Clark County: Critical Infrastructure & Key Assets
Final – May 19, 2008

Urban Environmental Research, LLC

TABLE OF CONTENTS

1.0 Introduction 1
2.0 Regulatory Framework 2
2.1 National Infrastructure Protection Plan 3
2.2 DHS Grant Programs 4
2.3 Local Government Best Practices 5
3.0 Methodology 7
4.0 Critical Infrastructure Sectors 10
4.1 Agriculture and Food 13
4.2 Water and Wastewater 22
4.3 Public Health 25
4.4 Emergency Services 27
4.5 Government 33
4.6 Defense Industrial Base 35
4.7 Information and Telecommunication 36
4.8 Energy 39
4.9 Transportation 42
4.10 Banking and Finance 44
4.11 Chemical Industry and Hazardous Materials 51
4.12 Postal and Shipping 53
5.0 Key Assets 60
5.1 Dams 60
5.2 Gaming & Casinos 63
5.3 Schools 69
6.0 Conclusion and Recommendations 71
References 72
Appendix A: Clark County Assessor Land Use Codes 75
Appendix B: CARVER+SHOCK Methodology Details 85
Appendix C: Business License Codes by Jurisdiction 92
Appendix D: Clark County Banks by Total Assets 93

LIST OF FIGURES

Figure 1: Employment Shares by Sector 11
Figure 2: Agriculture and Food Locations, Clark County 15
Figure 3: Agriculture and Food Locations, Las Vegas Valley 16
Figure 4: Grocery and Restaurant Locations, Unincorporated Clark County 18
Figure 5: Grocery and Restaurant Locations, City of Las Vegas 19
Figure 6: Grocery and Restaurant Locations, City of Henderson 20
Figure 7: Grocery and Restaurant Locations, City of North Las Vegas 21
Figure 8: Water Facilities, Clark County 23
Figure 9: Water Facilities, Las Vegas Valley 24
Figure 10: Public Health Facilities, Clark County 26

Figure 11: Emergency Services Facilities, Clark County 28
Figure 12: Police and Fire Facilities, Metropolitan Clark County..... 30
Figure 13: Health Services, Unincorporated Metropolitan Clark County 31
Figure 14: Health Services, City of Las Vegas..... 32
Figure 15: Government Facilities, Clark County..... 34
Figure 16: Information and Telecommunication Facilities, Clark County..... 37
Figure 17: Headquarters for Telecommunication Companies in Clark County 38
Figure 18: Energy Infrastructure and Facilities, Clark County..... 41
Figure 19: Transportation Infrastructure and Facilities, Clark County..... 43
Figure 20: Banking and Finance Facilities, Clark County..... 45
Figure 21: Banking and Finance Facilities, Unincorporated Metropolitan Clark County 47
Figure 22: Banking and Finance Facilities, City of Las Vegas 48
Figure 23: Banking and Finance Facilities, City of Henderson..... 49
Figure 24: Banking and Finance Facilities, City of North Las Vegas 50
Figure 25: Large Quantity Generators, Clark County: 2005 52
Figure 26: Postal Facilities, Clark County 54
Figure 27: Postal and Mail Facilities, Unincorporated Metropolitan Clark County..... 56
Figure 28: Postal and Mail Facilities, City of Las Vegas 57
Figure 29: Postal and Mail Facilities, City of Henderson..... 58
Figure 30: Postal and Mail Facilities, City of North Las Vegas 59
Figure 31: Key Assets, Clark County Dams 62
Figure 32: Key Assets, Clark County Casinos and Resorts..... 64
Figure 33: Gaming Facilities, Unincorporated Metropolitan Clark County..... 65
Figure 34: Gaming Facilities, City of Las Vegas 66
Figure 35: Gaming Facilities, City of Henderson..... 67
Figure 36: Gaming Facilities, City of North Las Vegas 68
Figure 37: Key Assets, Clark County Schools..... 70

LIST OF TABLES

Table 1: Infrastructure and Assets 8
Table 2: Homeland Security Grant Program and Urban Area Security Initiative Assets and Infrastructure 9
Table 3: Labels and Employment Sector Descriptions..... 10
Table 4: Employment and Sectoral Share..... 11

1.0 Introduction

The protection of the Nation's infrastructure assets (or "critical infrastructure") from disruption and destruction is a primary function and concern of all levels of government. The terrorist attacks on September 11, 2001 and the failure in government response to Hurricane Katrina in 2005 brought this concern and issue into sharper focus. Since these disasters, the United States has not experienced a similar terror attack or an equivalent failure in response to a natural disaster. However, clearly defined divisions of critical infrastructure responsibility remain elusive for all levels of government. In light of the Department of Energy's proposal to ship high-level nuclear waste (HNLW) and spent nuclear fuel (SNF) to Yucca Mountain utilizing critical Clark County transportation infrastructure, this investigation involves the initial identification and classification of the critical infrastructure assets of Clark County, Nevada. This study will provide the framework for the next effort, evaluating critical infrastructure vulnerability.

Clark County, internationally known for the Las Vegas Strip and lavish casino entertainment, is unique in that the structure of the local economy is built primarily on gaming. In response to the growth of gaming in numerous other national and international locations, Las Vegas has expanded recreational opportunities to include family and convention destinations, and continues to enjoy sustained revenues and stability in this basic economic sector that drives the region's economy. Because the local economy is so dependent on gaming, and the influx of visitors seeking this entertainment, disruptions to either air travel or economic confidence would have devastating impacts on the local economy.

Presidential directives have established the basis for critical infrastructure protection, beginning with the Clinton Administration's concern for cyber-space security and disruptions associated with computers and the new millennium. Following the events of September 11, 2001, focus shifted to vulnerability from terror attacks. President Bush directed the establishment of the Office of Homeland Security, and Congress enacted the new Department of Homeland Security (DHS) and codified its responsibilities. Broad guidance from DHS identified and categorized critical infrastructure sectors. This guidance also outlined procedural steps for evaluating and strengthening assets critical to the national economy and delivery of government services.

Sectoral inter-relationships involving critical infrastructures at the federal level can be examined by tracking compliance with federal regulations and federal funding for training in emergency preparedness. However, a detailed examination of local economic sectors and sectoral inter-relationships is also likely to reveal useful information beyond compliance. Tracking physical and operational trends and inter-relationships of local infrastructure sectors can provide the organization for proactive planning. The goal is to minimize vulnerability from local, natural hazards as well as the threats from terrorists.

This investigation is divided into four main sections. First, the regulatory environment and statutory framework for critical infrastructure reporting is presented in order to provide the reader the organizational structure of such an evaluation and the organization

of this report. This section includes the specific, required elements for conducting an evaluation of critical infrastructure. Second, a methodology section describes the federal guidance for the evaluation process and the steps used for an evaluation of critical infrastructure. This section also draws on best practice methods implemented in other locations to turn broad federal process guidance into formal evaluation. Third, the composition of the local economy is presented to demonstrate the unique nature of the local economy, and show how critical infrastructure in Clark County differs from other American municipalities. Federal guidance involves economic interactions, not just the schools, banks, roads, and buildings readily identifiable as critical infrastructure. A sector-by-sector evaluation of the County critical infrastructure is also described and categorized. This section tabulates critical infrastructure sector assets where available, identifies locations when applicable, and recommends methods for acquiring additional information if it is not publicly available. Finally, recommendations are presented for the steps necessary to evaluate vulnerabilities to local infrastructure.

2.0 Regulatory Framework

Under the Clinton Administration, the infrastructure used to support the world's largest economy and largest military was recognized as vulnerable, particularly to cyber-attack. Under Presidential Decision Directive (PDD) 63, critical infrastructures were identified as "*those physical and cyber-based systems essential to the minimum operations of the economy and government*" (Clinton, 1998). Under this directive, a national goal was formulated to protect critical infrastructures, with specific objectives for the federal government, state and local governments, and private industry.

PDD 63 defined the role of the federal government to provide essential national security and the protection of general public health and safety. The role of state and local governments under this directive was to maintain order and the delivery of minimum essential public services. Private industry was tasked specifically with delivering essential telecommunications, energy, financial, and transportation services, and maintaining the orderly function of the economy. Under the Clinton Administration, the primary concern was for cyber (internet) and computer-related crimes, particularly with the approach of the millennium.

Events of September 11, 2001, changed the federal focus. Travel and tourism were particularly hard hit in the aftermath of those attacks (Devol, et al., 2002). Reliant on the air-traveling tourist for much of its business, Las Vegas was particularly vulnerable. Layoffs in the casinos rippled throughout the economy. Recovery was slow due to enhanced security, as well as uncertainty and fear on the part of the flying public.

On October 8, 2001, President Bush signed Executive Order 13228, and established the Office of Homeland Security to protect the United States and its critical infrastructure from the consequences of terrorist attacks (Moteff, 2001). President Bush signed Executive Order 13231 on October 16, 2001 and outlined the Bush Administration's policy regarding critical infrastructure protection. This order established the President's

Critical Infrastructure Protection Board. Policy recommendations and coordination in this uncertain period were attained under these directives.

The Homeland Security Act of 2002 enacted the most massive restructuring of federal bureaucracy in decades. Functions of 22 federal agencies were combined in the new DHS. Codified within the Homeland Security Act of 2002 are provisions for the Critical Infrastructure Information Act (CIIA), which specifies some data collection requirements and addresses privacy and sensitive data issues for several sectors (Stevens, 2003). Guidance for critical infrastructure study is derived from Presidential decrees and DHS directives, including the National Strategy for Homeland Security (Office of Homeland Security, 2002), Homeland Security Act of 2002, National Strategy to Secure Cyberspace, National Strategy for Physical Protection of Critical Infrastructure and Key Assets, and Homeland Security Presidential Directive 7. While DHS efforts primarily involve national protection and response, considerable funding for training and interoperability between various levels of government is also at stake.

Five general steps are outlined as broad directions for investigation of critical infrastructure for all levels of government and private industry (Moteff, 2004):

- identify assets and identify which are most critical
- identify, characterize, and assess threats
- assess the vulnerability of critical assets to specific threats
- determine the risk (i.e., the *expected* consequences of specific types of attacks on specific assets)
- identify ways to reduce those risks prioritize risk reduction measures based on a strategy

The intent of this examination is to identify the assets of the sectors outlined in the DHS directives, and prepare them for a “weighting” process to determine relative importance. Mitigation and reduction in vulnerability will be the goal of the future effort. This document quantifies publicly available data that will serve as the primary input for future determination of relative importance and vulnerability. The conclusion of this report will include recommendations for assembling local committees for scoring these local assets and critical infrastructure conditions.

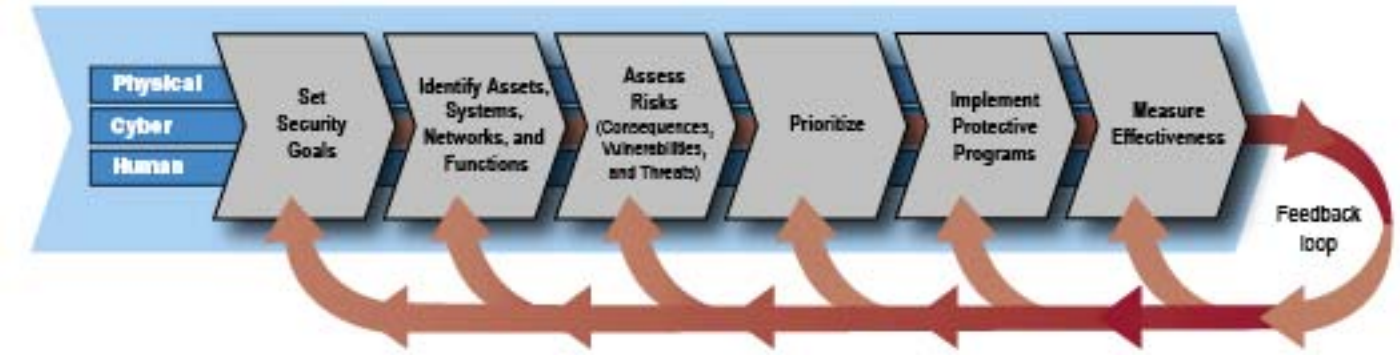
2.1 National Infrastructure Protection Plan

Guidance and responsibilities for the federal government and various other entities are presented within the framework of the National Infrastructure Protection Plan (NIPP). The NIPP provides the structure for integrating critical infrastructure and key resources (CI/KR) protection into a single national program (DHS, 2006). While the duties and responsibilities for the federal government, state governments, and sectors of private industry are clear within this guidance; guidance for local government is not definitively presented.

The Homeland Security Presidential Directive 7 (HSPD-7) assigned primary responsibility for the nation's CI/KR to DHS (Bush, 2003). HSPD-7 defines primary roles for CI/KR protection including the following:

- management and oversight of NIPP development and implementation to DHS
- guidance for sector-specific federal agencies
- implementation of specific roles for other federal agencies and entities
- direction for state, local, and tribal governments to develop CI/KR programs
- establishment of regional partnerships for protection within defined geographic areas
- establishment within and across sector advisory and oversight functions
- establishment of a private sector role to assist federal efforts
- establishment of Homeland Security Advisory Councils
- provision for academic research and CI/KR protection education

The stated cornerstone of the NIPP CI/KR protection is the risk management process to combine consequence, vulnerability, and threat estimates to dynamic and evolving risk management of national or sector infrastructure risk. Assets include physical structures, cyber systems and networks, and human knowledge and capabilities. While this all-hazards approach recognizes complexities and dependencies, specific guidance for local government is lacking.



2.2 DHS Grant Programs

In addition to the guidance to federal agencies and the private sector found in the NIPP, DHS funds and administers grant programs to state and metropolitan areas that include infrastructure requirements. The overall Homeland Security Grant Program (HSGP) includes the State Homeland Security Grant Program, Urban Area Security Grant Program, Law Enforcement Terrorism Prevention Program, Public Safety Interoperable Communications Grant Program, Citizen Corps Program, and Metropolitan Medical Response System Program. The State HSGP and Urban Area Security Grant Program have requirements relative to infrastructure evaluation, and are described in more detail in Section 3.0.

In fiscal year 2003, DHS began a funding program to states to provide financial assistance for the purchase of the equipment required for response to terror attacks, protection of critical infrastructure, and training related to terror incidents. Funds are distributed to state governments and allocated to various local entities by representatives designated by state governors.

The State Homeland Security Grant Program allocates funds for planning, equipment, and training to prepare for acts of terror. Funding can also be used for implementation of the National Preparedness Goal, National Incident Management System, and or National Response Plan, as states deem necessary. Funds allocated under this program can be used for evaluation of critical infrastructures as well as security equipment and personnel training for the protection of these critical assets as developed under State Homeland Security Strategies and Urban Area Homeland Security Strategies (U.S. Department of Justice [DOJ], 2007).

Under the risk-based Urban Areas Security Initiative, high-risk and high-density urban areas receive funding to prevent, protect, respond, and recover from acts of terrorism. There are 45 urban areas receiving funding under this program. For fiscal year 2007, the six urban areas at highest risk compete for 55 percent of the $746.9 million dollars allocated with the remainder distributed to the remaining jurisdictions (DOJ, 2007b).

2.3 Local Government Best Practices

The overwhelming majority of the nation's critical infrastructure elements are owned and operated by private industry. Additionally, the broad federal guidance for local government critical infrastructure evaluation lacks implementation detail. This investigation looks to efforts from other locations for appropriate tools and methods for identifying critical infrastructure elements, assessing threats and vulnerability, and identifying steps to minimize disruptions from all hazards. Within the broad guidelines found in Presidential directives, DHS and other federal acts and documents, and specific strategies implemented in other locations, a detailed approach is outlined for identifying and evaluating critical assets in Clark County. Successful efforts and lessons learned provide additional steps for assessing the vulnerability of these elements.

The Washington State Homeland Security Region 6, composed of King County, Washington and a portion of the Seattle metropolitan area, produced a Critical Infrastructure Protection (CIP) Plan (Washington State, 2005) with guidance and methodology useful to this investigation in Clark County. This voluntary, collaborative effort brought together partners with the common goal of ensuring infrastructure disruption does not jeopardize the region's way-of-life. This document is specifically a strategic planning guide for use prior to an incident, and is not a response plan. To attain vulnerability protection, a CIP Workgroup surveyed key stakeholders to prioritize infrastructure into the most crucial elements to the region. Three tiers or groups of infrastructure were established, with the top six interdependent sectors of energy, infrastructure technology, telecommunications, water and wastewater, transportation, and healthcare systems receiving the focus in effort.

The prioritization process referred to as “tiering” has been utilized to group functions based on relative importance in other programs as well. Tiers or groups of metropolitan areas are distinguished by importance to national infrastructure and uninterrupted function of the national economy. Use of tiers may be used within a specific sector or an individual facility to determine the relative importance of key personnel, without whom smooth delivery of services would be impaired. Defining hierarchical tiers of importance between sectors has also been used to determine where to allocate resources and efforts in a multi-step process.

In the chemical sector, a Chemical Security Assessment Tool (CSAT) was developed as DHS’s system for collecting and analyzing key data from chemical facilities to determine which facilities are at greatest risk of disruption (DHS, 2007b). This secure, web-based tool is used to identify, assess, and ensure effective security at high-risk chemical facilities. This process groups chemical facilities into three tiers according to specific security concerns involving off-site releases, vulnerability to theft, and sabotage or contamination. Tiering was also used by the chemical sector to prioritize critical personnel within individual facilities.

Prior to the terror attacks of September 11, risk assessment efforts primarily evaluated public health impacts but neglected other impacts such as economic damages, loss of public confidence, and other consequences of interruption of government services. Since that time, tools have been developed to evaluate other infrastructure vulnerability as well. For example, a tool developed by the Food and Drug Administration (FDA), in collaboration with the U.S. Department of Agriculture (USDA), Federal Bureau of Investigation (FBI), and DHS for evaluating the nation’s food and agricultural sector, has evolved into a very effective instrument for evaluating other infrastructure vulnerability. Adapted from a U.S. Special Forces target assessment instrument, the CARVER method categorizes and rates vulnerability factors including: **C**riticality, **A**ccessibility, **R**ecuperability, **V**ulnerability, **E**ffect, and **R**ecognizability.

