practice

A number of prerequisites must be met in order for urban farms to thrive. The degree to which these factors are met may impact yields, grade of produce, sales, and profit margins. These factors include:

- Climate, weather, and/or appropriate frost protection where necessary
- Solar radiation
- Insects and pests
- Access to land
- Access to capital
- Secure land tenure
- Healthy, uncontaminated soil
- Water
- Labor
- Financial and technical assistance
- Agricultural training and expertise
- Processing and transportation infrastructure
- Distribution channels
- Consumer demand
- Methods for crop management
- Viable markets

(Hodgson et al., 2011; Veenhuizen, 2006)

In siting a garden or farm that will be worked by hand without the use of large machinery, gentle slopes can make growing easier, especially where flood irrigation is used or plants that thrive in drier soils (such as grape vines) are cultivated. Steep slopes will result in soil erosion and instability if not terraced, although terracing slopes is costly. Steep slopes also make season extension infrastructure more difficult and costly to install.
Aspect, the horizontal direction that a slope faces, is measured in degrees clockwise, with 0 (or 360) degrees being north facing, with 180 degrees directly facing south. Aspect greatly impacts soil moisture and depth when insolation and wind are considered. Windward (western) slopes tend to have shallower soils, while slopes that receive morning sun (northeastern slopes) tend to stay cooler and moister, with slower snowmelt times and greater likelihood for crop-damaging frosts. Areas that receive sun in the morning when temperatures are cooler have lower average soil temperatures than areas that receive afternoon sun. Greater insolation positively relates with vegetative growth, thus the ideal conditions for growing summer crops would occur on southeast, south, southwest, and west facing slopes, or between 112.5° to 292.5°. As cool season crops like lettuce and kale would suffer during the summer months in that aspect range but be viable on north and northeastern slopes, all slope aspects should be considered for growing. Parcel aspect would need to be evaluated by potential growers to ensure that the aspect is compatible with the crops they wish to grow, and that no nearby structures are shading the land.

Daily temperature highs and lows, diurnal temperatures, as well as the average length of the frost-free growing season are key considerations. Season extension infrastructure including cold frames, row covers, hoop-houses, or greenhouses, are necessary in this region in order to prevent frost damage and allow slower crops to fully mature. Many plants, particularly those in the nightshade family such as tomato plants, need to be seeded indoors or under protective covering and later transplanted outdoors, or grown under a protective covering until maturity, as strong winds and frosts can be damaging to crops. Nevada has frequent wind storms, which requires heavier, stronger, and often costlier season extension infrastructure.
The Soil Survey Geographic Database (SSURGO) data available for this region (See Figure 4.2) is pre-classified for farmland potential, but the resolution is too generalized at 30 meters to be useful for inventory purposes. All growers in urban areas should have testing done to determine site-level soil opportunities and challenges, including heavy metals and other pollutants that could potentially be leached into foods.

With short growing seasons and unpredictable frosts, hoop-houses have created opportunities for local producers to step up and meet this demand in even the least temperate of climates. Northwestern Nevada has a short growing season of 90 days, while many plants wouldn’t mature until weeks after that. Hoop-houses are not greenhouses, as they are temporary (often portable) structures consisting of bent metal or PVC pipes, covered with polyethylene film. They are not as insulated as a greenhouse, and thus do not allow year round production, but are useful for planting spring crops sooner, and allowing summer and fall crops more time for plants to reach maturity if necessary.

Hoop-style row covers, which hover directly over plants and are too small to walk under, can cost as little as $1.50 per square foot, while pre-engineered Gothic arch high tunnels can cost around $4 per square foot (JohnnySeeds.com, 2013). Permitting and engineering are not required for structures less than 200 square feet in the region unless plumbing and irrigation are installed. While row covers can extend seasons by a few weeks, hoop-houses can extend the season by up to two months in the spring, and another two months in the fall – especially where water walls or aquaponics are utilized to conserve radiant heat and keep the structures warm at night. A number of barriers exist locally that prevent growers from producing local food, including hoop-house construction, but in Reno and Washoe County specifically, policy makers
have tasked staff with looking into various improvements, and been receptive to growers’ suggestions.

For small producers, methods of crop management (i.e. organic, biointensive, hydroponic, aquaponics, conventional) significantly impact both costs and profitability. Production costs for organic farms are higher despite not using pesticides, fertilizers, or herbicides; mostly due to the increase in labor required for weeding and maintaining soil health (NASS, 2007). A 2008 survey found that organic farmers spent an average of $171,978, compared to the national average of $109,359, yet their higher total sales and greater profit margins more than mitigated for the higher costs of production. The same survey found that organic farms sold $217,675 on average, compared with $134,807 nationally, for organic and conventional combined (USDA NASS, 2008). Although the 2013 survey has not yet been published, the 2008 survey results indicated that 78 percent of all certified organic and exempt producers planned on maintaining or increasing their production, with only 6.4 percent intending to reduce or phase out organic production (USDA NASS, 2008). These trends all support two important considerations for small scale farmers: First that the demand for organic and/or locally produced foods does not appear to be slowing any time soon; and second, that organic and locally produced foods have higher profit margins than conventionally produced goods.

Nationally, farmers’ markets have quadrupled from 1,755 in 1994 to nearly 8,000 in 2012 (Agricultural Marketing Service, 2012). The 2007 US Agricultural Census found that 136,817 self-reporting farms were selling agricultural products directly to consumers—a 17.2 percent increase from 2002. Most of these farms were small in scale, making less than $250,000 in annual sales and representing 56.7 percent of all direct-to-consumer sales, and more than 93 percent of all farms making direct sales. The USDA Agricultural Marketing Service's data shows
that the demand for local and organic food production has been consistently outpacing supply (Agricultural Marketing Service, 2012).

Where demands are not being met locally – but could be – an opportunity exists for investigating why it isn’t being met locally, and if and how it could be done profitably. This study aims to lay the groundwork for that research by determining how much land is available for production, and what scale of direct economic benefit urban agriculture would have for the local community.
Chapter 3: Related Work

A growing number of inventories and GIS-based land suitability assessments exist, as well as several studies that have projected the yields of urban agriculture (urban agriculture) at a city or regional scale. These studies’ motivations and methods are discussed in this chapter, as well as the broader community impact of using vacant land for food production.

3.1 Land Inventories & Suitability Indices

Cities and counties have been increasingly conducting inventories and suitability assessments in Canada and the United States with objectives ranging from finding the best sites for community gardens to mapping vacant land for market gardeners looking for sites to lease. A review of these inventories was completed to inform the purpose, methods, and results of this study.

Notable cities which have conducted comparable inventories include Boston, Cincinnati, Cleveland/Cuyahoga County, Detroit, New York, Oakland, Portland, San Francisco, Toronto, Seattle, and Vancouver. The studies compiled in Table 2.1 below, were adapted from Horst's 2011 literature review, with the addition of the 2013 Boston inventory (Chin, Infahsaeng, Jakus, & Oorthuys, 2013).