Criticality can be broadly defined as a measure of magnitude in importance of impacts on public health and the economy resulting from disruption, regardless of the nature of hazard or the cause of the disruption. Evaluation of ***Accessibility*** measures how easy a target is to breach, whether by human agents or natural hazards. The ability of a system or facility to rebound from disruption is measured by the ***Recuperability*** component. The ease with which a disruption may occur is addressed by ***Vulnerability***. Direct loss, either in production or capital facilities, is measured by ***Effect***. ***Recognizability*** evaluates the ease with which an attacker identifies the target.

The CARVER tool was specifically developed for collaborative efforts by federal, state, and private industry to protect the nation’s food supply. Vulnerability assessments comply with various government mandates for protection of the food and agricultural sector. Terror attacks; major disasters, and other emergencies are identified as potential disruptions to this critical infrastructure sector. The CARVER method is used to accomplish the following:

- identify and prioritize sector-critical infrastructure and key resources
- establish protection requirements
- develop awareness and early warning capabilities to recognize threats
- mitigate vulnerabilities at critical production and processing nodes
- enhance screening procedures for domestic and imported products
- enhance response and recovery procedures

Each attribute is appraised by a team of stakeholders, such as a Local Emergency Planning Committee or members of an industry advisory group. Each element is evaluated and scored using standard criteria based on assumptions agreed upon prior to scoring. Because a local group of knowledgeable experts and decision-makers are ranking and prioritizing based on intimate knowledge of local conditions and assets, realistic goals and concerns are specific to the community.

Five structured steps are involved in the CARVER process (see Appendix B for detailed explanation). Step 1 defines parameters of what requires protection and from what it is being protected. In step 2, the team of experts is assembled and agrees on the attributes to assign values for each CARVER element. Step 3 involves describing the system being evaluated and its components and sub-systems in as much detail as possible. Step 4 assigns values to the various infrastructure elements, and tallies the seven CARVER attribute totals for each infrastructure item. Those nodes or items with the highest scores are potentially most vulnerable. In Step 5, the evaluation concludes by applying the lessons learned and implementing changes to the system to minimize vulnerability. The CARVER method has been adapted to evaluate all sectors of infrastructure.

3.0 Methodology

For this initial identification of the critical infrastructure elements in Clark County, a comprehensive list of infrastructure elements was assembled from the County geographic information system (GIS) parcels using land use codes (see Appendix A for a detailed description). From this initial identification, some effort is directed to prioritizing this comprehensive list by using publicly available databases to either quantify activity or stratify by function. For example, the Federal Deposit Insurance Corporation (FDIC) maintains a database on all federally licensed banking facilities and compiles data on total assets and total deposits. Stratification in this sector is quantifiable. The transportation infrastructure, on the other hand, is easily categorized by function.

This initial identification and prioritization study will provide the framework for future efforts, which will involve discussion and scoring infrastructure sectors and individual elements by a group of knowledgeable experts and stakeholders. Using vulnerability assessment tools such as the CARVER+SHOCK method in this future work, the unique characteristics of the local economy and infrastructure will be accommodated and weighted by local experts. In that evaluation, the additional steps outlined in federal guidance documents (threat assessment, vulnerability assessment, risk determination of expected consequences, and risk mitigation) will be addressed.

Within this document, each critical infrastructure and key asset sector is presented individually, with a preliminary discussion of its importance to the local economy and potential disruptions to continued functions. Information related to infrastructure sectors is drawn from the DHS Sector Specific Plans, newspaper articles, scholarly publications, and other appropriate sources. Again, the intent of this descriptive evaluation is to provide background for the more detailed work that will be undertaken in future efforts.

The Critical Infrastructure Protection Decision Support System (CIP/DSS) developed for the DHS CIP program under a collaborative effort involving Argonne, Los Alamos, and Sandia National Laboratories, models consequences for 17 different critical infrastructure and key asset sectors (Bush et al., 2005). These 17 elements are examined and mapped in this study (Table 1).

Table 1: Infrastructure and Assets

Critical Infrastructure

1. Agriculture and Food
2. Water
3. Public Health
4. Emergency Services
5. Government
6. Defense Industrial Base
7. Information and Telecommunication
8. Energy
9. Transportation
10. Banking and Finance
11. Chemical Industry and Hazardous Materials
12. Postal and Shipping

Key Asset Categories

13. National Monuments and Icons
14. Nuclear Power Plants
15. Dams
16. Government Facilities
17. Commercial Key Assets

Other federal guidance related to the DHS HSGP and Urban Areas Security Initiative (UASI) for protection of national assets evaluates more detailed specific types of facilities and assets. While this report uses the sector and asset categories described above, information on these more specific urban assets and geographic attributes (Table 2) are also assembled in this effort.

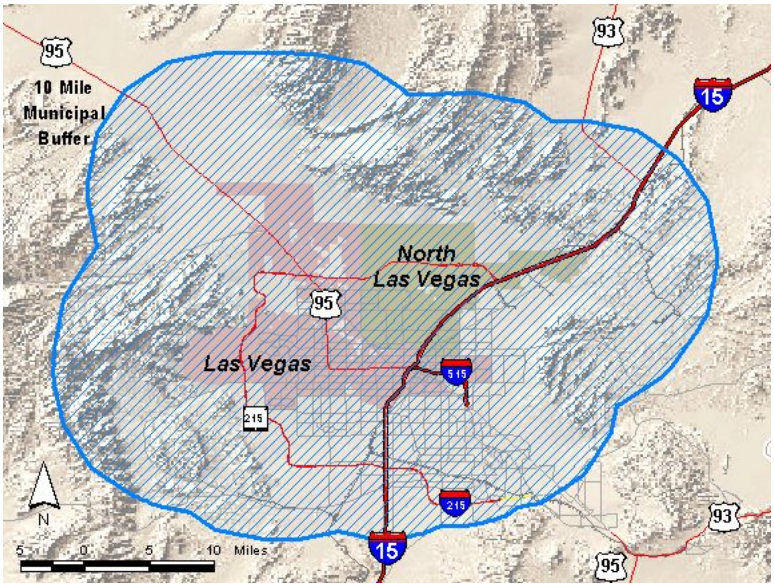
Table 2: Homeland Security Grant Program and Urban Area Security Initiative Assets and Infrastructure

Urban Area Asset Types

- Chemical Manufacturing Facilities
- City Road Bridges
- Colleges and Universities
- Commercial Airports
- Commercial Overnight Shipping Facilities
- Convention Centers
- Dams
- Electricity Generation Facilities
- Electricity Substations
- Enclosed Shopping Malls
- Ferry Terminals – Buildings
- Financial Facilities
- Hospitals
- Hotel Casinos
- Levees
- Liquefied Natural Gas (LNG) Terminals
- Maritime Port Facilities
- Mass Transit Commuter Rail & Subway Stations
- National Health Stockpile Sites
- National Monuments and Icons
- Natural Gas Compressor Stations
- Non-Power Nuclear Reactors
- Nuclear Power Plants
- Nuclear Research Labs
- Petroleum Pumping Stations
- Petroleum Refineries
- Petroleum Storage Tanks
- Potable Water Treatment Facilities
- Primary And Secondary Schools
- Railroad Bridges
- Railroad Passenger Stations
- Railroad Tunnels
- Road Commuter Tunnels
- Stadiums
- Tall Commercial Buildings
- Telcom-Telephone Hotels
- Theme Parks
- Trans-Oceanic Cable Landings

Urban Area Geographic Attributes

- Defense Industrial Base Facilities
- FBI Basic and Special Cases
- I-94 Visitors from Countries of Interest
- Intelligence Community Credible and Less Credible Threat Reports
- ICE Basic and Special Cases
- Nuclear Waste Isolation Pilot Plan (WIPP) Transportation Routes
- Military Bases
- Population
- Population Density
- Transient Population (Commuters and Visitors)
- Port Population
- Port Population Density
- Port of Entry/Border Crossings
- Special Events
- Suspicious Incidents (Credible and Less Credible)
- Vessels of Special Interest



4.0 Critical Infrastructure Sectors

The 12 critical infrastructure elements identified in Table 1 correspond in many ways to the industrial employment sectors reported by the U.S. Census. While several items in Table 1 require investigation from other information sources, understanding the industrial structure of the economy is essential when evaluating critical infrastructures. By first presenting the employment structure of the United States, Nevada, and Clark County, the discussion is placed in context and employment numbers and employment shares in the economy are used in the discussion of the individual critical infrastructure elements.

Data extracted from the 2005 American Community Survey (U.S. Census, 2007) provides industrial sector employment for major and minor categories of the economy. The same source of employment data is used for occupations in the discussion of portions of the CI/KR elements.

Table 3 provides a list of the major industrial employment sectors reported by the U.S. Census, and the labels for each sector found on Figure 1 and in Table 4 that follow. Sectoral shares and employment numbers are reported for the United States, Nevada, and Clark County for comparative purposes.

Table 3: Labels and Employment Sector Descriptions

Label	Description
Agric	Agriculture, forestry, fishing and hunting, and mining
Const	Construction
Manuf	Manufacturing
W Trade	Wholesale trade
R Trade	Retail trade
Transp	Transportation and warehousing, and utilities
Inform	Information
FIRE	Finance and insurance, and real estate and rental and leasing
Pro Srv	Professional, scientific, and management, and administrative and waste management services
Edsoc Srv	Educational services, and health care and social assistance
Ent Srv	Arts, entertainment, and recreation, and accommodation and food services
Othr Srv	Other services, except public administration
Admin	Public administration

Figure 1: Employment Shares by Sector

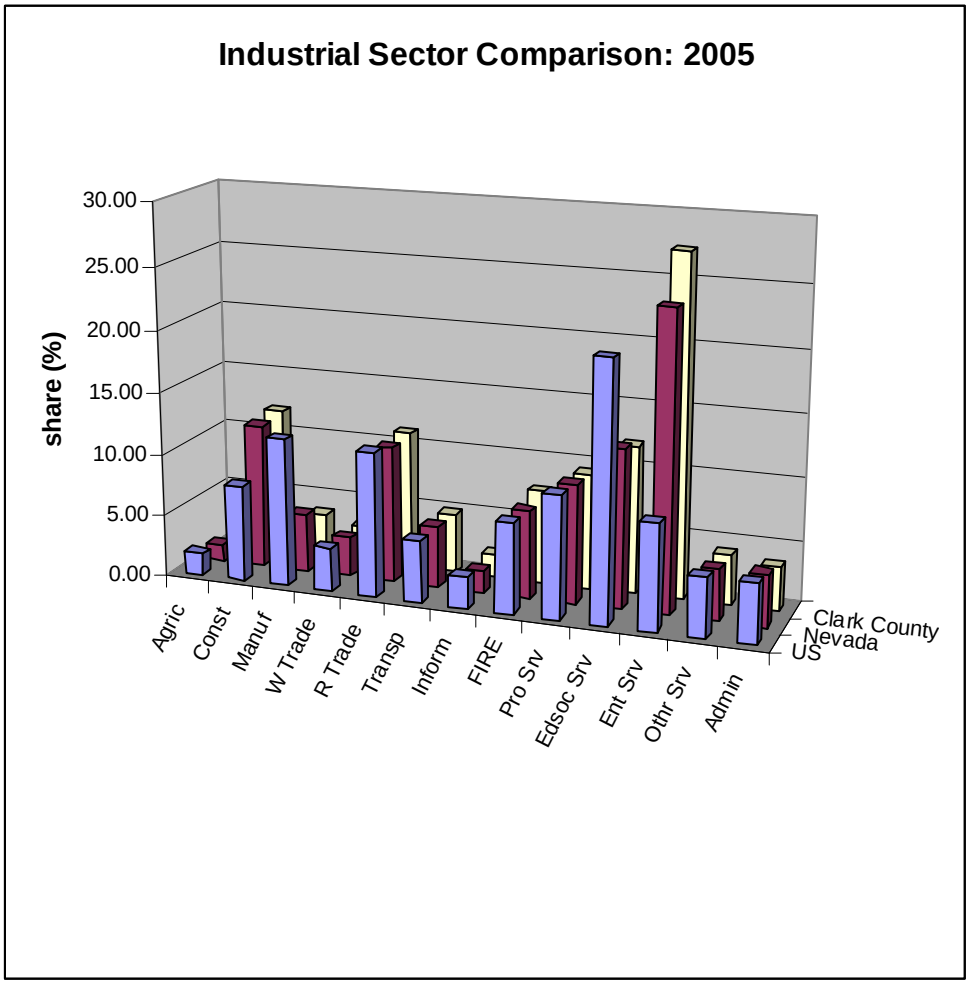


Table 4: Employment and Sectoral Share

	US Employment	US (%)	Nevada Employment	Nevada (%)	Clark County Employment	Clark County (%)
Total:	**136,458,810**	**100**	**1,161,150**	**100**	**826,065**	**100**
Agric	2,383,293	1.75	14,955	1.29	982	0.12
Const	10,532,912	7.72	135,271	11.65	98,122	11.88
Manuf	16,273,893	11.93	55,094	4.74	29,599	3.58
W Trade	4,829,662	3.54	36,894	3.18	24,273	2.94
R Trade	15,864,275	11.63	127,289	10.96	92,093	11.15
Transp	6,877,585	5.04	57,833	4.98	39,639	4.80
Inform	3,387,849	2.48	19,890	1.71	15,038	1.82
FIRE	9,905,115	7.26	81,454	7.01	62,061	7.51
Pro Srv	13,457,013	9.86	110,885	9.55	76,880	9.31
Edsoc Srv	28,225,662	20.68	148,064	12.75	98,530	11.93
Ent Srv	11,555,579	8.47	276,549	23.82	225,966	27.35
Othr Srv	6,596,459	4.83	47,920	4.13	33,452	4.05
Admin	6,569,513	4.81	49,052	4.22	29,430	3.56

While employment for agricultural activities in Clark County approaches 2 percent of the national economy and over 1 percent of the state economy, agricultural employment in the county is minimal. Similarly, manufacturing employment in Clark County is slightly over 3.5 percent while accounting for nearly 12 percent of the national economy. Education and Social Services employment are also under-represented in Clark County when compared to the national economy.

Employment in Clark County and statewide demonstrates the unique local economy in the share of Entertainment and Recreational Services. While this sector contributes less than 10 percent to nationwide employment, the Nevada share for employment in entertainment activities exceeds 20 percent and approaches 30 percent in Clark County. Construction activities in Nevada and Clark County are also elevated relative to the national average.

Employment in Nevada specializes in entertainment and recreation services. This level of specialization is even higher for Clark County. Any investigation of critical infrastructures in such an economy must examine these facilities and activities as one of the primary concerns for vulnerability and disruption. Evaluation of other sectors must recognize the importance of the economic base, and frame the investigation within that context.

4.1 Agriculture and Food

Clark County depends almost entirely on imports of food to support the local community (USDA, 2004). According to the 2002 Census of Agriculture, there are 253 farms in Clark County. There are no farms in the County producing corn or wheat for human consumption, but there are a few producing grains for silage. While there are a handful of farms producing livestock such as cows, pigs, sheep, and chickens, the primary agricultural activity in the county is raising alfalfa and hay for resale or pasture for winter grazing. Barely 0.12 percent of employment in Clark County is dedicated to agricultural activities.

Since most of the food consumed in Clark County must be imported, food distribution centers are the critical asset of the local agricultural sector. Several national grocery chains are present in the Las Vegas market including Albertson's, Smith's, Von's, and the discount chain Food-4-Less. Additionally, there are numerous food wholesalers and specialty food distributors serving the casinos and other commercial restaurants. Because virtually all-consumptive foodstuffs must be imported, the transportation infrastructure is particularly interdependent with agriculture where Clark County is concerned.

The Clark County GIS includes information pertaining to each parcel in the county. Included in the list of data fields is information related to each parcel's land use. The commercial land use includes a category for ***Food and Beverage Businesses*** that are distributors of food and/or drink items or other retail or wholesale business related to consumable items. Additionally, there are ***Transportation*** facilities that identify aircraft, railroad, bus, taxicab, truck, and marine terminals and depots; freight docks; storage compounds; and other related facilities. There may be facilities included in this land use category that are large depots for the transportation of agricultural or food products.

While geographic information on local agricultural production is available for Clark County, it would only be considered critical to its owners and clients. Not to minimize their investments and concerns, the critical infrastructure involving agriculture in Clark County involves the distribution and supplies of food for consumption. Market share in the food business is not in the public record. It is not possible to determine from public documents where the primary flows of food are distributed in Clark County, but future efforts should include discussions with the food-service industry to identify major distributors and concerns of the industry. Figure 2 shows the Clark County locations of agricultural production and commercial parcels with commercial food distribution activities, while Figure 3 shows the same information for the Las Vegas Valley in closer detail.

Potential threats to the food sector include natural hazards interrupting the transportation of food products, natural disasters such as prolonged drought or heat that diminish yields from crops, potential pathogens and contaminants that spoil food by natural causes, potential pathogens and contaminants inadvertently introduced to the food supply through the manufacturing process or transportation, and pathogens or contaminants deliberately

introduced to the food supply to disrupt, maim, or kill segments of the population. Specific threats include disease, pests or insects, contamination, poisoning from pesticides or bioterrorism, unsanitary conditions or preparation, and improper storage.

The FDA has established a Registration of Food Facility Database for the monitoring and protection of this vital sector (FDA, 2003). Under the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, any domestic or foreign facility that handles or produces food for human or animal consumption in the United States is required to register. However, due to privacy concerns, this information is not available to any but the registering party and designated federal authorities.

Figure 2: Agriculture and Food Locations, Clark County

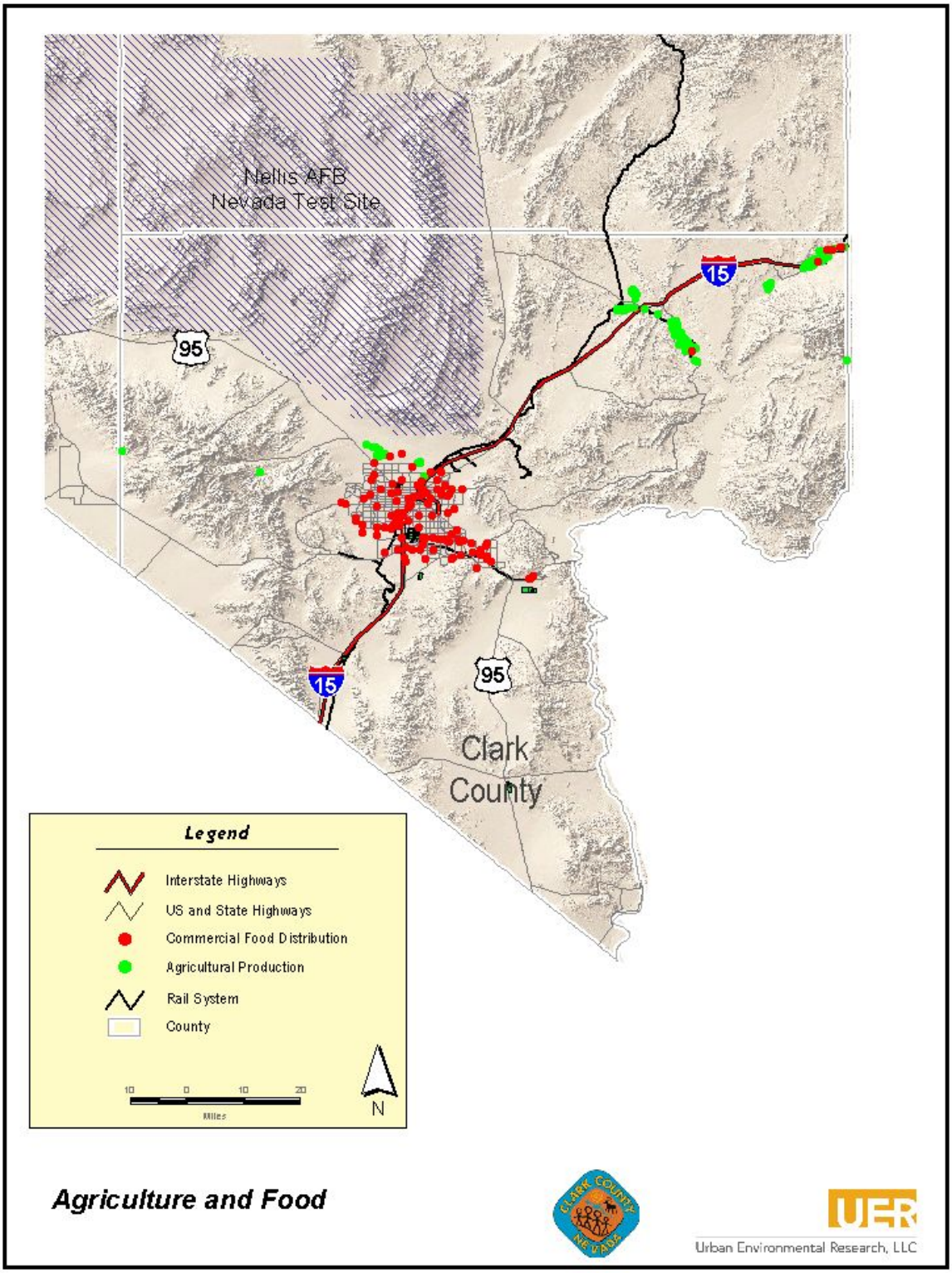
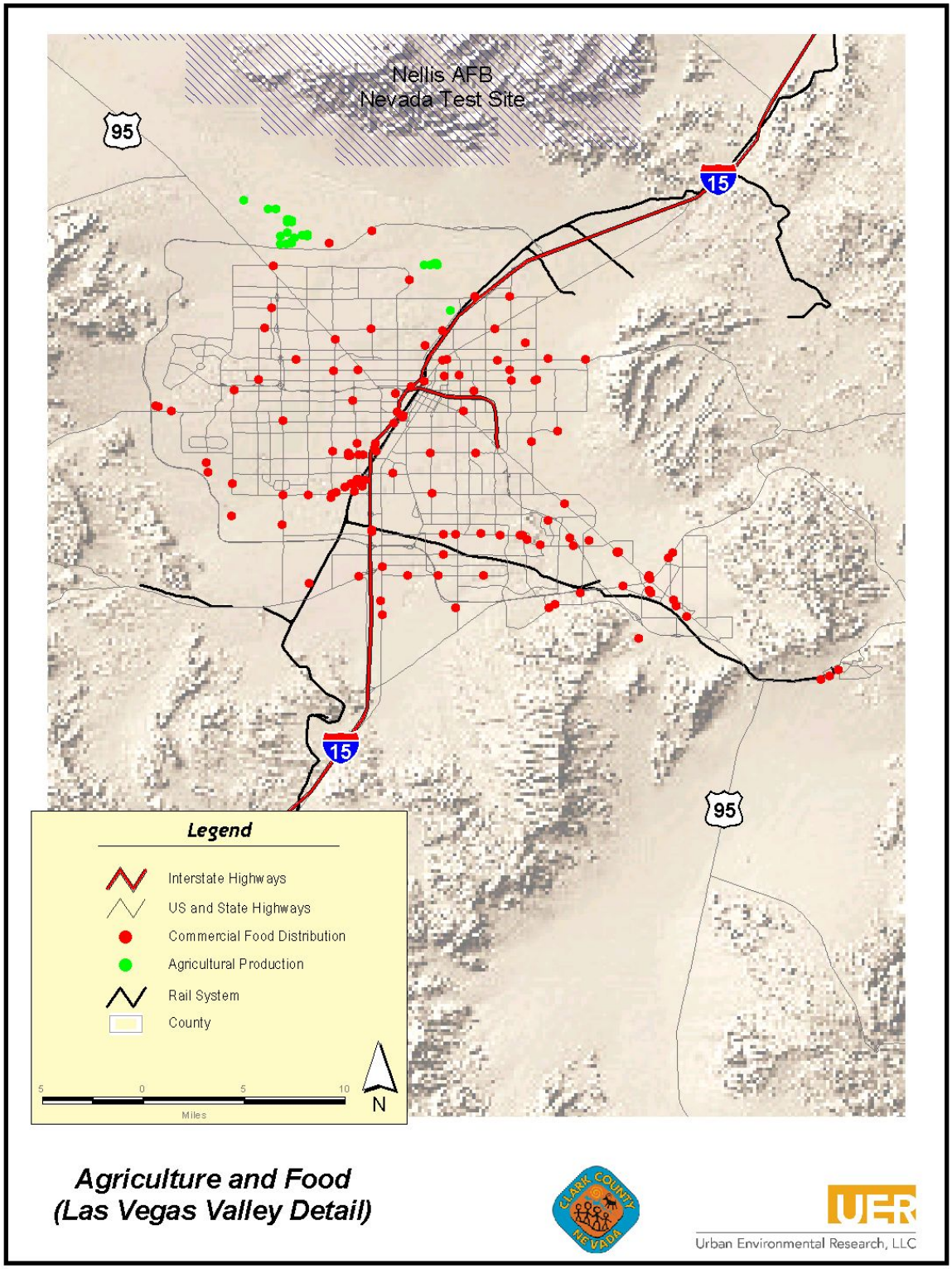


Figure 3: Agriculture and Food Locations, Las Vegas Valley



Additional information on the distribution of food-related business activities are gathered from the business licensing divisions of Clark County, the City of Las Vegas, the City of North Las Vegas, and the City of Henderson. These data include business names, business street addresses, business license numbers, and the business-licensing category. Because this information is compiled from different sources, comparison between jurisdictions does not always result with the identical type of business. However, unlike the parcel data from Clark County that reports land use by parcel, this data does reveal discrete business locations that can be geo-coded and mapped. A comprehensive list of the business codes used from each jurisdiction for each critical infrastructure element is included in Appendix C.

Food-related business activities in the unincorporated portion of Clark County include a Grocery/Food Products category and several categories of restaurants. Grocery stores include outlets for national chains as well as numerous smaller specialty and ethnic food distributors. Some of the locations mapped include neighborhood convenience stores with some food products in addition to a wide range of other merchandise. This type of business is distributed throughout the metropolitan area primarily on the major streets and thoroughfares. A dense cluster of restaurants is evident in the resort corridor to serve the needs of visitors on the Las Vegas Strip (see Figure 4). There are additional food and restaurant facilities sparsely distributed throughout the County to serve travelers and residents of outlying locations such as Mesquite, Boulder City, Laughlin, and other smaller locations.

The City of Las Vegas food data includes a Food Wholesale and Delivery category in addition to groceries and restaurants (see Figure 5). The distribution of these business facilities show a similar pattern to that of the unincorporated county, with a cluster of the food wholesalers located in close proximity to the Strip to service the large resorts and casinos.

In the City of Henderson, food-related businesses are highly concentrated along major streets. This concentration is most evident on South Eastern Avenue and the Boulder Highway resort corridor (see Figure 6). Henderson's business license category for grocery stores also includes convenience stores selling food products.

Figure 7 shows locations in the City of North Las Vegas engaged in food-related business. In addition to the restaurants and grocery stores found in other locations throughout the metropolitan area, there is a cluster of food wholesalers conducting business in this jurisdiction. While there may be there may be similar clusters in other valley locations not evident from the business license information, these operations may be located in proximity to take advantage of easy access to the transportation network.