Table 3.1: Comparison of urban agriculture Land Inventories by City

<table>
<thead>
<tr>
<th>City</th>
<th>Considered</th>
<th>Criteria</th>
<th>Purpose</th>
<th>Initiators</th>
<th>Strengths</th>
<th>Results Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston (2013)</td>
<td>Vacant, publicly owned parcels</td>
<td>Size, slope, and light exposure</td>
<td>Identify land suitable for urban agriculture</td>
<td>Mayoral directive and Tufts U.</td>
<td>Comprehensive and repeatable methods</td>
<td>Online Report</td>
</tr>
<tr>
<td>Cincinnati (Date Unknown)</td>
<td>Vacant public properties</td>
<td>Size, tree coverage, slope.</td>
<td>Identify fifteen properties leasable to gardeners</td>
<td>City of Cincinnati</td>
<td>Immediate use for property leasing program</td>
<td>No longer available, not published.</td>
</tr>
<tr>
<td>Location</td>
<td>Area of Focus</td>
<td>Land Features Considered</td>
<td>Analysis Focus</td>
<td>Collaborators</td>
<td>Methodology/Resource</td>
<td>Source</td>
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<tr>
<td>Cuyahoga County / Cleveland 2009</td>
<td>Vacant public and private lands; Excluded brownfields and riparian zones</td>
<td>Size, tree coverage, zoning, &amp; soil</td>
<td>Identify land suitable for urban agriculture for Cuyahoga Land Bank</td>
<td>Cleveland-Cuyahoga Food Policy Coalition</td>
<td>Sophisticated landcover measurement for forest cover</td>
<td>Conference Proceedings</td>
</tr>
<tr>
<td>Detroit 2012</td>
<td>All vacant parcels without structures, owned by the state, county, city and local land bank, excluding parks</td>
<td>None. No sites were removed from analysis</td>
<td>Identify land suitable for urban agriculture and estimate production potential</td>
<td>MSU students</td>
<td>Reported on perspectives by city residents on desirability and role of urban agriculture</td>
<td>Capstone Project; Online report available through Wayne State University</td>
</tr>
<tr>
<td>New York City 2012</td>
<td>All vacant public and private lands. Also evaluating rooftops</td>
<td>Solar access. A rooftop criterion includes size, slope, zoning, year of structure</td>
<td>Estimate potential implications for food production, waste, storm water run-off, and energy on urban agriculture lands</td>
<td>Columbia University, Earth Institute</td>
<td>Comprehensive reach</td>
<td>Interactive Website</td>
</tr>
<tr>
<td>Oakland 2010</td>
<td>All public land. Includes vacant and “fallow” properties such as fields, lawns, and some derelict parking lots</td>
<td>Size, slope, transit access, proximity to school, water access</td>
<td>Identify land suitable for urban agriculture and estimate production potential</td>
<td>Mayor’s Office via an Oakland Food System Assessment action item, completed by UC Berkeley student</td>
<td>Includes forested and steep slopes, which can be used for agroforestry. Interactive online map</td>
<td>Ph.D. Dissertation by UC Berkeley Student, Nate McClintock</td>
</tr>
<tr>
<td>Portland 2009</td>
<td>Individual parcels under mgmt. of particular Bureaus; Excluded parcels with buildings, developed parks, environmental zoning or in floodplains or wetlands</td>
<td>Size, slope, tree coverage, bus, bike and walking access, water access, parking, visual assessment</td>
<td>Identify land suitable for urban agriculture</td>
<td>City Council resolution, completed by PSU students</td>
<td>Pioneering effort. Highly involved advisory committee. Detailed</td>
<td>Diggable City Online Report</td>
</tr>
<tr>
<td>San Francisco 2012</td>
<td>Vacant/surplus parcels owned by particular agencies, including libraries; Excluded sites with streams / wetlands</td>
<td>Size, light, transit access, parking</td>
<td>Identify lands suitable for community gardens.</td>
<td>Mayor’s executive directive, completed by staff; Lobbied for by affordable housing office</td>
<td>Detailed description of methodology</td>
<td>Online Report</td>
</tr>
<tr>
<td>Seattle 2008</td>
<td>Vacant and under-used public properties, schools, public parks, and right-of-way along trails and transmission lines; Flat roofs on schools</td>
<td>Size, slope, transit access, parking availability, proximity to schools and other urban agriculture, density, socio-economic indicators</td>
<td>Identify land suitable for community gardens.</td>
<td>City Council resolution, completed by UW student</td>
<td>Included lands not typically considered, like rights-of-way</td>
<td>Online Report by Megan Horst, University of Washington Student</td>
</tr>
<tr>
<td>Vancouver 2006</td>
<td>Vacant public land, as identified by the Departments of Engineering Services and Public Works</td>
<td>Size, slope, distance to other urban agriculture, personal assessment</td>
<td>Identify land suitable for urban agriculture</td>
<td>City of Vancouver, UBC student</td>
<td>Considered rooftops</td>
<td>Graduate work by Terra M. Kaethler</td>
</tr>
</tbody>
</table>

(Chin et al., 2013; Horst, 2011)

In these examples, inventories were typically conducted as a result of policy, and often in collaboration with local universities and/or government agencies. In some cities, inventories were conducted through applied academic research, with findings published and/or presented to local policy makers as a tool for making land use decisions. These studies utilized existing secondary data without commissioning further data collection – and the types and resolutions of available data varied greatly from city to city. Where gaps existed between the time data were collected and inventories were begun, results were checked against the most recent aerial imagery and physical site visits. These studies each considered a unique combination of basic site characteristics, such as slope, access to water, proximity to roads and/or public transportation, census based food security indicators, impervious surface, tree canopy, status of land ownership, soil characteristics, zoning, and existing land uses (Horst 2011).

A more detailed look at each of the inventories' methods and results revealed that GIS methods varied greatly, and that few studies documented their methods enough such they could be
repeated. The most accurate method for precisely mapping all suitable and undeveloped land utilized LIDAR (Light Detection and Ranging) or four-band infrared data to classify parcels by their land cover, such as developed, impervious, tree canopy, grassland, dense vegetation, barren land, and open water (Managad 2012). LIDAR data is extremely cost prohibitive and not yet available in many areas (Comis 2010), including this study area. In studies that used either of these two data formats, further analysis was still required to find the most suitable slopes using digital elevation data and soil analysis, but time was saved by not needing to manually check thousands of individual parcels against satellite imagery or conduct site visits in person.

Where neither LIDAR nor four-band infrared data existed, analysis required more time and human input. The limited-data methodology relied mainly on parcel and assessor data to find parcels that were not developed. Unfortunately, this created at least two opportunities for human error, including during normal data collection and maintenance work done by community planners and public assessors’ offices, and during the visual inspection phase of an inventory. Other available layers, such as roads, water features, and building footprints, were used to refine the results, or introduce more error depending on the accuracy of supplemental data. When LIDAR data was utilized, unused portions of parcels could be considered as suitable for urban agriculture; however this was time prohibitive where it was necessary to manually trace, or digitize, developed and undeveloped portions of parcels. For these reasons, where LIDAR or infrared data did not exist, analyses were restricted to the parcel level.
3.2 Estimating Yields & Economic Potential of Agriculture

While no studies to date have discussed methods for estimating the economic potential of small-scale urban agriculture on all vacant land as a whole, researcher Joe Kovach estimated that one could generate $90,000 in sales per acre using integrated pest management (OARC, 2005). His methods of estimation and assumptions of production were not discussed, and other research was sparse. Profit margins have been estimated to be around 15-20% for conventional farms, and 40-50% for intensive small-scale farms, however no statistical data has been collected by the USDA for comparison (Ikerd, 2007).
Chapter 4: Study Area

The study area encompasses all areas within and around Reno and Sparks that are serviced by the region’s largest water purveyor, Truckee Meadows Water Authority (TMWA). This boundary includes 70,187 acres of semi-arid steppe land with a short growing season of 90 to 100 frost-free days, contributing to low crop yields from short harvest seasons.
According to the 2013 Nevada Agriculture Report produced by the Governor's Office of Economic Development, agriculture is an emerging sector – one that is developing, but not comparable to other states’ agricultural sectors yet (Northern Nevada Development Authority,
The report estimated, based on 2010 data, that the overall economic impact of agriculture on Nevada was $5.3 billion, including direct, indirect, and induced impacts, with $149.5 million in vegetable and melon crops alone. The main commodities were meat (37%), feed crops (22%), dairy products (22%), vegetables and melons (20%), and other crops (3.8%).

Agriculture is steadily growing, with 22.6% of Nevada farmers expecting to add jobs in the next year, and 73.8% expecting to maintain current employee numbers. According to the report's survey of Nevada farmers, their biggest barriers to business growth isn't the short growing season, poor soils, or other biophysical restrictions, but laws and regulations (23%), transportation costs (20.9%), and cost or availability of goods or materials (15.3%). Local consumers and processors purchased 40.5% of respondents' products (Northern Nevada Development Authority, 2013). From these responses, it can be deduced that local farmers want to reduce transportation costs and rely heavily on direct-to-consumer sales. If production costs could be reduced through increased local sales, as transporting goods fewer miles reduces fuel usage, and the regulatory environment for growing and selling foods in urban areas were to be relaxed, it may entice new farmers to try small-scale food production and current farmers to expand their operations. With the 2013 passage of a cottage food law (NRS 446.020) which allows certain value-added products to be produced in a home kitchen and sold directly to consumers, the regulatory environment appears ripe to work with local farmers and grow the state's food economy (University of Nevada Cooperative Extension, 2013). This thesis work builds upon current efforts to increase food production in Nevada by providing a tool for both policy makers and growers alike, while increasing awareness of the industry's potential.
Chapter 5: Methods

This chapter discusses the data, criteria, and methodological framework used for assessing the region's agricultural land assets and economic potential.

5.1 Land Capacity Inventory

Available data were collected and analyzed for capacity to contribute to the inventory. Both public and private land was considered, but only parcels which were entirely or mostly vacant, with no buildings larger than a utility structure (120 sf), such as a shed or a barn. Green fields and pastures were included however, as it is unknown whether or not they were being used for food production or equestrian purposes. Parks, golf courses, water bodies, roads, and schools were removed, as well as steep slopes and brownfields. The inventory used secondary geospatial data, as well as primary qualitative data (Table 5.1), and was queried using ESRI ArcMap 10.0. The parcel geometry and attributes were maintained by the Washoe County Community Development (WCCD) agency and Washoe County Assessor’s office (WCA).