Figure 4: Grocery and Restaurant Locations, Unincorporated Clark County

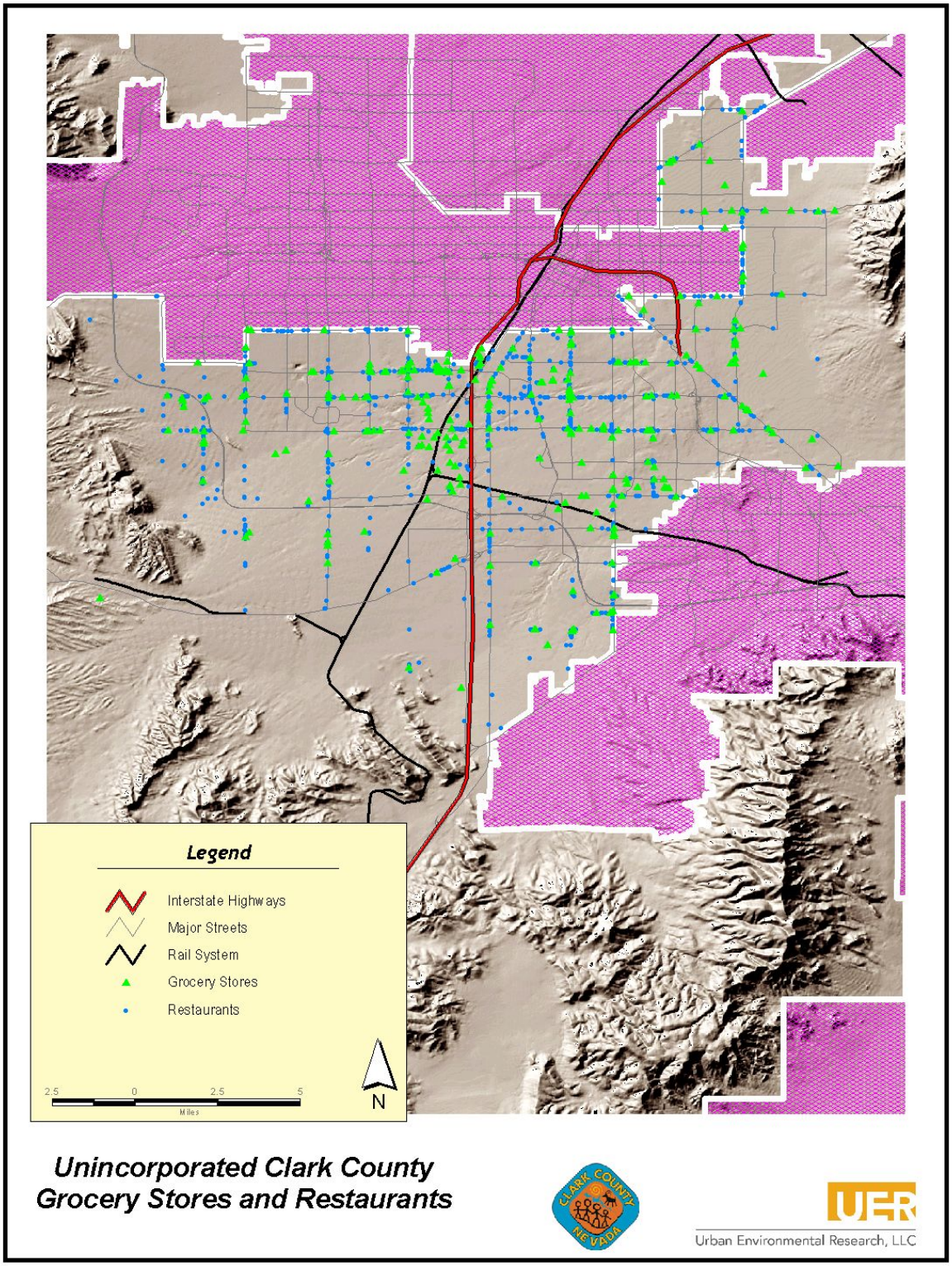


Figure 5: Grocery and Restaurant Locations, City of Las Vegas

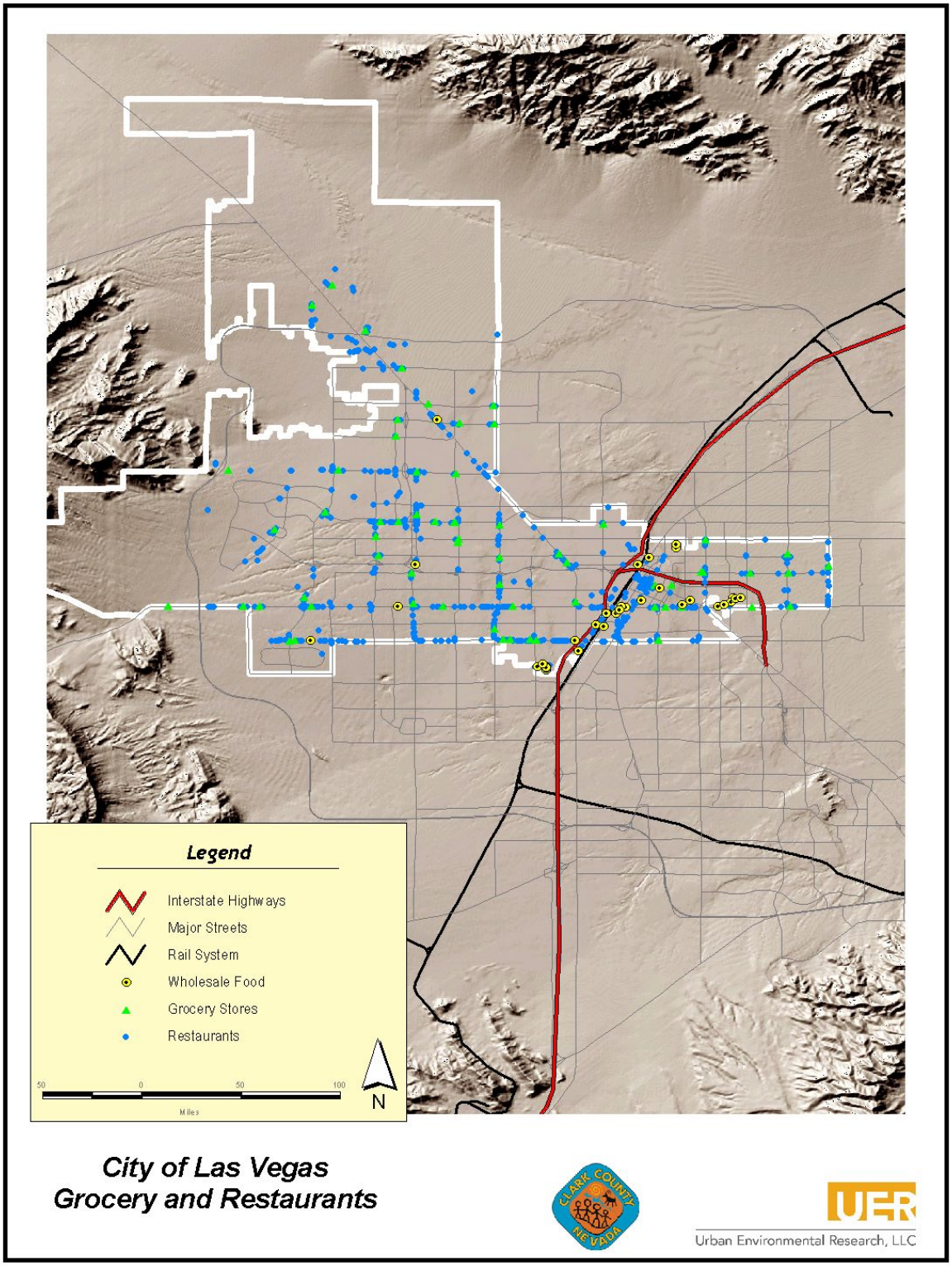


Figure 6: Grocery and Restaurant Locations, City of Henderson

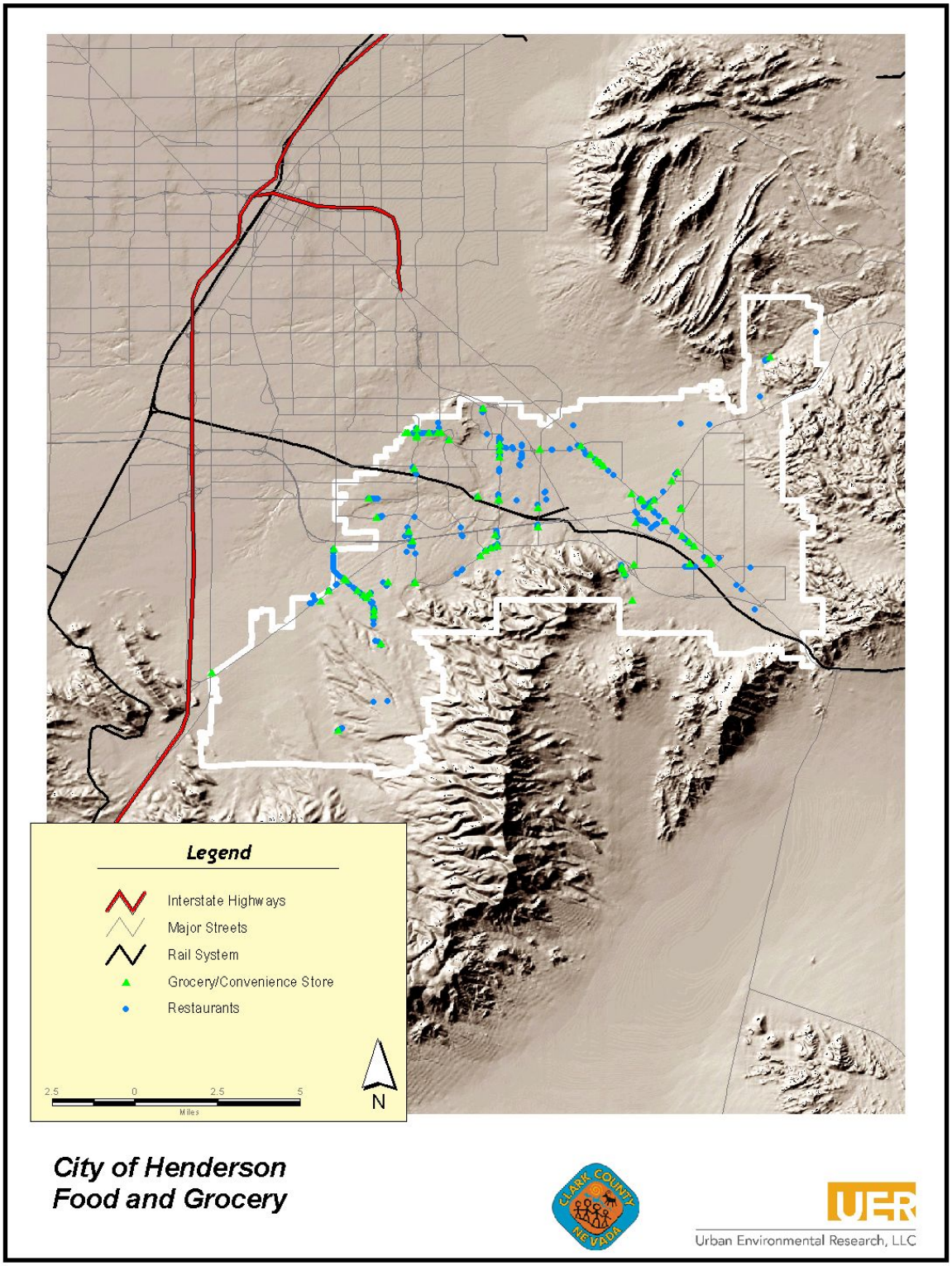
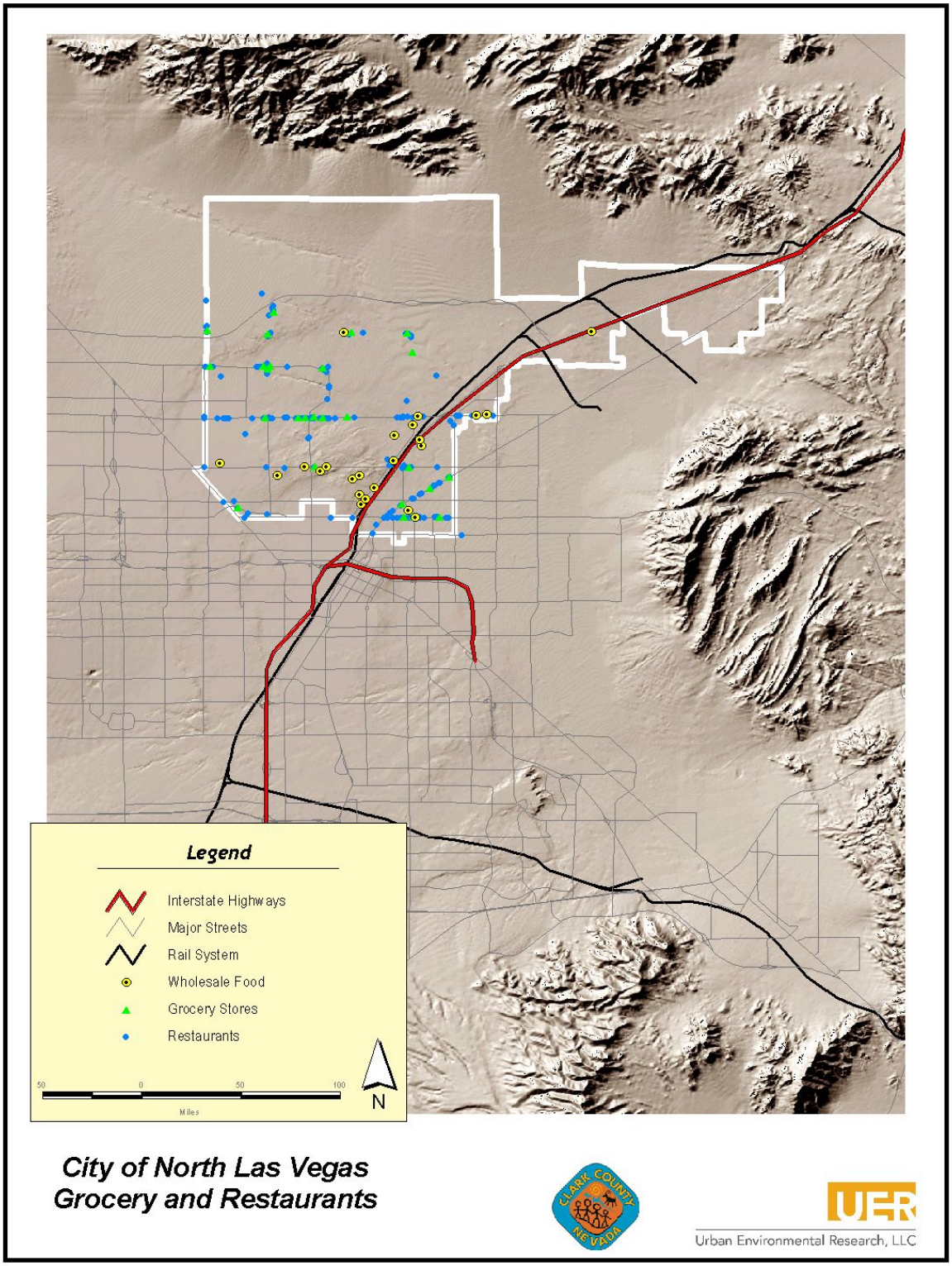


Figure 7: Grocery and Restaurant Locations, City of North Las Vegas



4.2 Water and Wastewater

The availability of water in the arid, American Southwest either provides opportunity for population and economic growth or constrains it. Southern Nevada gets 90 percent of the water required for urban consumption from Lake Mead and the Colorado River (Southern Nevada Water Authority, 2006). Groundwater and artesian springs provided drinking water for Las Vegas through most of its first hundred years. However, the rapid growth of the late twentieth century resulted in groundwater withdrawals that outpaced the recharge rate. Following the Second World War, southern Nevada increasingly looked to the Colorado River for water.

During the war, an industrial concentration known as the Basic Management Complex was established in Henderson to supply raw materials for the war effort. An allocation of Colorado River water was supplied for this purpose and a pipeline was constructed from Lake Mead for this allocation. This diversion to the Las Vegas Valley expanded over time, and groundwater pumping came under control of the State Engineer.

By the 1990s, it became clear that water constraints would limit growth in Las Vegas without drastic action. With the creation of the Southern Nevada Water Authority (SNWA), a search for new supplies and stringent water conservation efforts stabilized water supplies to the Valley. Integrated resource planning and stringent conservation efforts led to water banking, reclamation, and other long-range efforts to maintain and expand water supplies.

Figure 8 shows the distribution of water-related properties in Clark County. These properties were extracted from the Clark County GIS parcels database using the land use code for water utilities, and may include administrative facilities, water treatment plants, and pumping stations. Additional linear features of the distribution system are available, but were not acquired in time for this report. Figure 9 shows the same facilities, but examines the Las Vegas Valley in closer detail.

Las Vegas and Clark County are particularly vulnerable to disruptions in water supply. Though proximity to Lake Mead is advantageous, most of this water is allocated elsewhere and is subject to availability based on natural precipitation cycles. Any contamination of Lake Mead water or disruptions in delivery or treatment of this water could have catastrophic consequences locally.

Additionally, as population growth continues, SNWA is seeking groundwater supplies from other parts of the state. New infrastructure such as wells pumps, and pipes to transport this precious resource to the parched Las Vegas Valley will constitute a new vulnerability for which to prepare.

Figure 8: Water Facilities, Clark County

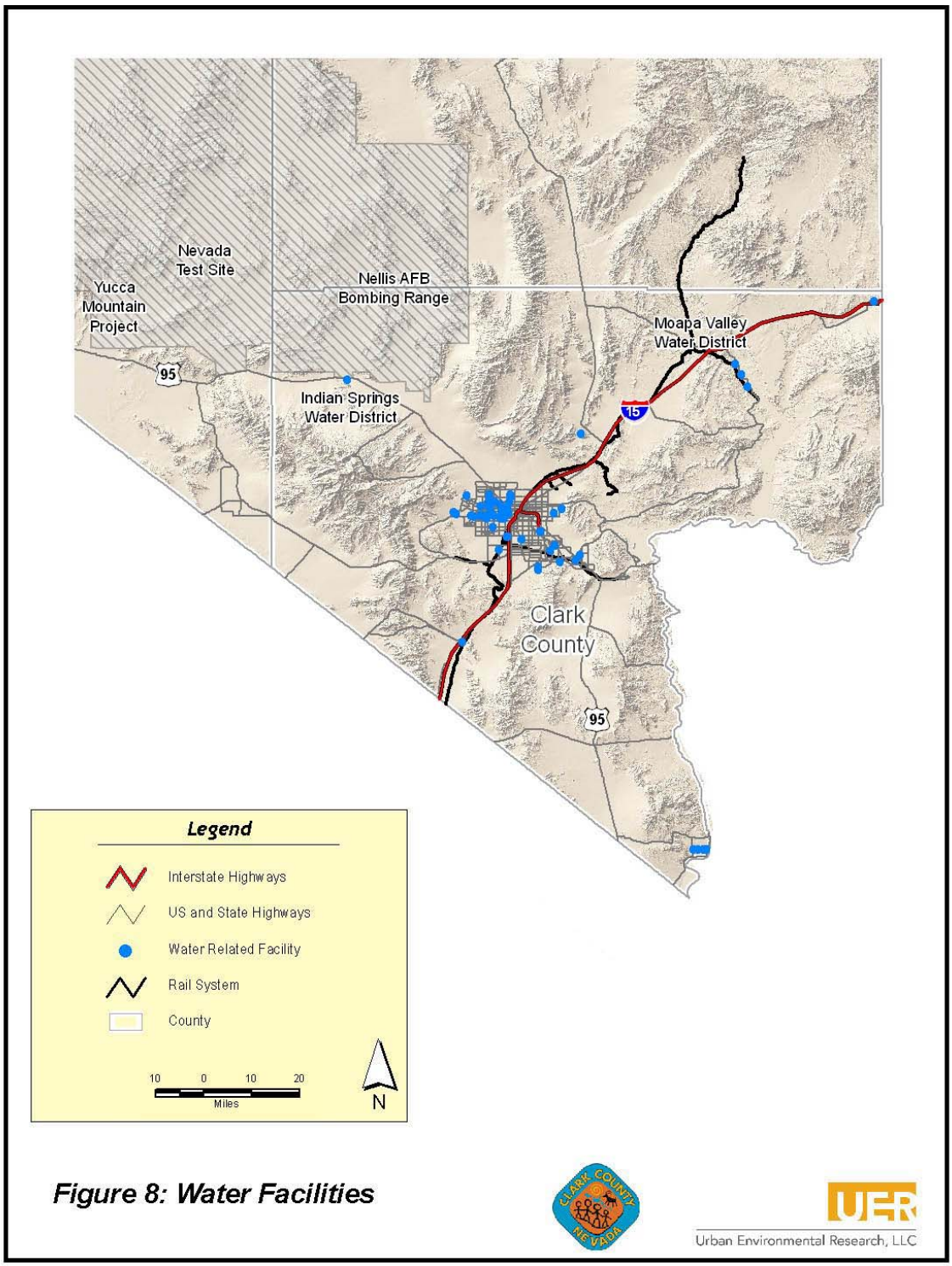
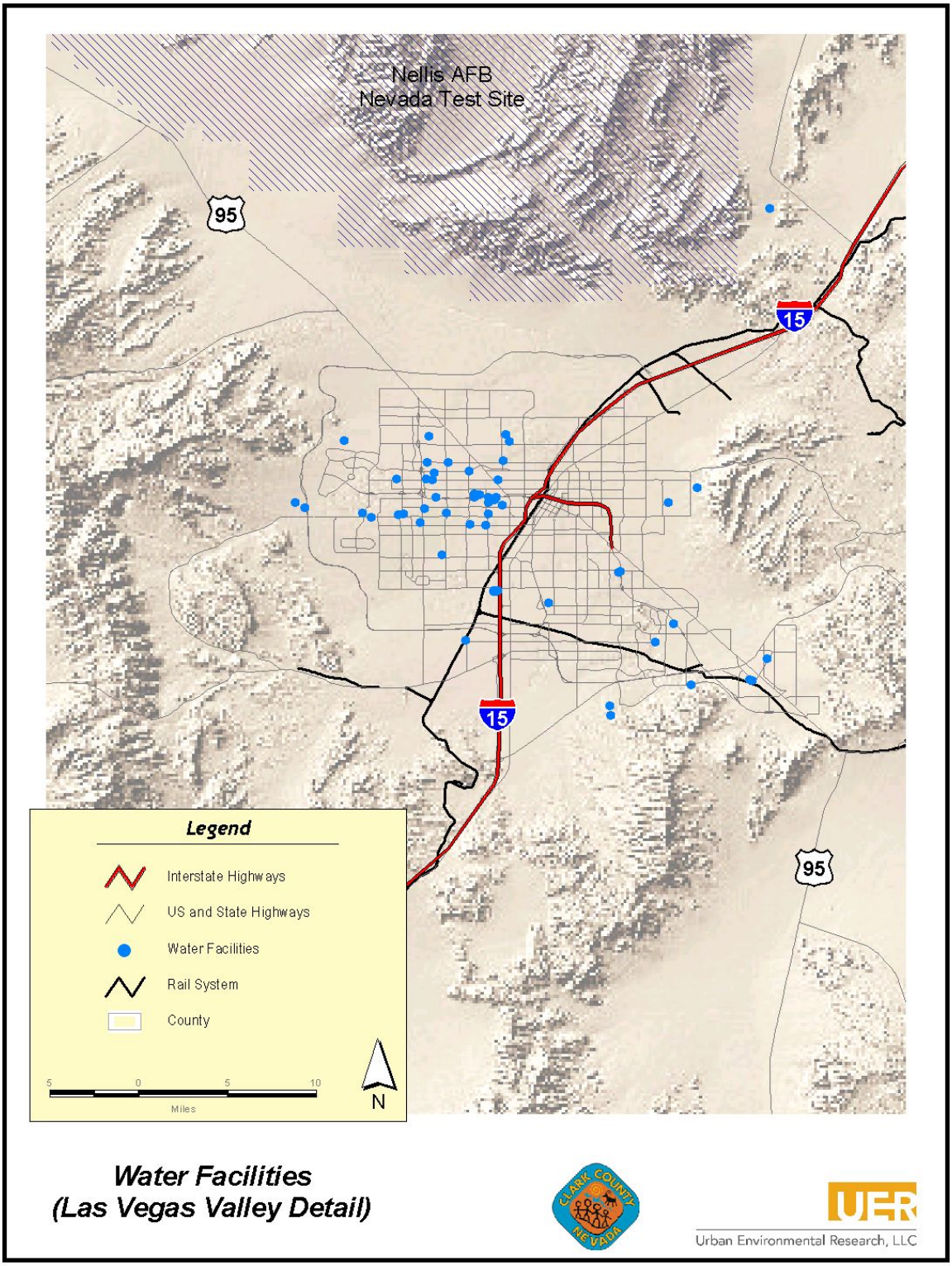


Figure 9: Water Facilities, Las Vegas Valley



4.3 Public Health

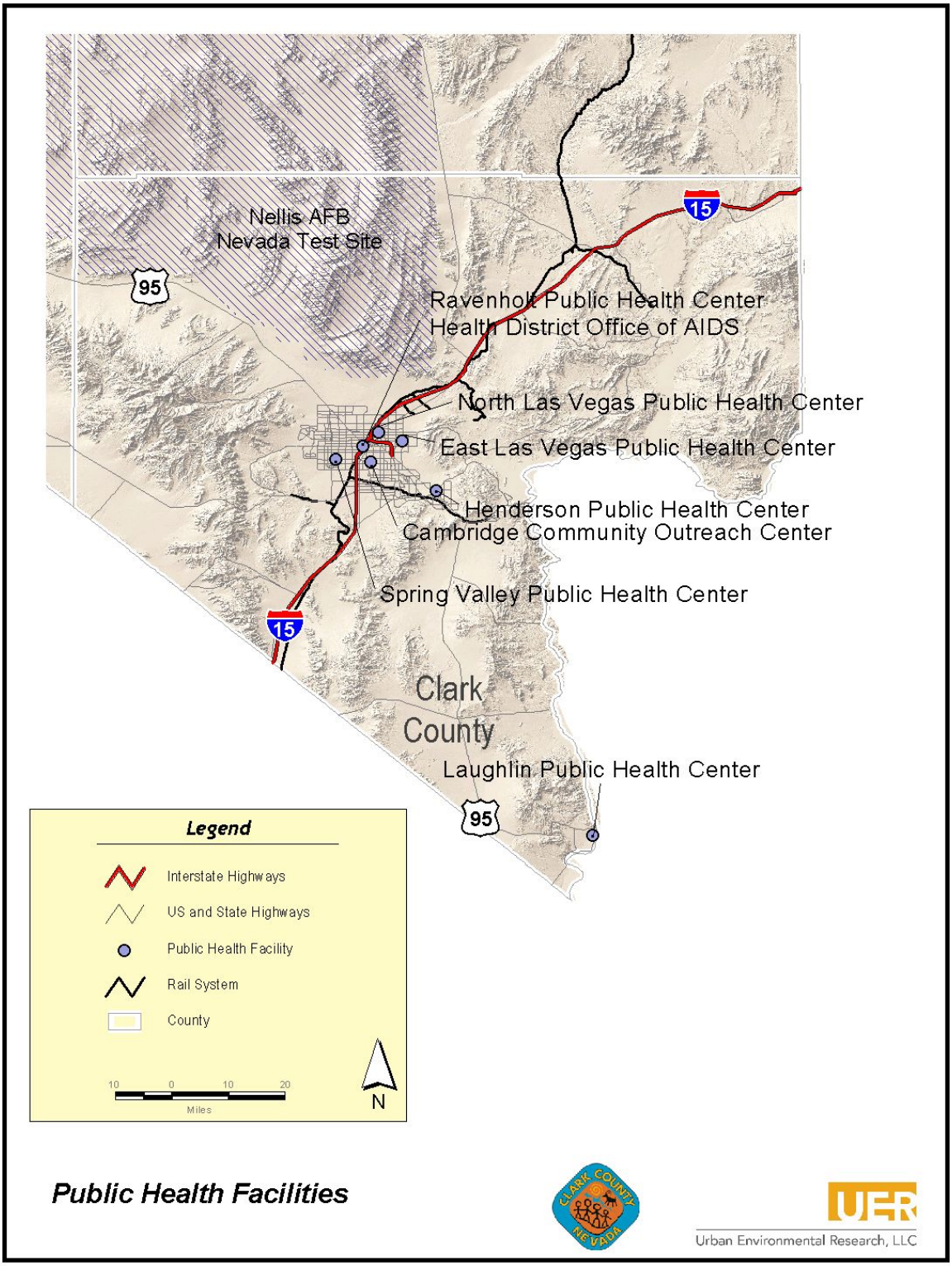
The Southern Nevada Health District represents Boulder City, Clark County, Henderson, Las Vegas, Mesquite, and North Las Vegas (Southern Nevada Health District, 2005). Serving over 1.7 million residents and millions of visitors each year, the District oversees restaurant inspections, drinking water quality, and tracks diseases and other community health issues. The District also contributes efforts to emergency planning.

With a mission to "protect and promote the health, the environment and the well-being of Clark County residents and visitors" (Southern Nevada Health District, 2007), the District oversight role is broad. In the event of an outbreak of disease, the District would be responsible for coordinating efforts and distribution of required supplies. Similarly, in the event of a natural or human-caused disaster, the District would oversee the medical response. With over 500 employees in four divisions, one of the District's primary jobs is sanitation inspection of food and drinking establishments. In recent years, expanded responsibility in emergency preparedness is increasingly important.

In this role, the District is charged with preparations for disease threats, chemical threats, nuclear/radiological threats, and disasters/emergencies. The multi-jurisdictional Local Emergency Planning Committee (LEPC) has designated the Southern Nevada Health District as the lead agency in the event of severe heat-related disaster. The Office of Public Health Preparedness (OPHP) oversees coordination efforts for disaster response including training activities, but also oversees a volunteer group of medical personnel, the Medical Reserve Corps, that would be an invaluable asset in the event of a disaster. This trained reserve group with pre-defined roles could rapidly supplement other dedicated response efforts in an emergency.

Figure 10 displays the location of the primary public health facilities in Clark County. In terms of public health vulnerability, Las Vegas is probably no more or less vulnerable than any other large, metropolitan area. The population concentration provides the potential for mass casualties from human-caused or natural disasters, but there are no structural increases to vulnerability from the location of public health facilities.

Figure 10: Public Health Facilities, Clark County



4.4 Emergency Services

Emergency services in Clark County include hospitals and urgent care facilities in addition to doctors' offices and clinics, ambulance services, and government activities to respond to emergencies. However, not all emergency services are specifically related to medical treatment in the current age with terrorism fears and growing impacts from natural hazards.

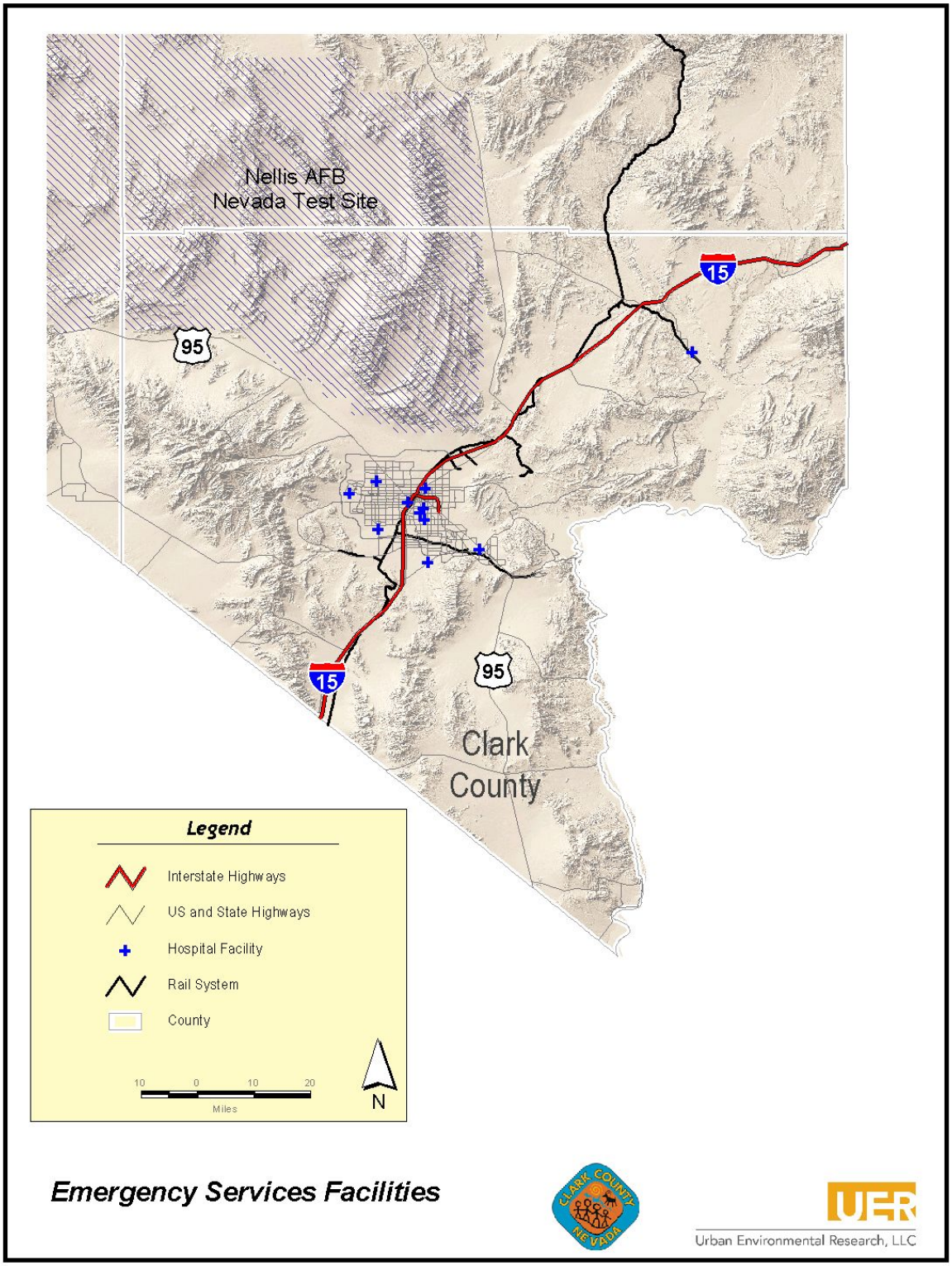
Recent emergency exercises illustrate how emergency responders and government collaborators operate in the current regime of emergency planning. A September 2006 exercise for Clark County emergency planning included "representatives from the American Medical Response and Medic-West ambulance companies, the county Fire Department, the Office of Emergency Management and Homeland Security, the FBI, the Las Vegas Fire and Rescue Department, the Las Vegas Metropolitan Police Department, the Nevada Highway Patrol, North Las Vegas, the UNLV Police Department, the Southern Nevada Area Communications Council, the Clark County Amateur Radio Emergency Service/Radio Amateur Civil Emergency Service and the All Hazards Multi-Agency Operations and Response group, a local multi-agency hazardous response team" (Clark County, 2006). Government oversight and input is as important as inclusion of medical personnel, and in this exercise, DHS gave high marks to the Clark County efforts.

Figure 11 shows the locations of major hospital facilities in Clark County. Additionally, the Clark County GIS includes a commercial land use code for parcels owned by professional services firms that include hospitals, doctors' offices, and ambulance services. However, this source also includes such activities as accountants, attorneys, and art schools. Additional work on these data and inputs from the LEPC will be required to refine this source of data.

Additional sources of data related to firms delivering emergency services include professional directories; government lists of licensed medical professionals such as doctors and nurses, and phonebook yellow pages. In addition, Clark County licenses hospitals and clinics as businesses. Appendix 4.4.1 includes the lists of these facilities.

Clark County enjoys a wide distribution of these professional services functioning within a framework of cooperation and coordination. While response to any disaster can be chaotic, Clark County and Las Vegas are not particularly vulnerable in expected response from emergency services. However, a natural disaster, such as intense flooding or a massive earthquake could destroy portions of the transportation infrastructure and disrupt the free movement of emergency response units.

Figure 11: Emergency Services Facilities, Clark County



In addition to the major hospitals located in Clark County, police and fire departments provide emergency services. The Clark County Fire Department provides urban and rural fire fighting services as well as emergency medical services, hazardous materials response, disaster and emergency response, and public information. Figure 12 shows the dispersed locations of fire stations in the Las Vegas metropolitan area required to respond to emergencies in all neighborhoods. This map also displays the locations for the police command centers of the Las Vegas Metropolitan Police Department and the two main City of North Las Vegas police stations. Impacts to Clark County's public safety critical infrastructure from Yucca Mountain shipments are documented in a series of public impact assessment reports completed for Clark County Nuclear Waste Division (UER 2002, 2005)

The Clark County Business License Department licenses and includes a category specifically for medical clinics. Figure 13 shows the location of hospitals and the licensed clinics in the unincorporated portion of the metropolitan area. The clinics include businesses providing urgent care, but also include such diverse, specialty medical services as weight loss and cosmetic surgery. These facilities are located mostly clear of the resort corridor, with an evident concentration south of downtown and to the east of the Las Vegas Strip.

The City of Las Vegas also licenses clinics and hospitals (see Figure 15). There are two clear concentrations of these medical facilities within the City, one west of Interstate 15 along Charleston Boulevard in proximity to the Valley Hospital Medical Center, and the other clustered near Mountainview Hospital and Healthsouth hospitals on Tenaya Way west of US 95.