Table 5.1: Data Sources

<table>
<thead>
<tr>
<th>Data</th>
<th>Format</th>
<th>Source</th>
<th>Version</th>
<th>Date Accessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Meter NAIP Orthographic Imagery</td>
<td>Raster</td>
<td>National Agriculture Imagery Program datagateway.nrcs.usda.gov</td>
<td>2010</td>
<td>21-May-13</td>
</tr>
<tr>
<td>NCRS Soil Classification</td>
<td>Polygons</td>
<td>Natural Resources Conservation Service soildatamart.nrcs.usda.gov</td>
<td>n.d.</td>
<td>21-May-13</td>
</tr>
<tr>
<td>Assessor's Attributes</td>
<td>Table</td>
<td>Washoe County Assessor’s Office <a href="http://www.washoe">www.washoe</a> county.us/assessor/dl.htm</td>
<td>2013</td>
<td>20-May-13</td>
</tr>
<tr>
<td>TMWA Retail Area</td>
<td>Polygons</td>
<td>Truckee Meadows Regional Planning Agency Personal Contact: Jeremy Smith</td>
<td>2012</td>
<td>15-Aug-12</td>
</tr>
<tr>
<td><strong>Residential Units</strong></td>
<td>Points</td>
<td>Washoe County Community Development Personal Contact: Chad Geisinger</td>
<td>2012</td>
<td>30-Sep-12</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------</td>
<td>---------------------------------------------------------------</td>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>Parks</strong></td>
<td>Polygons</td>
<td>Washoe County Community Development <a href="http://www.washoecounty.us/GIS/datawarehouse.htm">www.washoecounty.us/GIS/datawarehouse.htm</a></td>
<td>2012</td>
<td>30-Sep-12</td>
</tr>
<tr>
<td><strong>Schools</strong></td>
<td>Points</td>
<td>Washoe County Community Development <a href="http://www.washoecounty.us/GIS/datawarehouse.htm">www.washoecounty.us/GIS/datawarehouse.htm</a></td>
<td>2012</td>
<td>30-Sep-12</td>
</tr>
<tr>
<td><strong>Water Bodies</strong></td>
<td>Polygons</td>
<td>Washoe County Community Development <a href="http://www.washoecounty.us/GIS/datawarehouse.htm">www.washoecounty.us/GIS/datawarehouse.htm</a></td>
<td>2012</td>
<td>30-Sep-12</td>
</tr>
<tr>
<td><strong>Parcels</strong></td>
<td>Polygons</td>
<td>Northern Nevada Small Business Dev. Center Personal Contact: Brian Bonnenfant</td>
<td>2012</td>
<td>28-Apr-13</td>
</tr>
<tr>
<td><strong>10 Meter Digital Elevation Matrix (DEM)</strong></td>
<td>Raster</td>
<td>U.S. Geological Survey (USGS), EROS Data Center datagateway.nrcs.usda.gov</td>
<td>unknown</td>
<td>30-Sep-12</td>
</tr>
</tbody>
</table>

The main GIS objective was to find all land which met basic data-driven criteria for food production. Criteria for "suitable" parcels were based on what data were both available for this region and appropriate. Criteria included:

1. No Visible Development, Recreation (other than paths), or Landscaping
2. Access to Truckee Meadows Water Authority (TMWA) Water Meter
3. Average Parcel Slopes of Less than 30% Rise
4. No EPA Brownfield Status
5. No Areas within 50 Feet of Water
6. At least 0.2 Acres in contiguous land (small adjacent parcels can be aggregated to meet this requirement)

Vacant land was found at the parcel level due to lack of more refined LIDAR or infrared data for this region. Vacant undeveloped land could theoretically be quantified for each parcel by taking the total area and subtracting building square-footage; however these attributes were missing for many parcels' records and thus were not reliable. Parcels that contained more than 25% landscaping or otherwise appeared to physically restrict crop production were excluded. As irrigation is an essential requirement for any farm in arid regions, only areas with water meters were considered. Slopes greater than 30% were considered too steep in the Oakland inventory; Seattle considered slopes up to 40%; and Portland and Vancouver only up to 10% (Horst, 2008).
Crops such as grapes and fruit trees may thrive on slopes, but the clay-dominant soil composition here drains poorly and cultivation would be likely to create slope failures, thus 30% was estimated to be the regionally appropriate maximum.

Based on lessons learned from the Oakland study, EPA brownfield sites were removed in order to prevent growers from accidentally selecting sites with polluted soils (Mcclintock & Cooper, 2010). As it is important to leave a safety buffer around water features in order to protect banks from erosion, keep nitrates from going into the water, and to preserve space for wildlife, all areas within 50 feet were omitted. For pocket gardens and community gardens, scale is not as important of an issue as it is for market gardening. Most studies were not inventoried for profit alone and considered sites as small as a few hundred square feet. One fourth of an acre was used in Cuyahoga County, and 10,000 square feet in Boston. This study aimed for something in the middle, at 0.2 acres (8,712 sf). However, smaller parcels could be used for profitably producing high-value crops, such as herbs, specialty peppers, or cut flowers, which were not included in this study.

For the first step, all data was clipped to the general TWMA service boundary. Inspection of the parcel data showed that many parcels lacked attributes that would alert you that they were developed, yet the aerial imagery showed structures on the property. In other cases, buildings had been torn down and their sites cleared, but their building attributes remained. To address these issues, a tool was created in ESRI ModelBuilder that checked each parcel for a number of clues, and tallied them up in two different fields. One field was a counter, that counted any attribute occurrences related to development, and the other field recorded and concatenated abbreviations for what types of development attributes were present (See Appendix A for model flowchart, python code, and table of abbreviations).
Once these were generated, parcels were evaluated visually in groups to see which attributes were most indicative of development. Certain abbreviations were flagged as having attributes that didn’t accurately indicate land use (a table of these, and the number of occurrences found, are at the end of Appendix A). More than 8,000 parcels were checked visually by overlaying parcel polygons on top of satellite imagery, and marked as one of the following categories (which accomplished the first two criteria):

1. Vacant
2. No Water
3. Planned Development
4. Developed

With land use and access to water meters mapped (Appendix B), a slope map was generated from a ten-meter resolution DEM file. Zonal Statistics was used to get the average slope value, in percent rise, for each parcel. Parcels with slopes greater than or equal to 30 were removed, as slope stability, erosion, and intensive labor would be highly restrictive of urban agriculture.

EPA brownfield sites were removed from the analysis by geocoding their coordinates and selecting parcels that contained any points. Finally, water bodies were buffered by 50 feet and removed from the analysis, as agriculture could endanger ecologically sensitive areas through erosion and the leaching of nitrates into nearby water features. Final maps were generated to show suitable parcels, and classify them by their slopes (Appendix C). Table 6.1 summarizes the results of this process.

5.2 Projecting Gross Sales

Very generally, gross sales for produced goods can be projected by multiplying crop yields by respective retail prices. Projecting actual sales would be far more complex as scale, crop selection, crop management, biophysical influences, supply and demand, and cultural
preferences can result in varying yields, grades of produce, demand, and prices. To capture some of this variation in the sales estimates, a range of minimum and maximum yields for a number of regionally appropriate crops were used.

Understanding local price trends and profitability requirements was necessary for knowing which data to use, and how to interpret it. To do this, a local expert and the owner of Lattin Farms in Fallon, Nevada, which cultivates 58 acres of organic crops, was consulted. Rick Lattin works for the Nevada Cooperative Extension and Small Business Development Center at the University of Nevada as a mentor for beginning small farmers. Through personal communication, Lattin estimated that for small farms to be successful, they must sell at least half of their products directly to consumers, at full retail prices. Direct-to-consumer sales can consist of on-site farm stand sales, roadside sales, farmers' market sales, or community supported agriculture (CSA) subscriptions. Ideally, the remainder of products not sold direct-to-consumer would be grown specifically for local restaurants and bulk institutional users, such as schools. Lattin said that Community Supported Agriculture subscriptions and restaurant contracts are the best way for small scale farmers to mitigate risks associated with a bad growing season or other circumstances beyond their control, as they don't have subsidies or crop insurance to fall back on like industrial farmers do. In cases where excess produce cannot be sold directly to consumers or to bulk users locally, farmers can either sell to larger distributers at or below the cost of production, or produce value-added goods, such as jams, pickles, or salsa, in accordance with the state's new cottage food law.

No studies have developed a framework for estimating regional produce sales, and no historical data exists at the local scale. Therefore, this study estimates that 60 percent of sales will be made direct to consumer, and 40% to wholesale buyers. Sales records for most of 2012 were
obtained from the region's only local food hub, the Distributors of Regional and Organic Produce and Products (DROPP). Each DROPP sale was categorized into general crop categories. For example, all carrots, specialty or not, were categorized as just "carrots." Crops that were not reliably productive or viable in this region were not included. After cleaning the data and averaging annual crop prices per unit, the numbers were crosschecked with a pricelist from Veritable Vegetable, a wholesale distributor from San Francisco that delivers produce to the Great Basin Food Coop when local supply isn't enough to stock their shelves. The standard markup of this produce is 38%, and thus retail prices were not collected, but calculated by multiplying wholesale DROPP prices by 1.38. Prices were all converted to dollars per pound.

Yields data was obtained from two sources representing different crop management techniques. Self-reported crop yields from 2012 (and 2001 when more recent data was not available) were collected from USDA's National Agricultural Statistics Service to represent conventional single-crop growing methods. These yields represent the minimum potential yields that one could expect to produce, but were not intended to imply that conventional industrial-style growing methods would be utilized. One of the primary assumptions of this analysis was that all food would be grown organically, even if not certified, in order to fetch the highest prices at market and capture the highest profit margins. As in Oakland's inventory, this study used biointensive yields (Jeavons, 2012; Mcclintock & Cooper, 2010) to estimate the maximum potential crop yields. Jeavons lists three yields for each crop, representing low, medium, and high intensities. The highly intensive yields were considered too ambitious for this region, thus the medium biointensive yields were used.

In all, 14 regionally appropriate crops had DROPP data, USDA yields, and biointensive yields listed, and were therefore able to be compared with regard to value per square foot (Table 5.2).
Biointensive and conventional yields per square foot were averaged for both summer crops and cool season crops, producing four values: average biointensive summer yield, average biointensive cool season yield, average convention summer yield, and average convention cool season yield. To estimate production and sales per acre, two equations were used. The first one, equation 5.1, estimates the value of one crop per acre, depending on growing methods, and with 40% of land assumed to be used for utility purposes.

\[
\begin{align*}
\text{Equation 5.1: } & \quad \text{Seasonal value of conventionally and bio-intensively managed crops, per acre} \\
& \quad v(x) = 0.6 y(x) \times [0.4 w(x) + 0.6 w(x)1.38] \times 43,560 \text{ sqft} \\
\text{Where:} \\
& \quad (x) \quad \text{represents any one crop} \\
& \quad v(x) \quad \text{represents the estimated seasonal value of crop } x, \text{ per acre} \\
& \quad y(x) \quad \text{represents the average seasonal bio-intensive yield for crop } x, \text{ per square foot} \\
& \quad w(x) \quad \text{represents the average wholesale DROPP price for the given crop } x, \text{ per pound}
\end{align*}
\]

\[
\begin{align*}
\text{Equation 5.2: } & \quad \text{Annual sales projections for conventionally and bio-intensively managed crops, per acre} \\
& \quad v(m) = 0.6 (s + 2c) \\
\text{Where:} \\
& \quad (m) \quad \text{is the growing method – biointensive or conventional} \\
& \quad S \quad \text{is the average seasonal value of all summer crops, per acre} \\
& \quad C \quad \text{is the average seasonal value of all cool season crops, per acre}
\end{align*}
\]

Average summer crop values, per square foot were multiplied by 43,560 square feet (one acre), and added to twice the average cool season crop values (the doubled cool season crop averages represent both spring and fall harvests). Finally, these numbers were reduced by 40% to allow enough land for parking, paths, composting, on-site sales, seed production, storage, and other related purposes. To estimate the region's agricultural potential, these numbers were multiplied times the total amount of land that met the study's basic criteria.
<table>
<thead>
<tr>
<th>Season</th>
<th>Crop</th>
<th>Local Wholesale Prices, $ per lb</th>
<th>Local Retail Prices, $ per lb</th>
<th>USDA Conventional Yields, LB per SF</th>
<th>Biointensive Yields, LB per SF</th>
<th>Conventional Profit, $ per Acre (USDA Yield and Organic Price)</th>
<th>Biointensive Profit, $ per Acre (Biointensive Yield and Organic Price)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asparagus</td>
<td>$4.22</td>
<td>$5.83</td>
<td>0.07</td>
<td>0.19</td>
<td>$9,332</td>
<td>$25,745</td>
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<tr>
<td></td>
<td>Carrot</td>
<td>$0.97</td>
<td>$1.34</td>
<td>0.76</td>
<td>1.50</td>
<td>$23,679</td>
<td>$46,742</td>
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<tr>
<td></td>
<td>Garlic</td>
<td>$3.00</td>
<td>$4.14</td>
<td>0.38</td>
<td>1.20</td>
<td>$36,693</td>
<td>$115,542</td>
</tr>
<tr>
<td></td>
<td>Greens, Kale</td>
<td>$2.19</td>
<td>$3.02</td>
<td>0.41</td>
<td>1.14</td>
<td>$28,883</td>
<td>$80,128</td>
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<tr>
<td></td>
<td>Greens, Lettuce (Leaf)</td>
<td>$1.02</td>
<td>$1.41</td>
<td>0.56</td>
<td>2.02</td>
<td>$18,337</td>
<td>$66,129</td>
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<tr>
<td></td>
<td>Spinach</td>
<td>$6.09</td>
<td>$8.41</td>
<td>0.35</td>
<td>1.00</td>
<td>$68,259</td>
<td>$195,616</td>
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<tr>
<td></td>
<td>Radish</td>
<td>$2.00</td>
<td>$2.76</td>
<td>0.21</td>
<td>2.00</td>
<td>$13,557</td>
<td>$128,380</td>
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<td></td>
<td>Bean, Snap</td>
<td>$4.86</td>
<td>$6.71</td>
<td>0.13</td>
<td>0.72</td>
<td>$20,764</td>
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<td></td>
<td>Cucumber</td>
<td>$1.05</td>
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<td>$16,906</td>
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<td>Eggplant</td>
<td>$1.33</td>
<td>$1.83</td>
<td>0.67</td>
<td>1.08</td>
<td>$28,413</td>
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<td></td>
<td>Cantaloupe</td>
<td>$0.61</td>
<td>$0.84</td>
<td>0.61</td>
<td>0.72</td>
<td>$11,936</td>
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<td>Melon, Watermelon</td>
<td>$0.57</td>
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<td>1.00</td>
<td>$12,811</td>
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<td>Pepper, Bell</td>
<td>$3.09</td>
<td>$4.27</td>
<td>0.77</td>
<td>1.36</td>
<td>$76,288</td>
<td>$134,908</td>
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<tr>
<td></td>
<td>Tomato</td>
<td>$2.55</td>
<td>$3.52</td>
<td>0.67</td>
<td>1.94</td>
<td>$54,674</td>
<td>$158,774</td>
</tr>
</tbody>
</table>

\[ c = \text{Average Cool Season Value Per Acre:} \quad \$28,391 \quad \$94,040 \]

\[ s = \text{Average Warm Season Value Per Acre:} \quad \$31,685 \quad \$84,430 \]

\[ v(m) = \text{Average Annual Value Per Acre, Total:} \quad \$88,467 \quad \$272,510 \]

Table 5.2: Crop Yields & Values
Chapter 6: Discussion of Results

The incremental and final results of the study's two main objectives are described in this chapter, and the limitations of those results. Technical GIS notes for the first objective are provided in Appendix A.

6.1 Land Resources & Projected Gross Proceeds

The inventory of vacant land resulted in 4,603 parcels, equaling 8,611.5 acres of suitable growing space on both public and privately owned land. The study area is approximately 72.5 percent built to capacity based on these results, but some large parcels were categorized as developed if a home or building was present, even if a large portion of the parcel could be farmed or built upon. The majority (97 percent) of all vacant acreage with water access had slopes of less than 30 percent. Of the final suitable parcels, about 19% is publicly owned.

Table 6.1: Inventory Results Summary

<table>
<thead>
<tr>
<th>Removed:</th>
<th>Parcels</th>
<th>Acreage</th>
<th>% of Study Area (Ac.)</th>
<th>% of Vacant Land (Ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Area, Total</td>
<td>100,618</td>
<td>62,098.4</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Vacant (with Access to Water Meter)</td>
<td>5,186</td>
<td>9,523.5</td>
<td>5.2%</td>
<td>100%</td>
</tr>
<tr>
<td>Removed: No Water</td>
<td>22,390</td>
<td>14,383.2</td>
<td>22.3%</td>
<td>23.2%</td>
</tr>
<tr>
<td>Removed: Planned Development</td>
<td>5,146</td>
<td>1,624.2</td>
<td>5.1%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Removed: Developed</td>
<td>87,896</td>
<td>36,567.5</td>
<td>87.4%</td>
<td>58.9%</td>
</tr>
<tr>
<td>Removed: Vacant, Slopes &gt;=30%</td>
<td>61</td>
<td>292</td>
<td>0.1%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Vacant, Slopes 20 - 29%</td>
<td>225</td>
<td>2,446.2</td>
<td>0.2%</td>
<td>3.9%</td>
</tr>
<tr>
<td>Vacant, Slopes 11 - 19%</td>
<td>695</td>
<td>2,582.2</td>
<td>0.7%</td>
<td>4.2%</td>
</tr>
<tr>
<td>Vacant, Slopes 0-10%</td>
<td>3,683</td>
<td>3,583.1</td>
<td>3.7%</td>
<td>5.8%</td>
</tr>
<tr>
<td>Removed: Steep Slopes, Brownfields, &amp; Water Features</td>
<td>583</td>
<td>912.0</td>
<td>0.6%</td>
<td>1.5%</td>
</tr>
</tbody>
</table>
Table 6.2: Estimated Annual Produce Sales

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Max.</th>
<th>per one acre (0.6 acre, less utility land)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summer Crops:</strong></td>
<td>$31,685</td>
<td>$84,430</td>
<td></td>
</tr>
<tr>
<td><strong>Spring and Fall Crops,</strong></td>
<td>$56,782</td>
<td>$188,080</td>
<td></td>
</tr>
<tr>
<td><strong>Combined:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Totals:</strong></td>
<td>$88,467</td>
<td>$272,510</td>
<td></td>
</tr>
<tr>
<td><strong>Community-Wide Economic</strong></td>
<td>$761,877,804</td>
<td>$2,346,856,120</td>
<td>on 8,612 acres (5,167 acres, less utility land)</td>
</tr>
<tr>
<td><strong>10% of total Potential:</strong></td>
<td>$76,187,780</td>
<td>$234,685,612</td>
<td>on 861 acres (517 acres, less utility land)</td>
</tr>
<tr>
<td><strong>1% of total Potential:</strong></td>
<td>$7,618,778</td>
<td>$23,468,561</td>
<td>on 86 acres (52 acres, less utility land)</td>
</tr>
<tr>
<td><strong>0.5% of total Potential:</strong></td>
<td>$3,809,389</td>
<td>$11,734,281</td>
<td>on 43 acres (26 acres, less utility land)</td>
</tr>
</tbody>
</table>

*Utility Land = 40% of Land Set Aside for Setbacks, Paths, Storage, Sales, Composting, Parking, & Seed Production*

The final estimations of economic potential, as summarized above in table 6.2, show that urban agriculture has the potential to significantly impact the local economy. If just one percent of vacant land were to be used for three seasons of crop production, $7.6 to $23.5 million (depending on crop management and yields) could be injected into the local economy annually and not exported to large commercial food retailers. These numbers are conservative as they do not account for indirect benefits, such as the added impacts of purchasing necessary supplies, tools, and equipment, nor the added jobs. They also do not take into account what is known as the multiplier effect, or the amount of each dollar spent locally that will be recirculated again into the local economy, as opposed to being exported to other communities where non-local food would have come from.