Figure 12: Police and Fire Facilities, Metropolitan Clark County

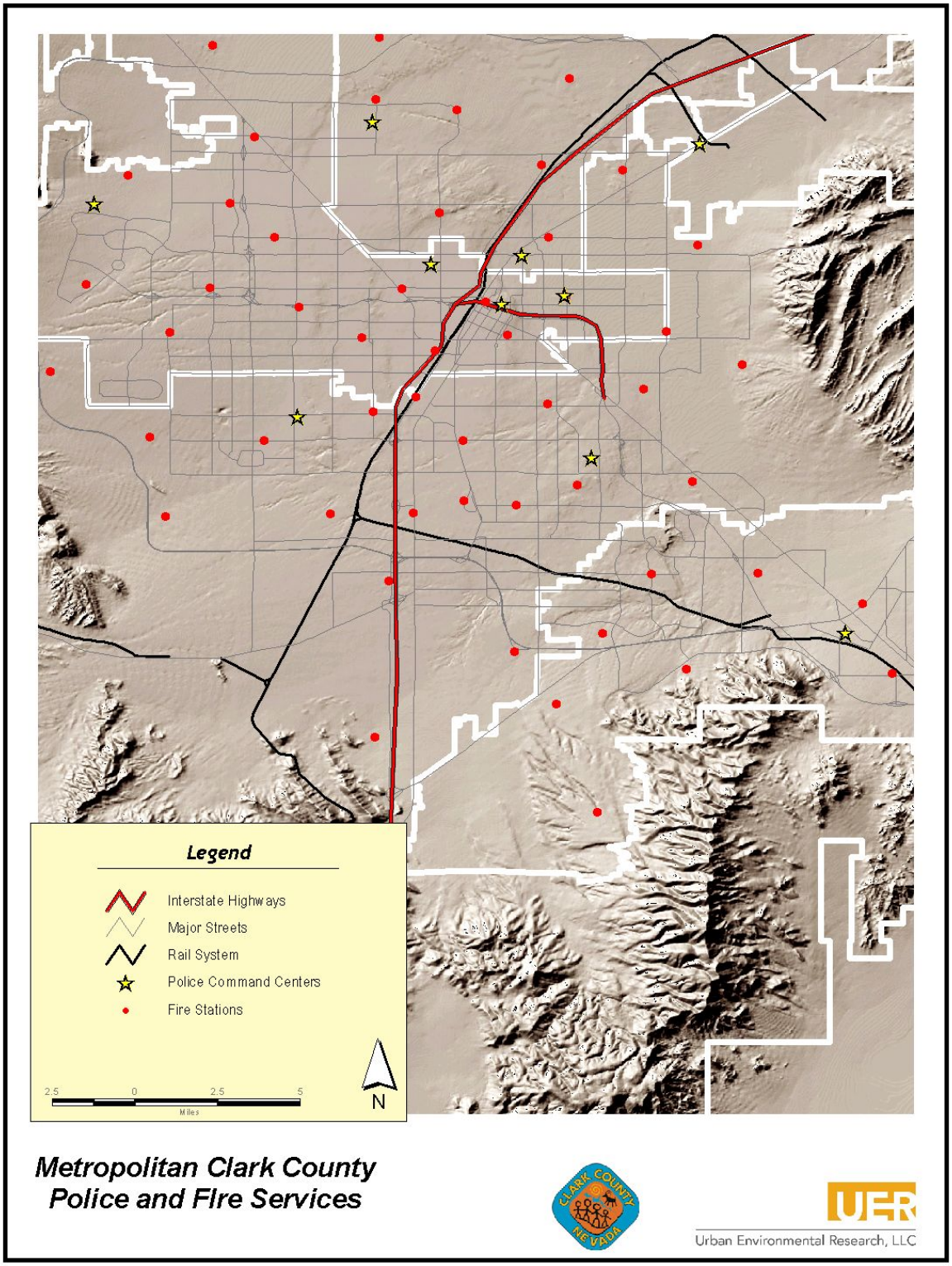


Figure 13: Health Services, Unincorporated Metropolitan Clark County

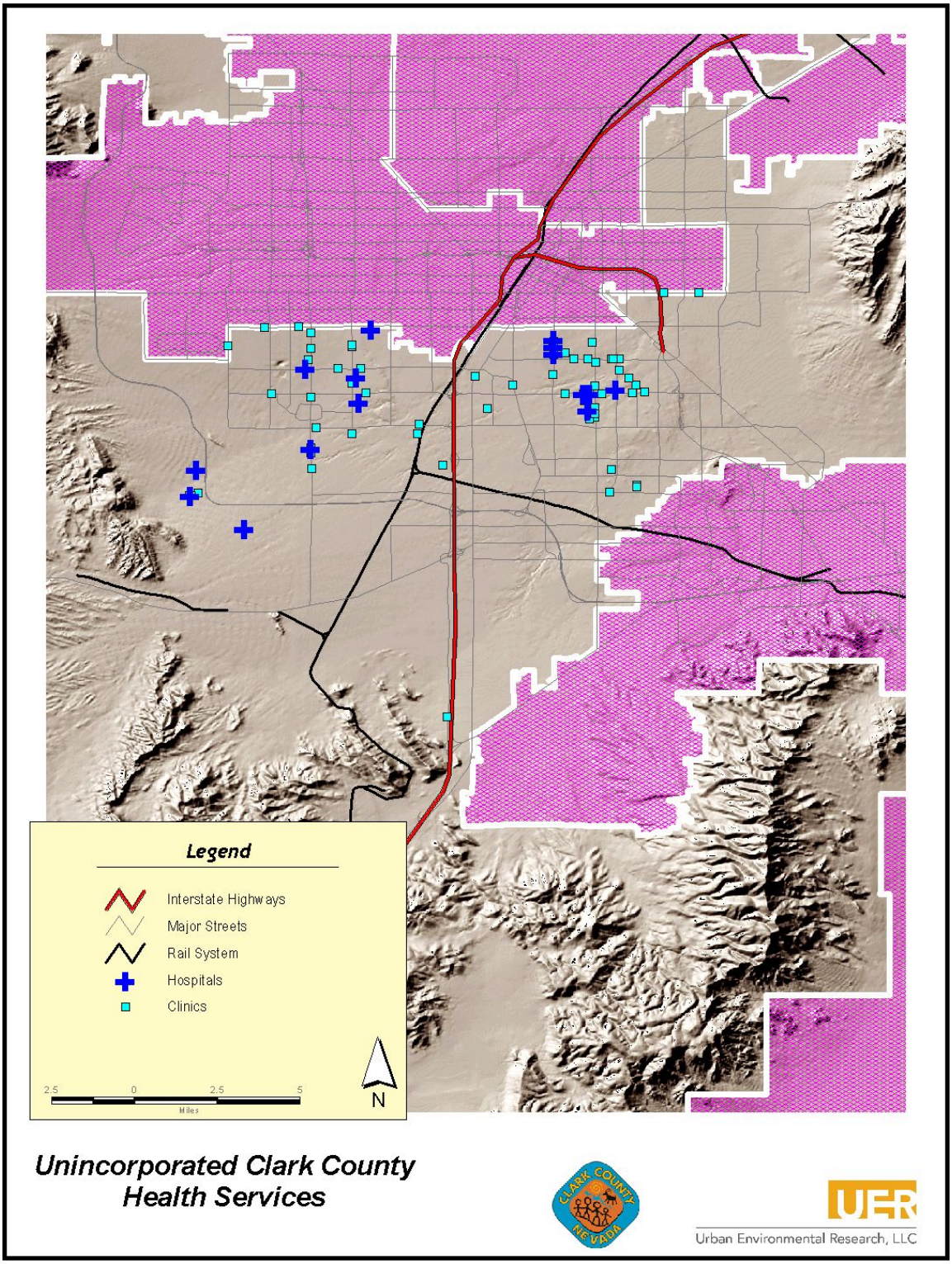
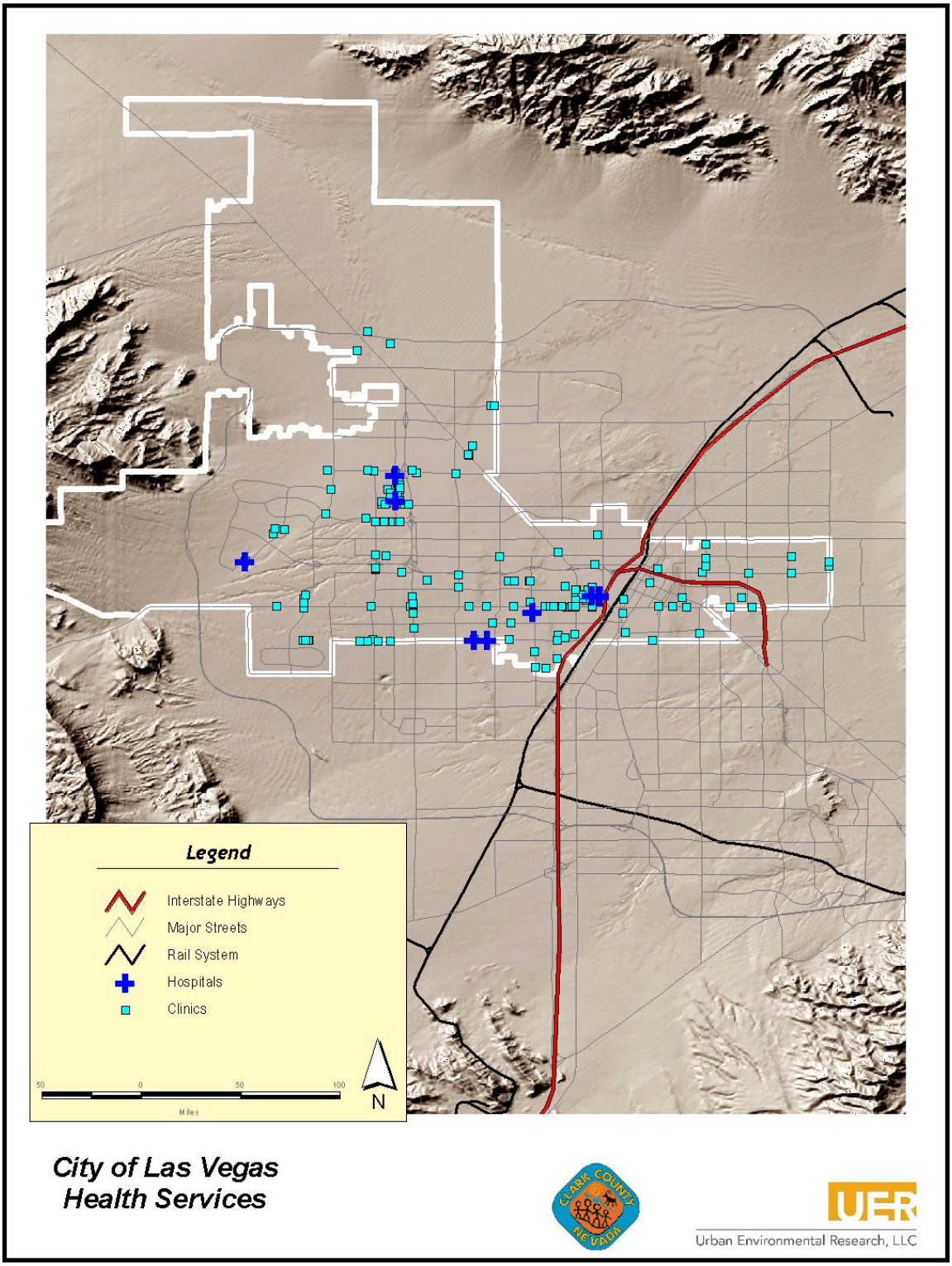


Figure 14: Health Services, City of Las Vegas



4.5 Government

Government services in Clark County include representatives of the federal government, the State of Nevada, Clark County, regional governmental authorities, and local municipalities. In the event of disaster response, local government representatives are best positioned and possess the required local knowledge for initial response.

The federal government presence in Clark County includes U.S. Air Force activities at Nellis Air Force Base and U.S. Department of Defense (DOD) recruiting stations throughout the County; U.S. Department of Energy (DOE) activity related to the Nevada Test Site and Yucca Mountain; Bureau of Reclamation offices for operations on the Colorado River; several U.S. Environmental Protection Agency (EPA) labs and offices; FBI and Internal Revenue Service (IRS) field offices; a National Weather Service office for Lakes Mead and Mojave; Secret Service and Probation and Parole offices; and several Social Security offices. None of these federal activities could be considered essential to the day-to-day functioning of the local economy.

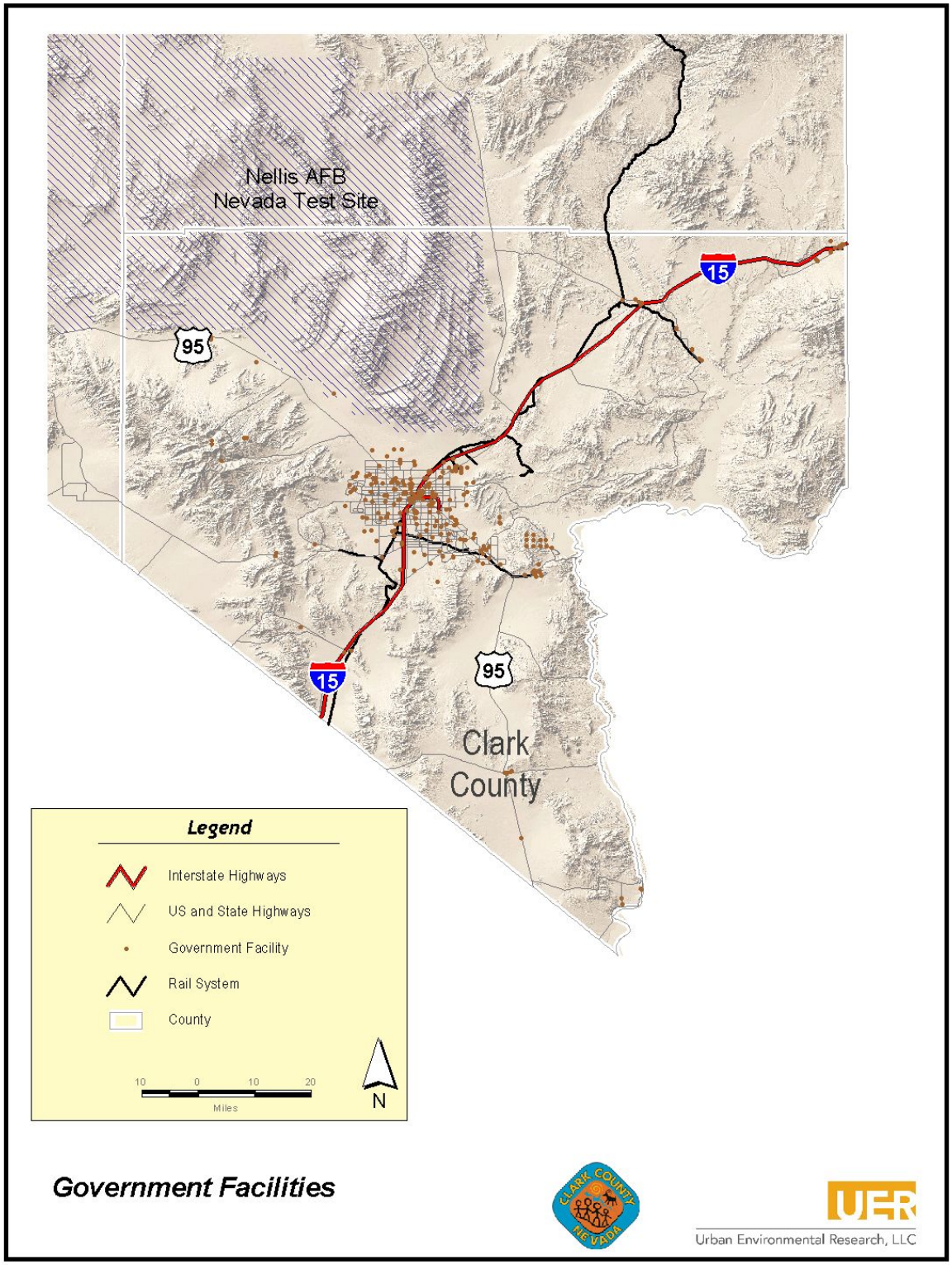
The State of Nevada presence is notable for the Office of the Gaming Control Board that strictly regulates the operations of the gaming establishments that drive the state and local economy. The Department of Public Safety, Highway Patrol, and Motor Vehicle Department operate offices related to traffic operations and safety. Other state offices include welfare and social services operations.

County and municipal government agencies would be in the spotlight for any local disaster response. The Southern Nevada Health District would lead in the event of a heat-related natural disaster and would play a prominent role in any outbreak of disease. The LEPC, a multi-jurisdictional group of first-responders, planners, and decision-makers, would use their working relationships and distinctive talents for the initial collective response and event stabilization.

Because of the unique structure of the local economy and local experience with large crowds and events, local law enforcement is particularly adept at crowd control and maintaining public order. Las Vegas and Clark County are not particularly vulnerable from the standpoint of personnel or their capabilities. However, the dense concentration of government, commercial facilities, and the casinos and resorts along the Las Vegas Strip does provide an attractive target for terrorists. While this geographic concentration has provided economic benefits from centralized function, increased vulnerability to intentional attack and the potential for mass casualties also comes with concentration.

Figure 15 shows locations in Clark County for parcels with the land use designated for government facilities. Additional effort will be required to differentiate these by type of government, by agency, and by importance in maintaining ongoing operations.

Figure 15: Government Facilities, Clark County



4.6 Defense Industrial Base

Nellis Air Force Base is the most obvious element of the local defense industrial base. Nellis is home to the U.S. Air Force Warfare Center, with five air wings and over 150 aircraft engaged in advanced combat training, tactics development, and operational testing. In addition to the Air Force presence, Clark County is adjacent to the Nevada Test Site, which is used for a gunnery range as well as the nuclear weapons testing and associated research for which the location is famous. Subsequent to the moratorium on nuclear testing, the site has diversified into other activities. Emergency response training, hazardous spill response, conventional weapons testing, and other activities are now conducted at the Test Site.

Camp Mercury, located just across the county line in Nye County, contains housing, laboratories, and other support activities required for operational commitments (DOE, 2007). While this facility is not located in Clark County, many of the workers here and at other locations on the Nevada Test Site live in, and commute to, work from the Las Vegas area. Presumably, many federal activities located here are classified and could not be described in this type of document.

The proposed Yucca Mountain Nuclear Waste facility is also located just across the Clark County line in Nye County. Personnel employed by DOE at Yucca Mountain similarly reside primarily in the Las Vegas area. The Yucca Mountain site itself is remote enough, and under intense monitoring and surveillance, to be an unlikely terrorist target. The transportation of high-level nuclear waste to Yucca Mountain will increase vulnerability to both human and a natural hazard accident, when and if the facility is licensed, built, and becomes operational.

There are undoubtedly support activities for the DOE and DOD facilities in and surrounding Clark County that do business from the Las Vegas area. Disruptions to these activities would likely have little impact on the local economy dominated by gaming and entertainment. However, as events following the World Trade Center attack clearly demonstrated, anything that interrupts the flow of tourists to the Las Vegas area has devastating effects on both the local economy and that of the state. Perception and image are closely associated with vulnerability in this arena.

There are no maps for the local defense industrial base included in this report. The combined boundary for Nellis Air Force Base and the Nevada Test Site in Clark County is prominently displayed on all the other maps.

4.7 Information and Telecommunication

The computer has transformed the exchange of information in the modern era. Virtually all business conducted in a modern American city is dependent on the digital transmission of data in all aspects of modern life. While temporary outages and disruptions are annoying, these disruptions are not at all unusual. However, an extended disruption in the ability to transmit data and information would devastate any urban center reliant on telecommunication technology.

Technology can be thought of as the hardware, software, and personnel that assemble and transmit digital information. Each element is subject to unique and specific vulnerabilities. Hardware consists not just of the computers and devices, but also the buildings that house and protect them, and the cables, wires, transmitters, satellites, and receivers that move and store the information. Software is the bundled and packaged code and instructions that facilitate information flows. The personnel gather, organize, manage, store, and create information according to need.

Because all aspects of our modern society are intricately linked with ubiquitous flows of information, we are particularly vulnerable to disruption of these flows. The hardware involved in telecommunications is particularly susceptible to disruption from natural hazards. Flooding, excessive heat, violent shaking, and the like are not compatible with the stable, temperature-controlled environment required for computers and computer systems to operate efficiently and reliably. Software is particularly vulnerable to the introduction of malicious code, and all levels of industry expend enormous capital to manage this vulnerability. Key personnel with specific skills and knowledge generally design and maintain computer systems to operate and keep these systems running efficiently. If there is no redundancy or cross training to these skills, the whole system is vulnerable to loss of these key personnel.

Figure 16 shows the locations in Clark County of parcels with land use designated as communication utilities. High-speed cable, fiber-optic phone lines, and other telecommunication transmission networks are essential components of this sector. Geographic information on these networks in Clark County is not publicly available, but is available from industry sources if not from the local governments.

The Nevada and Clark County economies are dominated by the gaming and resort industries dependent on digital transfers of wealth and information. The information and telecommunication sector is a particularly critical element of Clark County infrastructure. Transactions for gasoline, food, accommodations, travel reservations, and the host of other essential and mundane daily activities would grind to a halt without the ability to swipe plastic cards or without a reliable online connection

Figure 16: Information and Telecommunication Facilities, Clark County

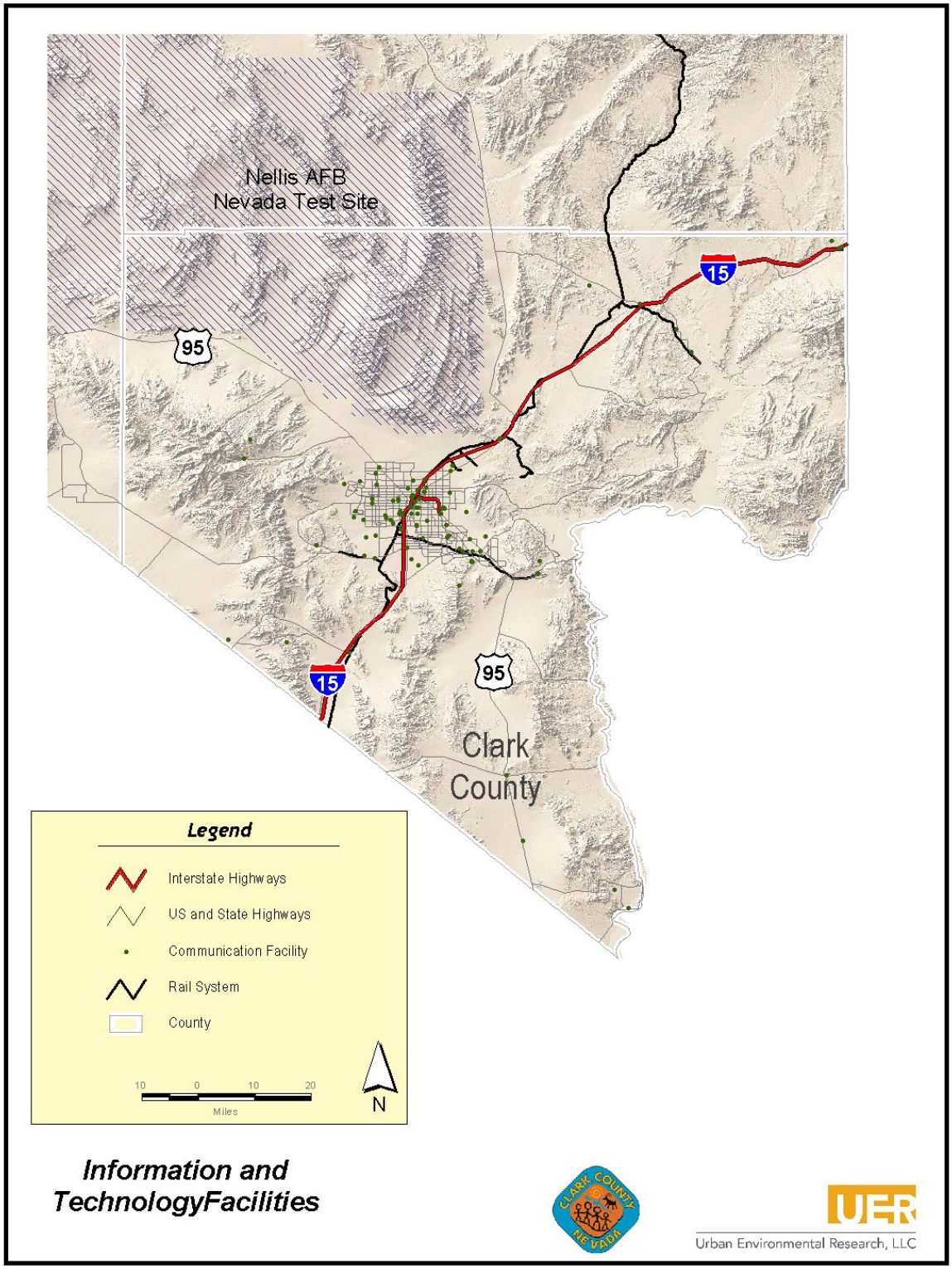


Figure 17: Headquarters for Telecommunication Companies in Clark County

Clark County specifically licenses telecommunications companies, while the other local jurisdictions do not include this category. Most of the companies licensed for this business activity are national firms, with corporate offices located outside Clark County and in other states. Figure 17 shows the headquarter locations for those firms outside of the County. These firms include such well-known names as Embarq, Verizon, and Sprint in addition to smaller carriers and providers of specialty communications services.

This sector is particularly vulnerable to disruptions and cascading effects from events outside of the County. Increasing flows and demands on telecommunications infrastructure accompanies an increasing reliance on the instant communication this sector provides. Potential disruptions include natural disasters and cyber/terror attacks, but may also include equipment failure from intense solar activity and magnetic reversals that are not yet well-understood.

4.8 Energy

Energy is another critical infrastructure sector where all of modern, technological society is particularly vulnerable to disruptions. Ninety percent of Nevada's electricity comes from fossil fuel (Nevada Department of Conservation and Natural Resources, 2002). Coal is the dominant fuel in the generation of electricity, but natural gas use is rising. Nevada's abundant potential for the generation of renewable electricity remains largely untapped.

Hoover Dam is a highly visible component of the local energy infrastructure, but contributes only a small share to the local electrical demand (U.S. Bureau of Reclamation, 2007). Over 23 percent of the power generated at Hoover Dam goes to the state of Nevada, but only 10 percent of the energy needs of Las Vegas come from Hoover Dam hydroelectric power. This inexpensive and renewable source of electricity, and the other hydroelectric projects built at the same time, spawned the intricate web of power transmission lines that link the West.

Numerous reclamation projects during the Depression and World War II spawned the transmission infrastructure that developed to serve the hydroelectric production to power the war effort against Germany and Japan. Supplementing production inputs to this infrastructure were fossil fuel generation plants to serve growing demand, as well as nuclear-powered facilities. This infrastructure is particularly visible across the American West.

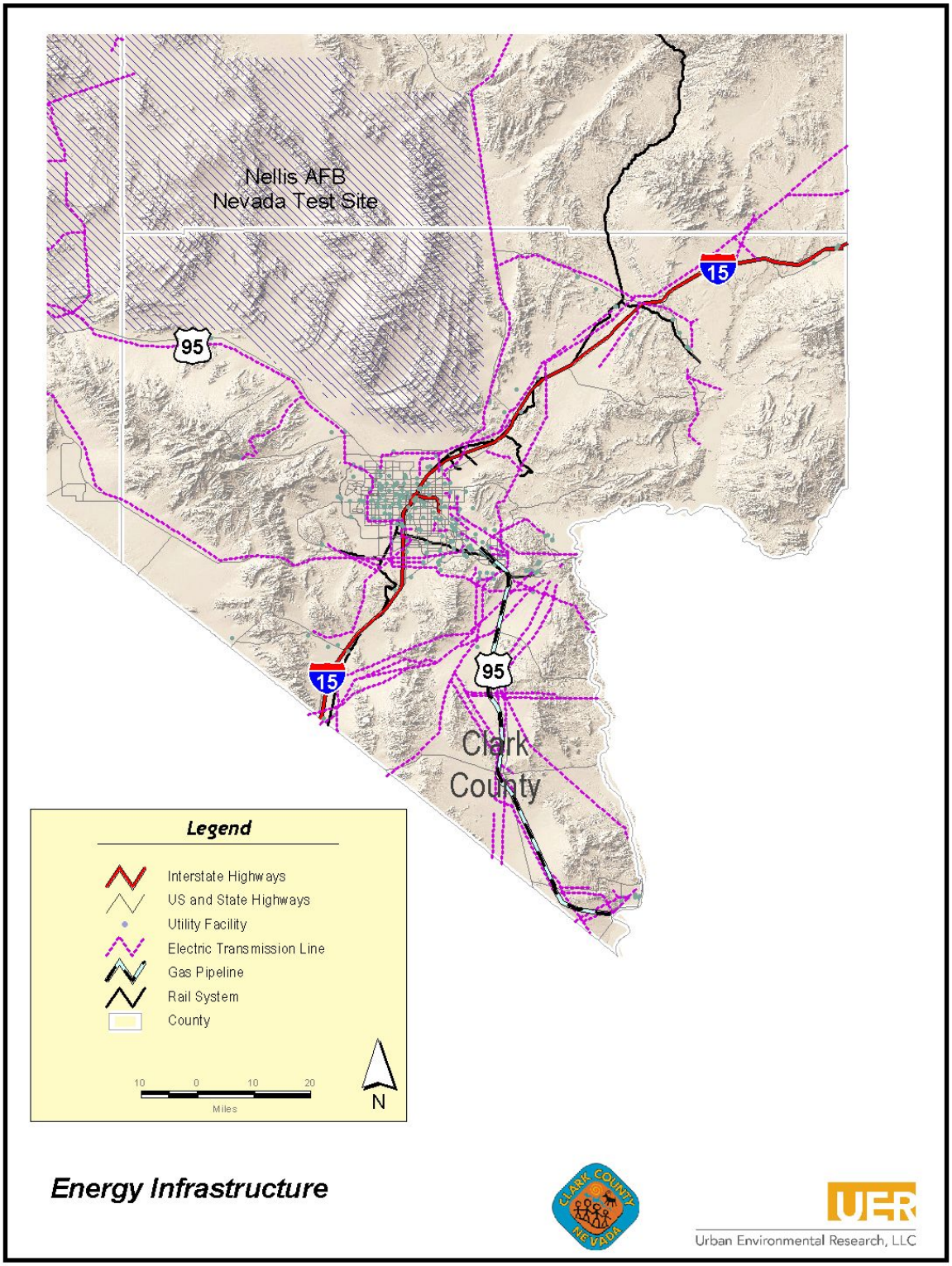
The American fascination with the automobile, and the inexpensive fuel that led to its fabulous rise, is at the heart of another critical infrastructure vulnerability. Most Americans are dependant on the automobile to get to work, and for most other aspects of personal transportation. This dependence is particularly accentuated in the western states. Clark County is entirely dependent on fuel imports for transportation, and the majority of those petroleum sources are foreign. Total reliance on external sources for fuel for transportation and electrical power leaves Las Vegas particularly vulnerable to disruptions in the energy sector.

Figure 18 shows the main electrical transmission lines through Clark County, the major gas transmission pipeline, and the energy-related parcels from the utility component of the GIS database. The rail and highway infrastructure is displayed on all maps for visual reference, but has a special significance for the energy sector. A large portion of the hazardous commodity flows on Clark County rail and highways are fuels for various purposes (Urban Environmental Research [UER], 2007; UER, 2007b). Energy vulnerability should rank high when weighting critical infrastructure, although local concerns and efforts would likely have no effect on larger scale energy flows.

Vulnerability of the energy sector, both locally and nationally, is increasing as demand for electricity continues to outpace the ability to generate and transmit electric power (National Energy Policy Development Group [NEPDG], 2001). Over the next decade, demand is forecast to grow by 25 percent while growth in generation is only expected to

grow by 4 percent. Another vulnerability in electric infrastructure was revealed when a large, electrical transformer burned in the Phoenix metropolitan area in the summer of 2004 (Arizona Republic, 2004). The only available replacement transformer was found in the Seattle area and required movement by sea to the Port of Long Beach. Upon arrival in Long Beach, the replacement was then transported by truck to the transmission location. Many weeks passed before normal operations were restored. Out of concern for this vulnerability related to spare parts, 43 participating utilities controlling 60 percent of the nation's interstate transmission infrastructure entered into an agreement to share or sell spare parts in case of a terror attack or system failure (Idaho Public Utilities Commission [IPUC], 2007)

Figure 18: Energy Infrastructure and Facilities, Clark County



4.9 Transportation

Transportation is a particularly important critical infrastructure component for Clark County and Las Vegas. Because of the importance of tourism and gaming to the County and to Nevada, an efficient transportation system is essential to manage the flow of visitors. This same transportation infrastructure imports all the consumables and supplies required to sustain visitors and local residents alike.

Air travel is particularly important to the Las Vegas metropolitan area. The Las Vegas McCarran International Airport was the nation's fifth busiest airport destination in 2006 (Robison, 2007). Traffic increased by 0.8 percent in 2006, one of the few major airports in the United States to experience an increase in volume for the year. Most of this volume is attributable to recreation and tourism.

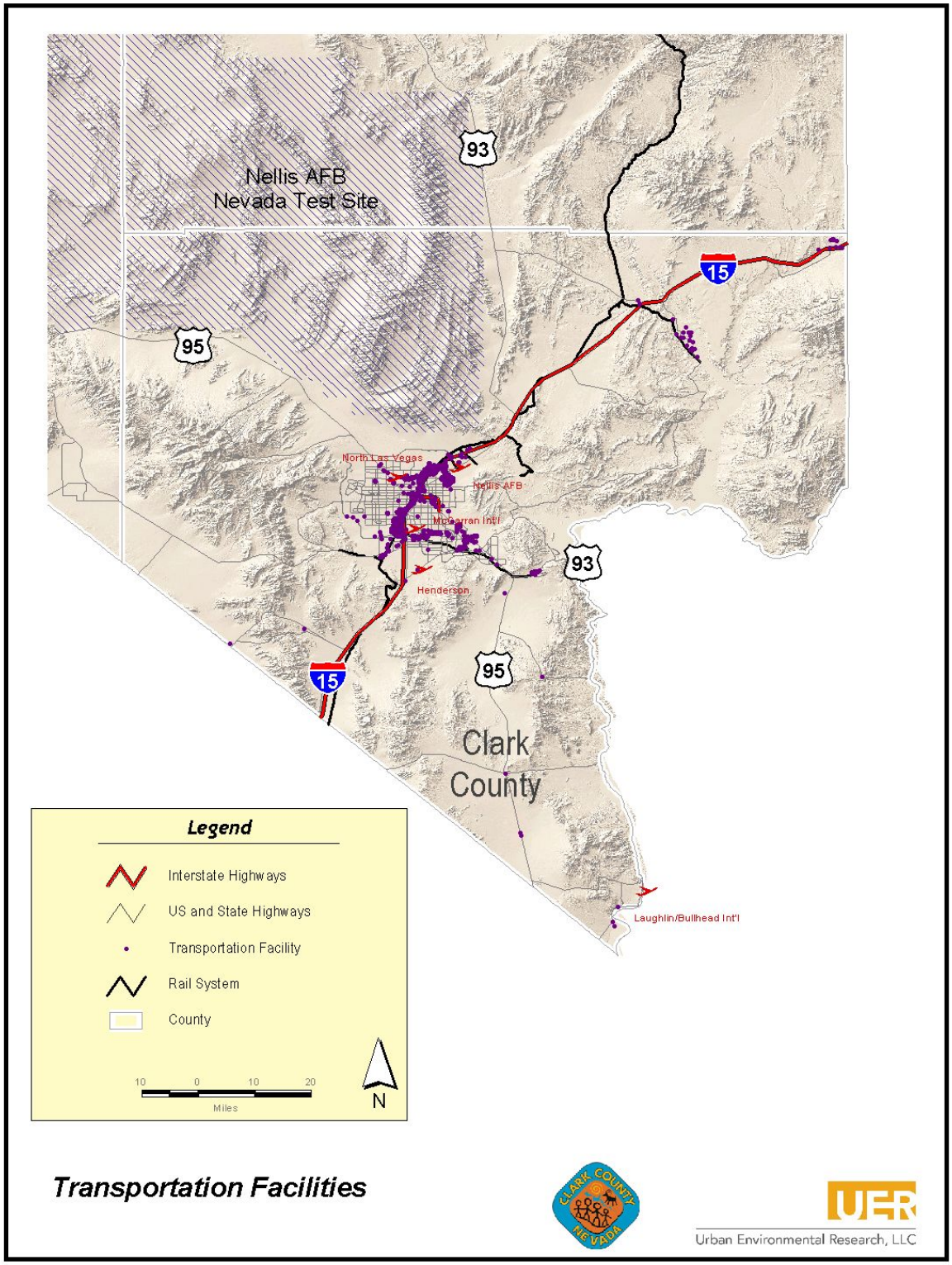
During the 1960s, increased air travel demand resulted in terminal facilities moving from Las Vegas Boulevard to the airport's current location (Koch, 2003). Rapid growth in air travel demand in the 1970s led to a quadrupling of the airport size. Sometime in the next decade, capacity constraints will limit the number of potential flights to McCarran, and an additional airport is planned for the Ivanpah area 30 miles to the south. Currently, 80 percent of this air travel volume is drawn by tourism and convention-related activities.

Las Vegas lost passenger rail service when the three times per week Amtrak "Desert Wind" Salt Lake City to Los Angeles route was eliminated in 1997. Because of congestion on the freeways between Los Angeles and Las Vegas, and with airline travel into McCarran International approaching capacity, passenger rail options are again being reconsidered (Las Vegas Review-Journal, 2006).

Las Vegas is particularly vulnerable to disruptions in transportation as was strikingly evident following the events of September 11. With all air traffic halted for days and the flying public hesitant to travel for months, the economy of southern Nevada suffered a tremendous shock and a downturn driven by a lack of consumer confidence (Travel Business Roundtable [TBR], 2001). The TBR/World Travel and Tourism Council (TBR/WTTC) Index of Leading Economic Indicators dropped at the highest monthly rate ever following the attacks.

If events across the continent have such an impact on the Las Vegas economy, it does not require much imagination to anticipate the public reaction from a major accident or release of nuclear waste from shipments to Yucca Mountain. Las Vegas is likely to remain particularly vulnerable to disruptions in transportation for the foreseeable future. Figure 19 shows the Clark County transportation infrastructure.

Figure 19: Transportation Infrastructure and Facilities, Clark County



4.10 Banking and Finance

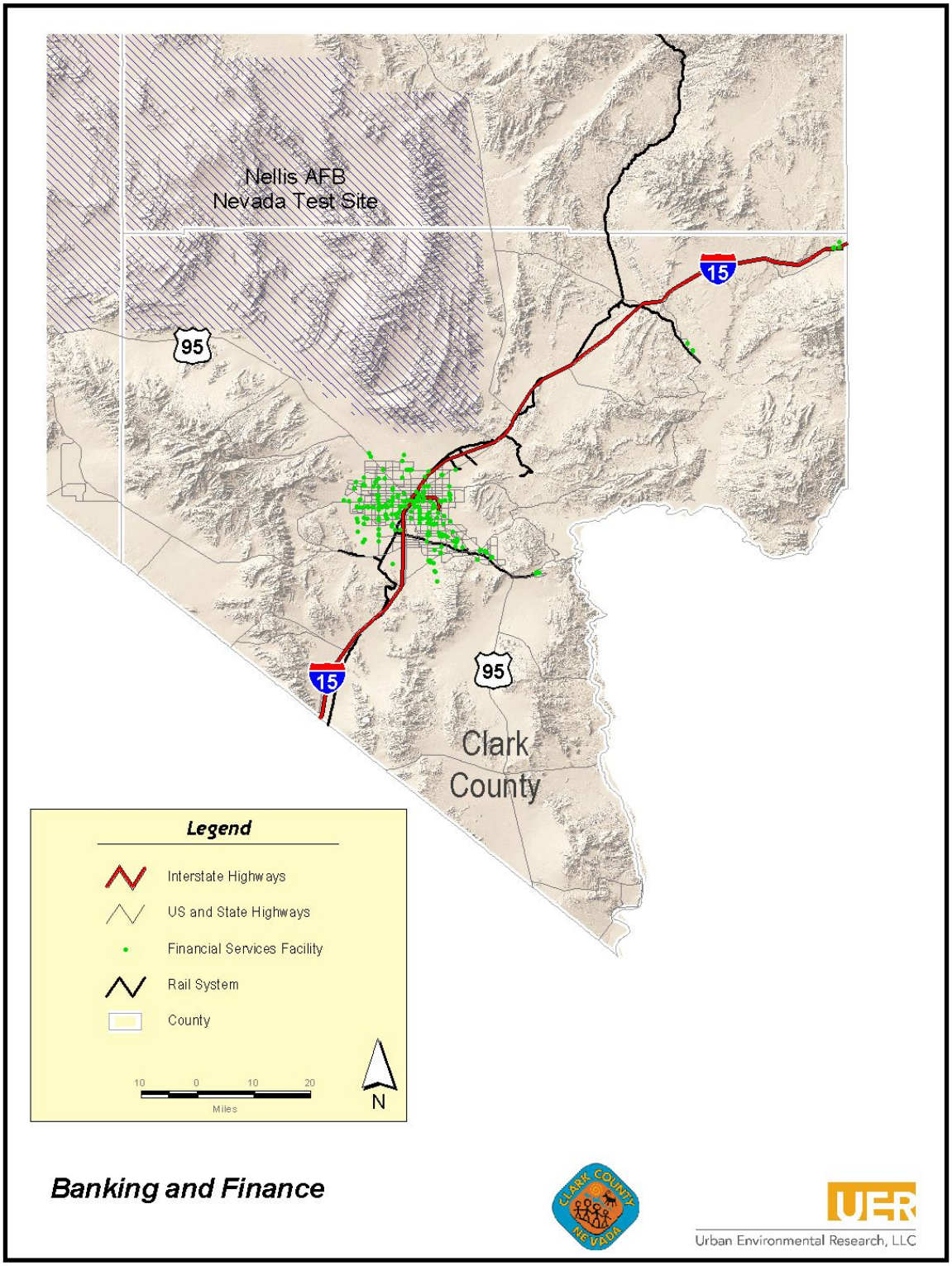
Banking and finance is an enormously important and critical infrastructure element of Clark County and Las Vegas in particular. The DHS Treasury report on banking critical infrastructure identifies four types of banking and finance products: 1) deposit and pay system products, 2) credit and liquidity products, 3) investment products, and 4) risk-transfer products commonly referred to as insurance (DHS, 2007). In the Las Vegas economy, the credit and liquidity products serving the gaming tourists are of utmost importance to keeping that industry operating.