6.2 Accuracy & Limitations

In viewing the mapped results in Google Earth or in a GIS application, there was a small amount of error and the results could possibly be confusing to someone unfamiliar with the parcel
boundaries. For example, when zooming in on any given area, you may see a vacant parcel that looks perfect for farming, but it is not considered suitable. This could be for a number of reasons:

- Half of the parcel could be developed, but this may not be apparent unless parcel boundaries are also visible. This was especially true of land owned by the local Tribes, as their parcel boundaries did not appear to follow the same administrative mapping conventions as other areas.
- The parcel may not have access to a water meter, may have polluted soil, or perhaps the parcels was developed between the time of the inventory and the date which the aerial imagery was last updated.
- It could also be that the model indicated that the parcel was built when it wasn't, or that it was marked as developed during the visual inspection phase.

This study is intended to look at urban agriculture as a whole for the region. Although the mapped results may help aspiring urban farmers to locate potential growing sites, due diligence should be taken to physically visit sites, meet with neighbors, and test soils prior to determining that any site identified in this study is truly suitable or ideal for food production. Due to the time consuming process of visually checking more than 8,000 parcels for land use against aerial imagery, this inventory will not likely be updated. With that in consideration however, it is unlikely that the results will become dated in the next few years, as construction starts for the state are still moving slowly, and vacant parcels may not be developed in the near future.

Findings from this study may serve as the groundwork for further economic analyses by mapping land assets and summarizing crop yield and price data, but is not an attempt to
realistically assess the economic sustainability of urban agriculture in the study area. More work will need to be done to develop and test a framework for how local growers could maximize profits at various scales. As Nevada's economy has suffered greatly during the recent recession, Nevada's policy makers may wish to investigate the profitability of alternative and emerging industries such as urban agriculture. If it is found to be profitable, or a practice which community planners wish to utilize for its broader community benefits, greater political, statistical, and programmatic support, could make the industry more attractive to entrepreneurs and those who simply enjoy the new American farmer lifestyle.

The estimates for annual crop sales per acre seemed steep at first glance, but prudent methods were used to ensure conservative results, such as the assumption that only 60% of each acre would be cultivated, and that the minimum yields would be equivalent to those of industrial agriculture. It is likely that yields will fall somewhere in the middle of this range, however. It remains unknown how profitable farming on a small scale is in this climate compared to more temperate ones, as the costs of establishment may be higher here. For example, heavy snowfalls and gale-force winds make heavy-duty gothic-style hoop-houses the safest choice, but they cost more than regular hoop-houses. It could cost an estimated $40,000 in materials alone per acre (for just the 60% not set aside for utility purposes), and the film covering would need to be replaced every three to ten years, depending on the quality purchased and degree of exposure to weathering.

Other options for food production exist in the areas that were not considered in this study. Hydroponics and aquaponics, a closed-system indoor method for growing plants or plants and fish, respectively, may be well suited not on vacant land as this study researched, but in warehouses or vacant buildings. These buildings only require one-time establishment costs and
regular maintenance costs, but save on labor for weed pulling and pest management as they are indoors; but would save on soil amendment costs, labor for weed pulling, and risks associated with weather. Although this type of farming is still exploratory, it has thus far been profitable and may offer Nevadans a greater chance of regional food security should our climate or water scarcity make outdoor food production too difficult. One indoor hydroponic and aquaponics farm in Chicago called FarmedHere sold more than $1 million in 2012 on slightly more than two acres, and was able to employ twenty-five full time employees with benefits (Weber, 2013).

While the results of this study only pertain to opportunities on vacant land, it is worth noting that alternatives to growing in soil do exist and are worth considering prior to deciding which methods to utilize for crop management.

For those planting directly in the soil, further research would be needed at the individual parcel level to accurately assess site suitability and estimate costs, revenues, and profits. While this research is best left to producers as they complete feasibility analyses and business plans, the results of this study can serve as a baseline estimate of what they could expect to make growing the crops and growing methods listed in this study, and selling their product at standard market prices. Support for making a custom business plan is a free service through the Northern Nevada Business Development Center at the University of Nevada.
Chapter 7: Conclusion

This study researched the economic potential of utilizing urban agriculture as an alternative land use in the Reno-Sparks-Washoe area. An inventory of suitable parcels, based on criteria such as land use, slope, proximity to water, scale, and pollution was mapped and quantified in terms of acres and parcels using GIS. Economic potential was estimated using local food sales data and a range of crop yields. While many studies have conducted inventories of land for various types of urban agriculture, none have looked at semi-arid environments such as this one, and none attempted to estimate sales potential. Other cities which have conducted similar land inventories likely have more than one food hub, making local sales data more difficult to obtain and interpret. In this way, lower Washoe County was ideal for this type of analysis, as the DROPP center provides one consolidated source of data for locally produced foods' sales, and data collection occurs daily. The U.S. Census of Agriculture's data is also far less detailed and is only collected every five years. Furthermore, this study describes methodology that can be repeated in future years, and the results have the potential to serve as a baseline for comparing and tracking land use changes at the parcel scale for our region.

Based on the inventory and sales projections, if the entire 8,612 acre land base were hypothetically cultivated, the region would generate between $762 million and $2.3 billion in revenues. What is more feasible to look at is just one half of one percent of all vacant land. If the policy recommendations of section 7.1 were to enable 86 farmers to produce half an acre each in the study area, between $3.8 and $11.7 million would be injected into the local economy. These numbers assume that no barriers to urban agriculture exist, however, which is not the case. Farming at any scale is challenging, but political and programmatic support can ease difficulties to some degree. New farmers may first look at what is legally allowed and
restricted, and what types of public information is available to help them be successful.

Conducting this study provided some key insights as to where those challenges and opportunities existed.

The process of locating and assessing data sources in the region revealed a significant gaps in data collection and sharing which local government agencies, businesses, producers, and non-profit organizations could collaboratively improve, however. State and regional efforts to promote small businesses and "buy local" campaigns lack the data necessary to support local food entrepreneurs, and the lack of interagency data sharing agreements make economic analyses inefficient and less accurate, with the same work sometimes being done within multiple agencies.

Although the demand for organic and local foods continues grow, data has not yet been collected from local producers to see what they are growing, and when, where, and how they are growing it. One way to fill this gap could be for a local nonprofit or government agency, such as the USDA Farm Service Agency, to conduct annual interviews or send out postcard surveys to collect data, and to publish the results. Nationally, agricultural data tends to focus on commodities such as corn, soy, and wheat, and classify fruits and vegetables as "specialty crops." By tracking specialty crop production, sales, marketing, and even challenges that the farmers face, a new generation of farmers could be benefited. Today's producers would be unable to determine which crops would be most in demand and most profitable based on past trends, and would have to rely on their connections with other producers. Providing solid data could serve to increase new farmers' ability to make realistic business plans, and thus increase their chances of economic sustainability.
Economic analyses of any sector, not just agriculture, could be greatly enhanced if local government agencies come to an amicable data sharing agreement that would allow county data, such as geospatial and statistical data, to be shared with the cities of Reno and Sparks, and vice versa; and for appropriate data to be shared with local researchers and entrepreneurs (even if for a cost). Sharing data for economic analyses, such as this one, could indirectly help to increase tax revenues through business growth, and in turn increase government agencies' funds for creating and maintaining data. This would benefit all parties and the economic sustainability of the region as a whole.

7.1 Policy Recommendations & Further Research

The results show that we have plenty of land resources available for food production. Based on the current unemployment rate, Nevada also has the labor resources to increase food production, should both training and opportunities become available, as nearly one in ten Nevadans are currently unemployed (Bureau of Labor Statistics, 2013). A local market for these foods also exists, as we currently import at least two-thirds of "local" foods from California. We feature a low-tax and low-regulation environment when it comes to welcoming new warehouse distribution centers and mining operations in rural areas, but there is still both policy and programmatic work that needs to be done in order to pave the way for new industries such as urban agriculture and reap its added environmental, health, and social benefits. Based on other cities' triumphs and failures in doing this, the following are steps that Reno, Sparks, and Washoe County could consider.
1. **Strengthen Political Support**

Comprehensive plans and master plans are intended to guide policies so that they can accomplish long term community goals. The goals are typically based on data-driven projections, such as the need to explore methods of delivering essential services to our aging population. Despite the data showing increasing rates of obesity, rising health care costs, and the need for job creation, the regional plan for Reno and Sparks has not yet incorporated urban agriculture, food security, or goals to improve the healthiness of residents' lifestyle choices.

Within the Truckee Meadows Regional Plan, the word "food" occurs one time. From its glossary, urban growth is defined as "Development that makes intensive use of land for the location of buildings, other structures, and impermeable surfaces to such a degree as to be incompatible with the primary use of such land for the production of food, fiber, or other agricultural products, or the extraction of mineral resources and that, when allowed to spread over wide areas, typically requires municipal services" (TMRPA, 2007). Thus far, food security and nutrition research has been led by the WCHD, but this agency isn't charged with setting land use policies.

Though the City of Reno recently took steps to regulate urban food production, its Master Plan lacks any mention of food security related goals. The City of Sparks' Master Plan and ordinances also lack any mention of food or urban agriculture. Washoe County has improved ordinances in their Development Code to define aquaculture in its definition for animal production, and to allow on-site agricultural sales with a permit. None of the four planning entities – Reno, Sparks, TMRPA, nor Washoe County have consistent codes, and information on what is allowed and not allowed within each jurisdiction is difficult to find, and the lack of food security and food production related terminology makes codes and regulations open to different interpretations.
and differing opinions on what should be enforced. A collaborative effort is needed to incorporate key terms into definitions in a regionally consistent manner, and to make the rules and regulations easily accessible and understandable.

7. **Strengthen Programmatic Support**

While this study may help connect people with land opportunities, 1,600 acres of public land was found to be suitable, but lacking channels for interested producers to pursue leasing that land. In some cities, land can be leased for $1 per year for set lengths of time to urban farmers. To encourage private property owners to lease their vacant land out to growers, policy levers such as tax credits can be offered. Using vacant land for food production has a number of benefits, from the direct economic sales impacts, to reduced costs of removing weeds and trash to the empty lot, to security costs. Using vacant land for gardening has been shown to increase property values of surrounding properties (Voicu & Been, 2006), which may in turn result in greater property tax revenues. Existing farmland, a growing scarcity in the study area, may be saved should the cities or county offer voluntary conservation easements in exchange for tax credits, or begin purchasing lands through a land bank.

The results of this study are intended to inform planners and policy makers during periodic updates of the Reno and Sparks master plans, the Truckee Meadows Regional Plan, and the codes for which these plans are intended to guide. More indirectly, findings could contribute to the awareness of policy barriers that restrict the ability of local producers to be commercially successful. Should those barriers removed, it may promote greater economic activity within local food production and related industries, and maybe even inspire neighbors to eat healthy fresh produce more often during production seasons. As a state with rising obesity levels, and
an abundance of blighted vacant land, what we have to gain through urban agriculture is significantly greater than the costs associated with amending policies and leasing public land to urban farmers.

The results illustrate how a small amount of land can have a substantial impact on the local economy through local food sales alone. Greater political and programmatic support could lead to more urban agriculture, greater access to healthy fresh foods, and greater cultural acceptance of those foods through more frequent exposure. Any positive shift in eating habits, such as increased daily per capita intake of fruits and vegetables, could reduce health costs and spending, allowing people to spend those savings in other ways in the economy.
Bibliography


Jeavons, J. (2012). How to Grow More Vegetables: (and fruits, nuts, berries, grains, and other crops) than you ever thought possible on less land than you can image (8th ed.). Ten Speed Press.


Appendix A: GIS Methods
# python.py
# Created on: 2013-08-23 10:38:17.00000
# (generated by ArcGIS/ModelBuilder)
# Usage: python <Roads> <Business_Points> <Residence_Points> <Park_Polygons> <Parcels> <TMWA_Polygons> <School_Points>
# Description:
# Set the necessary product code
# import arcinfo

# Import arcpy module
import arcpy

# Script arguments
Roads = arcpy.GetParameterAsText(0)
if Roads == '#' or not Roads:
    Roads = "C:\DATA\MODEL\Geodatabase\ParcelFinder2.gdb\TMWA_Lines\Roads" # provide a default value if unspecified

Business_Points = arcpy.GetParameterAsText(1)
if Business_Points == '#' or not Business_Points:
    Business_Points = "C:\DATA\MODEL\Geodatabase\ParcelFinder2.gdb\TMWA_Points\Businesses" # provide a default value if unspecified

Residence_Points = arcpy.GetParameterAsText(2)
if Residence_Points == '#' or not Residence_Points:
    Residence_Points = "C:\DATA\MODEL\Geodatabase\ParcelFinder2.gdb\TMWA_Points\Residences" # provide a default value if unspecified

Park_Polygons = arcpy.GetParameterAsText(3)
if Park_Polygons == '#' or not Park_Polygons:
    Park_Polygons = "C:\DATA\MODEL\Geodatabase\ParcelFinder2.gdb\TMWA_Polygons\Parks" # provide a default value if unspecified

Parcels = arcpy.GetParameterAsText(4)
if Parcels == '#' or not Parcels:
    Parcels = "C:\DATA\MODEL\Geodatabase\ParcelFinder2.gdb\TMWA_Polygons\Parcels" # provide a default value if unspecified
TMWA_Polygons = arcpy.GetParameterAsText(5)
if TMWA_Polygons == '#' or not TMWA_Polygons:
    TMWA_Polygons = "C:\DATA\MODEL\Geodatabase\ParcelFinder2.gdb\TMWA_Polygons"
    # provide a default value if unspecified

School_Points = arcpy.GetParameterAsText(6)
if School_Points == '#' or not School_Points:
    School_Points = "C:\DATA\MODEL\Geodatabase\ParcelFinder2.gdb\TMWA_Points\Schools" # provide a default value if unspecified

# Local variables:
Parcels_L = TMWA_Polygons
Parcels_L_1 = Parcels_L
Parcels_2 = Parcels_L_1
Parcels_L_3 = Parcels_2
Parcels_L_4 = Parcels_L_3
Parcels_L_17__2_ = Parcels_L_4
Parcels_L_5 = Parcels_L_17__2_
Parcels_L_6 = Parcels_L_5
Parcels_L__7 = Parcels_L_6
Parcels_L_8 = Parcels_L__7
Parcels_L_9 = Parcels_L_8
Parcels_L_10 = Parcels_L_9
Parcels_L_11 = Parcels_L_10
Parcels_L_12 = Parcels_L_11
Parcels_L_13 = Parcels_L_12
Parcels_L_14 = Parcels_L_13
Parcels_L_15 = Parcels_L_14
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Parcels_L_17 = Parcels_L_16
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Parcels_L_47__2_ = Parcels_L_46__2_
Parcels_L_48__2_ = Parcels_L_47__2_
Parcels_Layer__2_ = Parcels_L_48__2_
Likely_Developed__but_Vacant_Land_Use_Code = Parcels_Layer__2_
Parcels_Layer__2_ = Likely_Developed__but_Vacant_Land_Use_Code
Common_Areas_without_Attributes = Parcels_Layer__2_
Parcels_Layer__6_ = Common_Areas_without_Attributes
Not_Open_Space = Park_Polygons
Park_Points = Not_Open_Space
Paved_Roads = Roads

# Process: Make Feature Layer (3)
arcpy.MakeFeatureLayer_management(Parcels, Parcels_L, "", TMWA_Polygons, "OBJECTID OBJECTID VISIBLE NONE;Shape Shape VISIBLE NONE;BldgUnits BldgUnits VISIBLE NONE;BldgSF BldgSF VISIBLE NONE;YearBlt YearBlt VISIBLE NONE;LandUse LandUse VISIBLE NONE;Zoning Zoning VISIBLE NONE;LandSize LandSize VISIBLE NONE;UnitType UnitType VISIBLE NONE;Water Water VISIBLE NONE;Sewer Sewer VISIBLE NONE;AssessedTo AssessedTo VISIBLE NONE;TaxableLan TaxableLan VISIBLE NONE;TaxableImp TaxableImp VISIBLE NONE;TaxableTot TaxableTot VISIBLE NONE;LandUnitTy LandUnitTy VISIBLE NONE;ValueLandU ValueLandU VISIBLE NONE;ValueLandL ValueLandL VISIBLE NONE;ValueLandB ValueLandB VISIBLE NONE;ValueLandN ValueLandN VISIBLE NONE;ValueLan_1 ValueLan_1 VISIBLE NONE;ValueLan_2 ValueLan_2 VISIBLE NONE;ValueLan_3 ValueLan_3 VISIBLE NONE;ValueLan_4 ValueLan_4 VISIBLE NONE;ValueLan_5 ValueLan_5 VISIBLE NONE;ValueLan_6 ValueLan_6 VISIBLE NONE;ValueLan_7 ValueLan_7 VISIBLE NONE;ValueLan_8 ValueLan_8 VISIBLE NONE;ValueLan_9 ValueLan_9 VISIBLE NONE;ValueLan_10 ValueLan_10 VISIBLE NONE;Perimeter Perimeter VISIBLE NONE;APN APN VISIBLE NONE;PIN_1 PIN_1 VISIBLE NONE;SUBNAME SUBNAME VISIBLE NONE;FLR FLR VISIBLE NONE;STREETNUM STREETNUM VISIBLE NONE;STREET_1 STREET_1 VISIBLE NONE;SITUSZIP_1 SITUSZIP_1 VISIBLE NONE;FIRSTNAME FIRSTNAME VISIBLE NONE;LASTNAME LASTNAME VISIBLE NONE;LAND_USE LAND_USE VISIBLE
# Process: Add "Built_Like" Score Field
arcpy.AddField_management(Parcels_L, "Built_Like", "LONG", "", "", "1", "Built Likelihood", "NULLABLE", "NON_REQUIRED", "")

# Process: Set Field to 0
arcpy.CalculateField_management(Parcels_L_1, "Built_Like", "0", "VB", "")

# Process: Add "BL_Type" Field
arcpy.AddField_management(Parcels_2, "BL_Types", "TEXT", "", "", "40", "BL Types", "NULLABLE", "NON_REQUIRED", "")

# Process: Clear Field
arcpy.CalculateField_management(Parcels_L_3, "BL_Types", "" \"\"", "VB", """)

# Process: Golf Courses
arcpy.SelectLayerByAttribute_management(Parcels_L_4, "NEW_SELECTION", "\\SPECPROPCO\\ LIKE '%%225%%'"")

# Process: Select Parks, not OS
arcpy.Select_analysis(Park_Polygons, Not_Open_Space, "\\PARK_TYPE\\ <> 'OS' ")

# Process: Feature To Point
arcpy.FeatureToPoint_management(Not_Open_Space, Park_Points, "INSIDE")

# Process: Select Pacels with Parks
arcpy.SelectLayerByLocation_management(Parcels_L_17, "CONTAINS", Park_Points, ",", "ADD_TO_SELECTION")

# Process: (P) +1
arcpy.CalculateField_management(Parcels_L_5, "Built_Like", "[Built_Like] +1", "VB", ",")

# Process: Calculate Field "P"
arcpy.CalculateField_management(Parcels_L_6, "BL_Types", "[BL_Types] + "P"", "VB", ",")

# Process: Select Parcels with Homes
arcpy.SelectLayerByLocation_management(Parcels_L_7, "CONTAINS", Residence_Points, ",", "NEW_SELECTION")

# Process: (R) +1
arcpy.CalculateField_management(Parcels_L_8, "Built_Like", "[Built_Like] +1", "VB", ",")

# Process: Calculate Field "R"
arcpy.CalculateField_management(Parcels_L_9, "BL_Types", "[BL_Types] + "R"", "VB", ",")

# Process: Select Parcels with Buss.
arcpy.SelectLayerByLocation_management(Parcels_L_10, "CONTAINS", Business_Points, ",", "NEW_SELECTION")

# Process: (B) + 1
arcpy.CalculateField_management(Parcels_L_11, "Built_Like", "[Built_Like] +1", "VB", ",")

# Process: Calculate Field "B"
arcpy.CalculateField_management(Parcels_L_12, "BL_Types", "[BL_Types] + "B"", "VB", ",")

# Process: Select Parcels with Schools
arcpy.SelectLayerByLocation_management(Parcels_L_13, "CONTAINS", School_Points, ",", "NEW_SELECTION")

# Process: (S) +1
arcpy.CalculateField_management(Parcels_L_14, "Built_Like", "[Built_Like] +1", "VB", ",")

# Process: Calculate Field "S"
arcpy.CalculateField_management(Parcels_L_15, "BL_Types", "[BL_Types] + "S"", "VB", ",")

# Process: Select Parcels where Bldg Units >0
arcpy.SelectLayerByAttribute_management(Parcels_L_16, "NEW_SELECTION", ""BldgUnits" >0")

# Process: (U) +1
arcpy.CalculateField_management(Parcels_L_17, "Built_Like", "[Built_Like] +1", "VB", ",")
# Process: Calculate Field "U"
```
arcpy.CalculateField_management(Parcels_L_18, "BL_Types", "[BL_Types] + "U_\n"", "VB", ")
```

# Process: Select Parcels where Bldg SF >0
```
arcpy.SelectLayerByAttribute_management(Parcels_L_19, "NEW_SELECTION", "\"BldgSF\" >120")
```

# Process: (sf) +1
```
arcpy.CalculateField_management(Parcels_L_20, "Built_Like", ":[Built_Like] +1", "VB", "")
```

# Process: Calculate Field "sf"
```
arcpy.CalculateField_management(Parcels_L_21, "BL_Types", "[BL_Types] + \"sf_\n"", "VB", "")
```

# Process: Select Parcels where Bedrooms >0
```
arcpy.SelectLayerByAttribute_management(Parcels_L_22, "NEW_SELECTION", "\"BEDROOMS\" > 0")
```

# Process: (br) +1
```
arcpy.CalculateField_management(Parcels_L_23, "Built_Like", ":[Built_Like] +1", "VB", "")
```

# Process: Calculate Field "br"
```
arcpy.CalculateField_management(Parcels_L_24, "BL_Types", "[BL_Types] + \"br_\n"", "VB", "")
```

# Process: Select Parcels where Bathrooms>0
```
arcpy.SelectLayerByAttribute_management(Parcels_L_25, "NEW_SELECTION", "\"BATHS\" >0")
```

# Process: (ba) +1
```
arcpy.CalculateField_management(Parcels_L_26, "Built_Like", ":[Built_Like] +1", "VB", "")
```

# Process: Calculate Field "ba"
```
arcpy.CalculateField_management(Parcels_L_27, "BL_Types", "[BL_Types] + \"ba_\n"", "VB", "")
```

# Process: Select Parcels with Townhomes
```
arcpy.SelectLayerByAttribute_management(Parcels_L_28, "NEW_SELECTION", "\"TOWNHOUSE\" <> ' '')
```

# Process: (T) +1
```
arcpy.CalculateField_management(Parcels_L_29, "Built_Like", ":[Built_Like] +1", "VB", "")
```

# Process: Calculate Field "T"
```
arcpy.CalculateField_management(Parcels_L_30, "BL_Types", ":[BL_Types] +\"T_\n"", "VB", "")
```

# Process: Select Parcels where Stories >0
```
arcpy.SelectLayerByAttribute_management(Parcels_L_31, "NEW_SELECTION", "\"STORIES\" <> ' ' AND "STORIES" <> 'C000'")
```


```
# Process: (st) +1
arcpy.CalculateField_management(Parcels_L_32, "Built_Like", "[Built_Like] +1", "VB", ""

# Process: Calculate Field "st"
arcpy.CalculateField_management(Parcels_L_33, "BL_Types", "[BL_Types] +1\"st\"", "VB", ""

# Process: Select Parcels where Building Type is not NULL
arcpy.SelectLayerByAttribute_management(Parcels_L_34, "NEW_SELECTION", "BUILDINGTY\" <> ' ' AND "BUILDINGTY\" <> '305' AND "BUILDINGTY\" <> '472"

# Process: (bt) +1
arcpy.CalculateField_management(Parcels_L_35, "Built_Like", "[Built_Like] +1", "VB", ""

# Process: Calculate Field "bt"
arcpy.CalculateField_management(Parcels_L_36, "BL_Types", "[BL_Types] +1\"bt\"", "VB", ""

# Process: Clear Selection
arcpy.SelectLayerByAttribute_management(Parcels_L_37, "CLEAR_SELECTION", ""

# Process: Select
arcpy.Select_analysis(Roads, Paved_Roads, "CLASS\" <> 'ACCESS' AND "FULLNAME\" <> 'UNSPECIFIED"

# Process: Select Parcels that Intersect with Roads
arcpy.SelectLayerByLocation_management(Parcels_L_38, "INTERSECT", Paved_Roads, "", "NEW_SELECTION"

# Process: Select Parcels that ARE Roads
arcpy.SelectLayerByAttribute_management(Parcels_L_39, "NEW_SELECTION", "LandUse\" = 'PBRD' OR \"SPECPropCO\" LIKE '%042%' OR \"SPECPropCO\" LIKE '%045%' OR \"ValueLandN\" LIKE '%ARTERIAL%' OR \"ValueLandN\" LIKE '%STREET%' OR \"ValueLandN\" LIKE '%ROAD' AND NOT \"SPECPropCO\" LIKE '%004%' OR \"SPECPropCO\" LIKE '%009%' OR \"SPECPropCO\" LIKE '%012%' OR \"SPECPropCO\" LIKE '%034%' OR \"SPECPropCO\" LIKE '%037%' OR \"SPECPropCO\" LIKE '%040%' OR \"SPECPropCO\" LIKE '%046%' OR \"SPECPropCO\" LIKE '%047%' OR \"SPECPropCO\" LIKE '%051%' OR \"SPECPropCO\" LIKE '%056%' OR \"SPECPropCO\" LIKE '%070%' OR \"SPECPropCO\" LIKE '%072%' OR \"SPECPropCO\" LIKE '%075%' OR \"SPECPropCO\" LIKE '%080%' OR \"SPECPropCO\" LIKE '%083%' OR \"SPECPropCO\" LIKE '%085%' OR \"SPECPropCO\" LIKE '%086%' OR \"SPECPropCO\" LIKE '%087%' OR \"SPECPropCO\" LIKE '%088%' OR \"SPECPropCO\" LIKE '%090%' OR \"SPECPropCO\" LIKE '%095%' OR \"SPECPropCO\" LIKE '%096%' OR \"SPECPropCO\" LIKE '%225%' OR \"SPECPropCO\" = '099')"

# Process: (rd) +1
arcpy.CalculateField_management(Parcels_L_40, "Built_Like", "[Built_Like] +1", "VB", ""

# Process: Calculate Field "rd"
```
# Process: Select Parcels with Dev. Codes
arcpy.SelectLayerByAttribute_management(Parcels_L_42, "NEW_SELECTION", "(" \"SPECPROPCO\" LIKE '%004%' OR \"SPECPROPCO\" LIKE '%009%' OR \"SPECPROPCO\" LIKE '%012%' OR \"SPECPROPCO\" LIKE '%034%' OR \"SPECPROPCO\" LIKE '%037%' OR \"SPECPROPCO\" LIKE '%040%' OR \"SPECPROPCO\" LIKE '%046%' OR \"SPECPROPCO\" LIKE '%047%' OR \"SPECPROPCO\" LIKE '%051%' OR \"SPECPROPCO\" LIKE '%056%' OR \"SPECPROPCO\" LIKE '%070%' OR \"SPECPROPCO\" LIKE '%072%' OR \"SPECPROPCO\" LIKE '%075%' OR \"SPECPROPCO\" LIKE '%080%' OR \"SPECPROPCO\" LIKE '%083%' OR \"SPECPROPCO\" LIKE '%085%' OR \"SPECPROPCO\" LIKE '%086%' OR \"SPECPROPCO\" LIKE '%087%' OR \"SPECPROPCO\" LIKE '%088%' OR \"SPECPROPCO\" LIKE '%090%' OR \"SPECPROPCO\" LIKE '%095%' OR \"SPECPROPCO\" LIKE '%096%' OR \"SPECPROPCO\" LIKE '%225%' OR \"SPECPROPCO\" = '099') OR (\"LandUse\" = '025' OR \"LandUse\" = '030' OR \"LandUse\" = '031' OR \"LandUse\" = '032' OR \"LandUse\" = '033' OR \"LandUse\" = '034' OR \"LandUse\" = '035' OR \"LandUse\" = '036' OR \"LandUse\" = '041' OR \"LandUse\" = '042' OR \"LandUse\" = '031' OR \"LandUse\" = '032' OR \"LandUse\" = '033' OR \"LandUse\" = '034' OR \"LandUse\" = '035' OR \"LandUse\" = '036' OR \"LandUse\" = '041' OR \"LandUse\" = '042' OR \"LandUse\" = '043' OR \"LandUse\" = '044' OR \"LandUse\" = '050' OR \"LandUse\" = '051' OR \"LandUse\" = '052' OR \"LandUse\" = '071' OR \"LandUse\" = '072') AND NOT \"LandUse\" = '010' OR \"LandUse\" = '011' OR \"LandUse\" = '012' OR \"LandUse\" = '013' OR \"LandUse\" = '014' OR \"LandUse\" = '015') OR \"YearBlt\" > 0")

# Process: (LU) + 1
arcpy.CalculateField_management(Parcels_L_43, "Built_Like", "[Built_Like] + 1", "VB", "")

# Process: Calculate Field "LU"
arcpy.CalculateField_management(Parcels_L_44, "BL_Types", "[BL_Types] + \"LU\"", "VB", "")

# Process: Select Parcels that are Common Areas, but not Open Space
arcpy.SelectLayerByAttribute_management(Parcels_L_45, "NEW_SELECTION", "\"SPECPROPCO\" = '044' OR \"SPECPROPCO\" = '189' OR \"SPECPROPCO\" = '233' OR \"LandUse\" = '024' OR \"LandUnitTy\" = 'CA' OR \"NBHD\" LIKE '%VV' AND \"BUILDAPR\" <= 400 AND \"ValueLandN\" <> 'OPEN SPACE' AND \"Zoning\" <> 'OS' AND \"BUILDAPR\" <= 400 AND \"TOTALAPR\" <= 2000")

# Process: (ca) +1
arcpy.CalculateField_management(Parcels_L_46, "Built_Like", "[Built_Like] + 1", "VB", "")

# Process: Calculate Field "ca"
arcpy.CalculateField_management(Parcels_L_47, "BL_Types", "[BL_Types] + \"ca\"", "VB", "")

# Process: Select Parcels with no water meter
arcpy.SelectLayerByAttribute_management(Parcels_L_48, "NEW_SELECTION", \"\"Water\"" = 'NONE WATER'\")

# Process: (nw) +1
arcpy.CalculateField_management(Parcels_L_46__2_, "Built_Like", "[Built_Like] + 1", "VB", "")
# Process: Calculate Field "nw"
arcpy.CalculateField_management(Parcels_L_47__2__, "BL_Types", "[BL_Types] + \\
"nw_", "VB", """)

# Process: Clear Selection (2)
arcpy.SelectLayerByAttribute_management(Parcels_L_48__2__, "CLEAR_SELECTION", """)

# Process: Add Field "Conflict_2"
arcpy.AddField_management(Parcels_L_43__2__, "Conflict_2", "TEXT", "", "", "3", "", "NULLABLE", "NON_REQUIRED", """)

# Process: Select Layer By Attribute
arcpy.SelectLayerByAttribute_management(Parcels_Layer__2__, "NEW_SELECTION", "\\"Built_Like\" > 0 AND (\\"LandUse\" = '010' OR \\"LandUse\" = '011' OR \\"LandUse\" = '012' OR \\"LandUse\" = '013' OR \\"LandUse\" = '014' OR \\"LandUse\" = '015' ) AND \\
"BL_Types" NOT LIKE '%_ca_%' AND \\
"BL_Types" NOT LIKE '%_rd_%' AND \\
"BL_Types" NOT LIKE '%_nw_%'"")

# Process: Calculate Field: Conflict Type "A"
arcpy.CalculateField_management(Likely_Developed__but_Vacant_Land_Use_Code, "Conflict_2", '"A\"", "VB", """)

# Process: Select Layer By Attribute (S)
arcpy.SelectLayerByAttribute_management(Parecls_Layer__2__, "NEW_SELECTION", \\
"\\"BL_Types\" = '_ca_' AND "BUILDAPR" <=400 AND "TOTALAPR" <= 2000")

# Process: Calculate Field: Conflict Type "B"
arcpy.CalculateField_management(Common_Areas_without_Attributes, "Conflict_2", '"B\"", "VB", """)
Appendix B: Parcels by Type of Land Use & TMWA Water Service
Appendix B: Map of Parcels by Type of Land Use and TMWA Water Service

Legend:
- TMWA Service Boundary
- Vacant
- No Water
- Planned Development
- Developed

Scale: 1:220,000
MAP B-A3: Parcels by Type of Land Use & TMWA Water Service

- Vacant
- No Water
- Planned Development
- Developed
- TMWA Service Boundary

Scale: 1:75,000

Legend:
- Miles

Map showing different land use categories and TMWA service boundary.
MAP B-B2: Parcels by Type of Land Use & TMWA Water Service

- Vacant
- No Water
- Planned Development
- Developed
- TMWA Service Boundary

Scale: 1:75,000
MAP B-C2: Parcels by Type of Land Use & TMWA Water Service

- Vacant
- No Water
- Planned Development
- Developed
- TMWA Service Boundary

Scale: 1:75,000
Appendix C: All Suitable Land
Appendix C: Map of Parcels Suitable for Food Production, with Slope Intensity

- TMWA Service Boundary
- 0-9% Rise
- 10-19% Rise
- 20-29% Rise

1:220,000
MAP C-A1: Parcels Suitable for Food Production, with Slope Intensity

- TMWA Service Boundary
- 0-9% Rise
- 10-19% Rise
- 20-29% Rise

Scale: 1:75,000

Legend:
0 0.375 0.75 1.5 2.25 3 Miles
MAP C-A2: Parcels Suitable for Food Production, with Slope Intensity

- **TMWA Service Boundary**
- **0-9% Rise**
- **10-19% Rise**
- **20-29% Rise**

Legend:
- 0 0.375 0.75 1.5 2.25 3 Miles
- 1:75,000 Map Scale
MAP C-A3: Parcels Suitable for Food Production, with Slope Intensity

- **TMWA Service Boundary**
- **0-9% Rise**
- **10-19% Rise**
- **20-29% Rise**

Legend:

- TMWA Service Boundary
- 0-9% Rise
- 10-19% Rise
- 20-29% Rise

Scale: 1:75,000

Legend:

- TMWA Service Boundary
- 0-9% Rise
- 10-19% Rise
- 20-29% Rise

Legend:

- TMWA Service Boundary
- 0-9% Rise
- 10-19% Rise
- 20-29% Rise
MAP C-B1: Parcels Suitable for Food Production, with Slope Intensity

- **TMWA Service Boundary**
- **0-9% Rise**
- **10-19% Rise**
- **20-29% Rise**

Scale: 1:75,000

Legend:
- TMWA Service Boundary
- 0-9% Rise
- 10-19% Rise
- 20-29% Rise
MAP C-B2: Parcels Suitable for Food Production, with Slope Intensity

- TMWA Service Boundary
- 0-9% Rise
- 10-19% Rise
- 20-29% Rise

Scale: 1:75,000
MAP C-B3: Parcels Suitable for Food Production, with Slope Intensity

- **TMWA Service Boundary**
- **0-9% Rise**
- **10-19% Rise**
- **20-29% Rise**

Scale: 1:75,000
MAP C-C1: Parcels Suitable for Food Production, with Slope Intensity

- **TMWA Service Boundary**
- 0-9% Rise
- 10-19% Rise
- 20-29% Rise

Distance Scale: 1:75,000
MAP C-C2: Parcels Suitable for Food Production, with Slope Intensity

- TMWA Service Boundary
- 0-9% Rise
- 10-19% Rise
- 20-29% Rise

1:75,000