Banking and finance operations in the United States and the entire developed world are increasingly reliant on telecommunications and instantaneous digital transfers of digital information and capital. Disruptions related to this transfer of funds and information are subject to natural hazards and terror activities. The sheer volume of demand on the telecommunications system and the Internet poses additional challenges as new users in the developing world further strain the existing infrastructure.

Figure 20 shows locations in Clark County identified by land use as commercial operations with finance as their chief function, including banks, savings and loan companies, credit unions, financing firms, and stock brokers. While not all of these commercial operations are of a size or importance considered critical, the land use data do not include sufficient information to stratify based on their importance to the local economy.

In an initial prioritization of the banking facilities located in Clark County, federal databases maintained by FDIC were examined to elicit information pertaining to the magnitude of assets and deposits for those financial institutions licensed and registered by the federal government. While these are publicly available data, they may be considered sensitive information and are included as appendices at the end of this report (see Appendix 4.10.1 and Appendix 4.10.2).

Figure 20: Banking and Finance Facilities, Clark County



Banking and financial services represent a particularly important infrastructure sector for Clark County. Gaming is the backbone of employment in the County, while revenues stimulated in the casinos largely finance many services provided throughout Nevada by the state. Banks provide the infrastructure for these capital flows, and financial institutions provide the capital to build and maintain gaming facilities in addition to the homes of the workers that operate the casinos.

Vulnerabilities in the financial sector are primarily linked to the communications infrastructure, though economic confidence is also a consideration. Disruptions in the casinos would be particularly acute if visitors could not access funds from remote locations because of communications outages. A loss of confidence in the economy could result in declines in the number of visitors and less spending in the resorts and a prolonged recession for the industry.

Figures 21 through 24 show the distributions of banking and financial firms in metropolitan Clark County and the various jurisdictions. There is no concentration of these facilities in the county, and any localized natural disaster or terror event should not pose any particular concern for this infrastructure sector.

Figure 21: Banking and Finance Facilities, Unincorporated Metropolitan Clark County

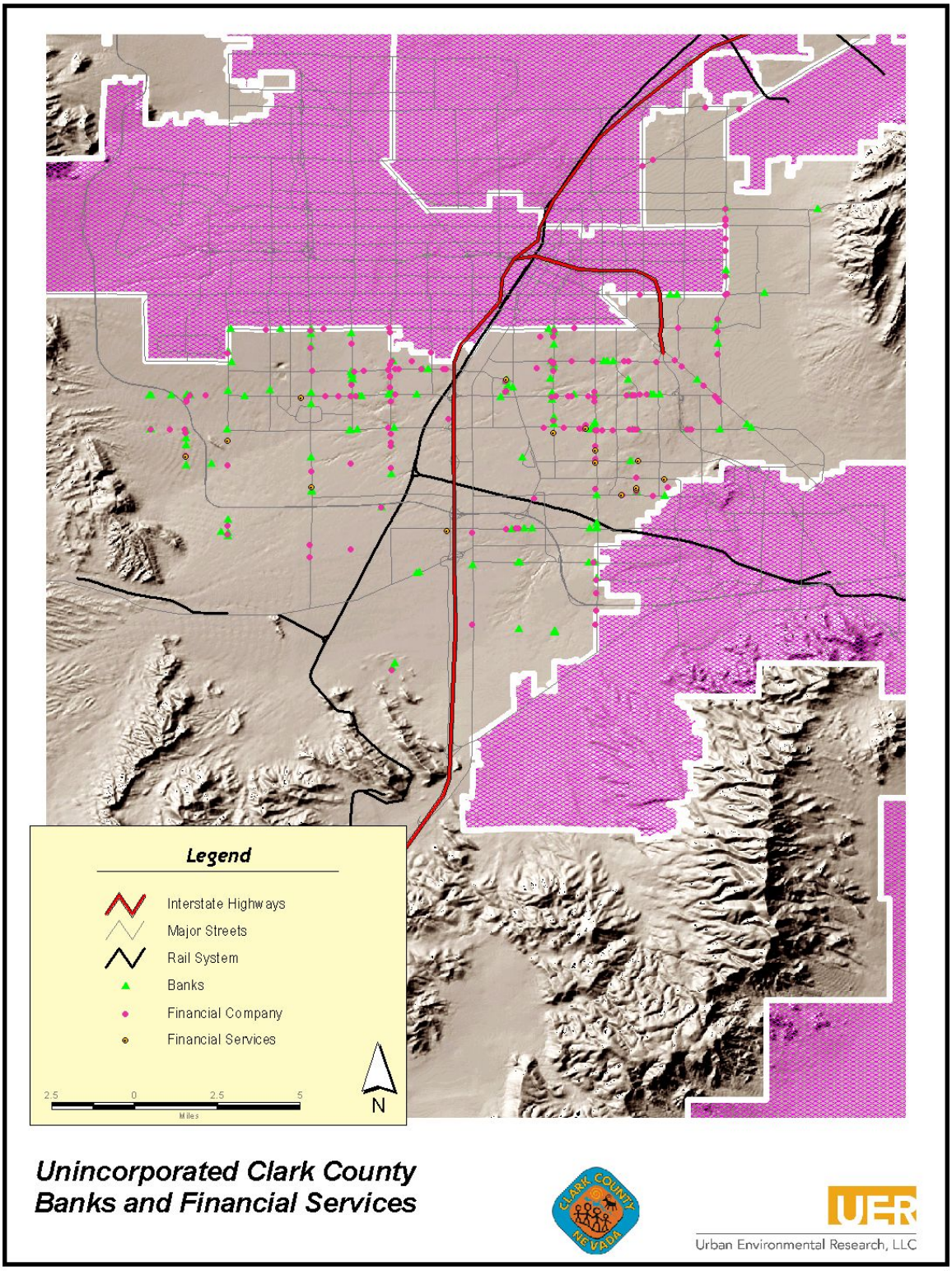


Figure 22: Banking and Finance Facilities, City of Las Vegas

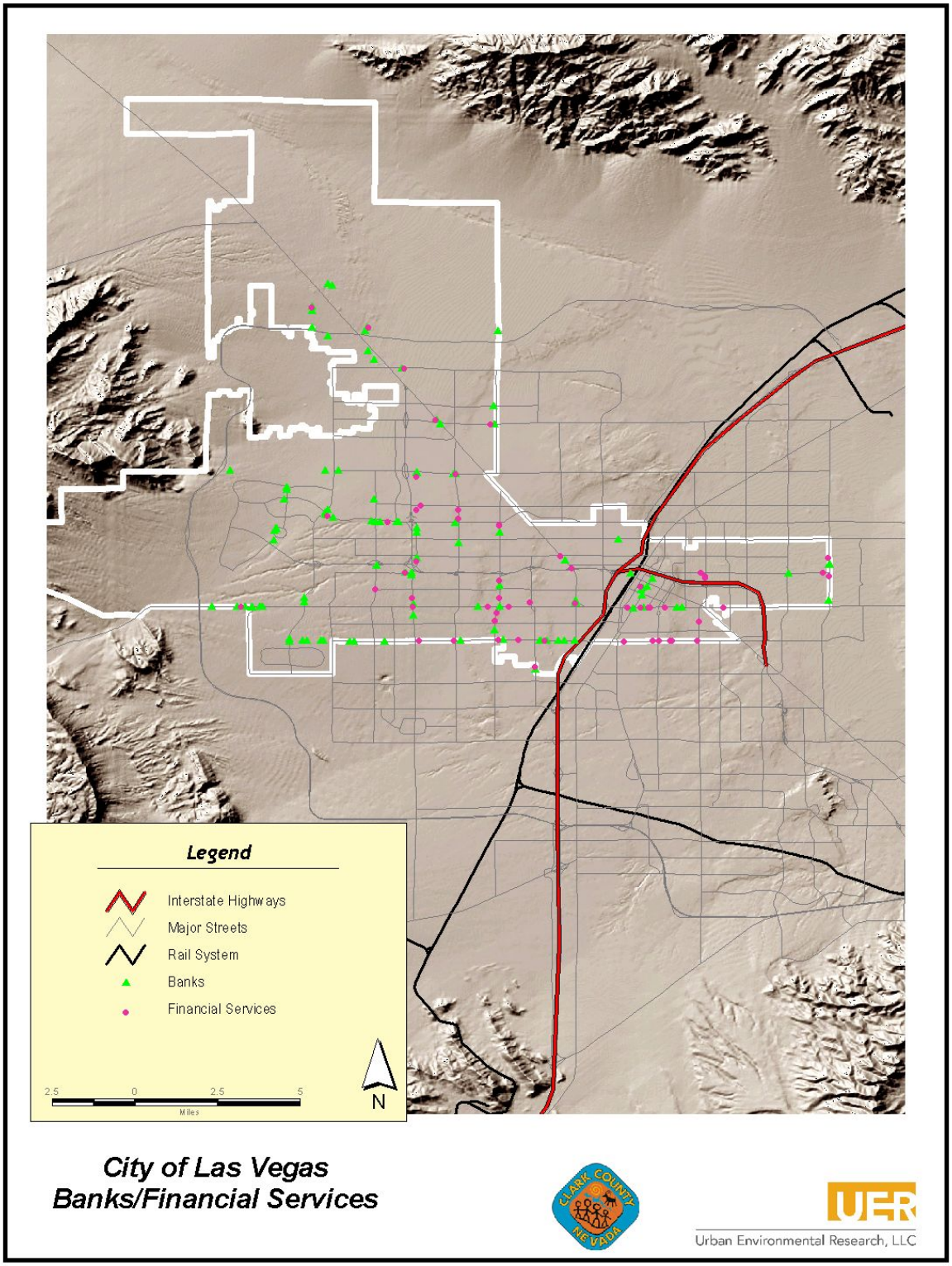


Figure 23: Banking and Finance Facilities, City of Henderson

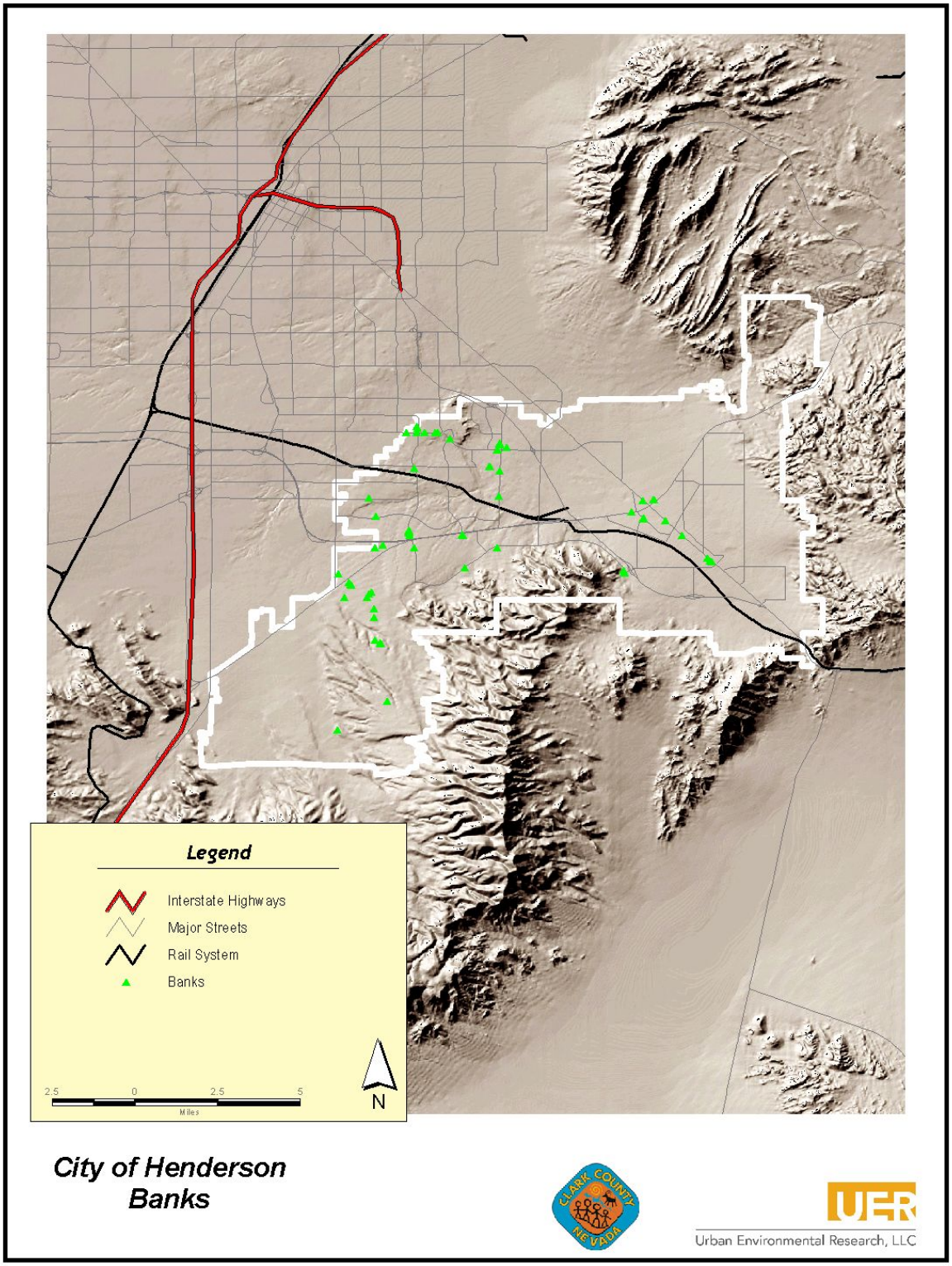
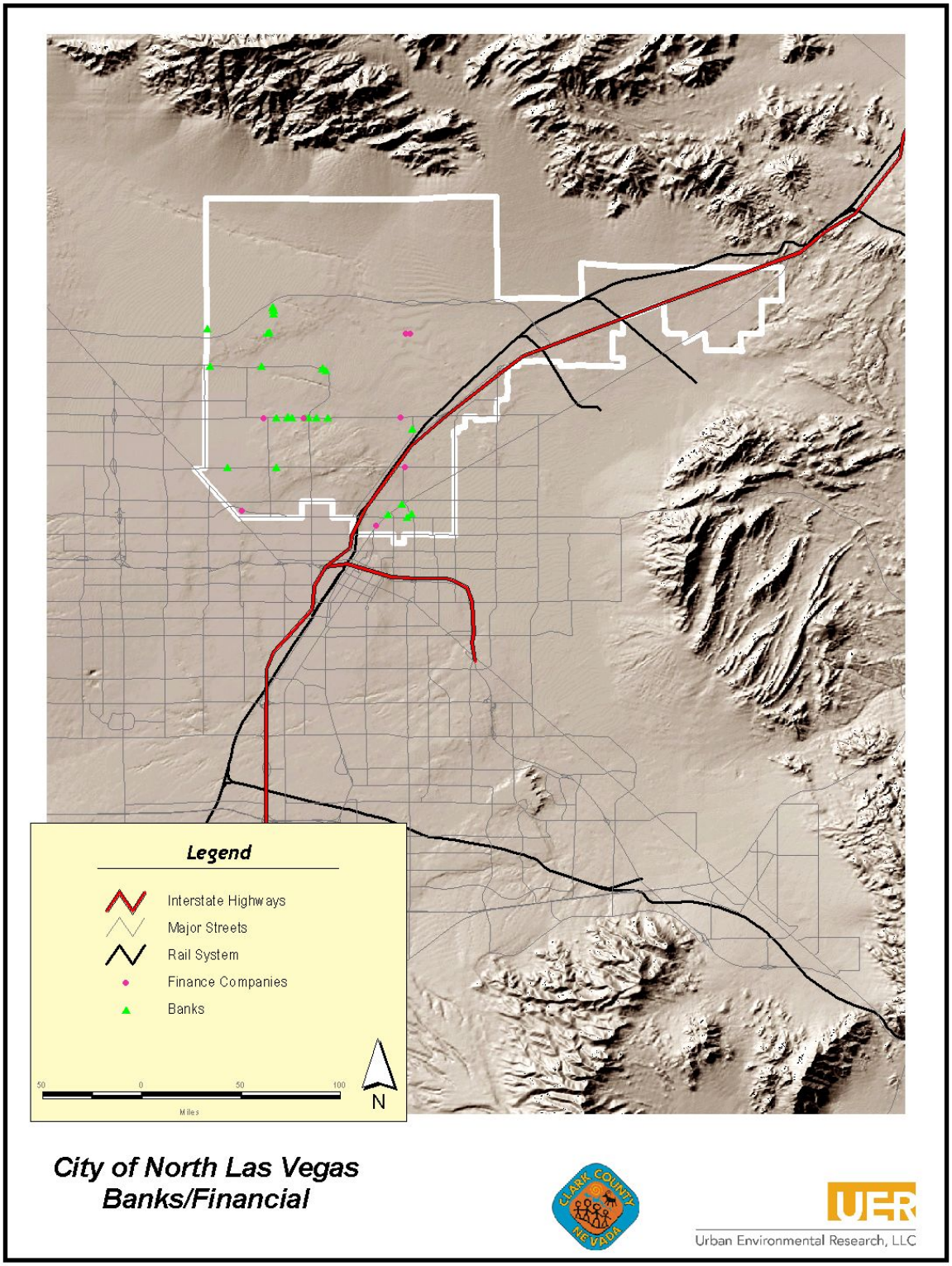


Figure 24: Banking and Finance Facilities, City of North Las Vegas



4.11 Chemical Industry and Hazardous Materials

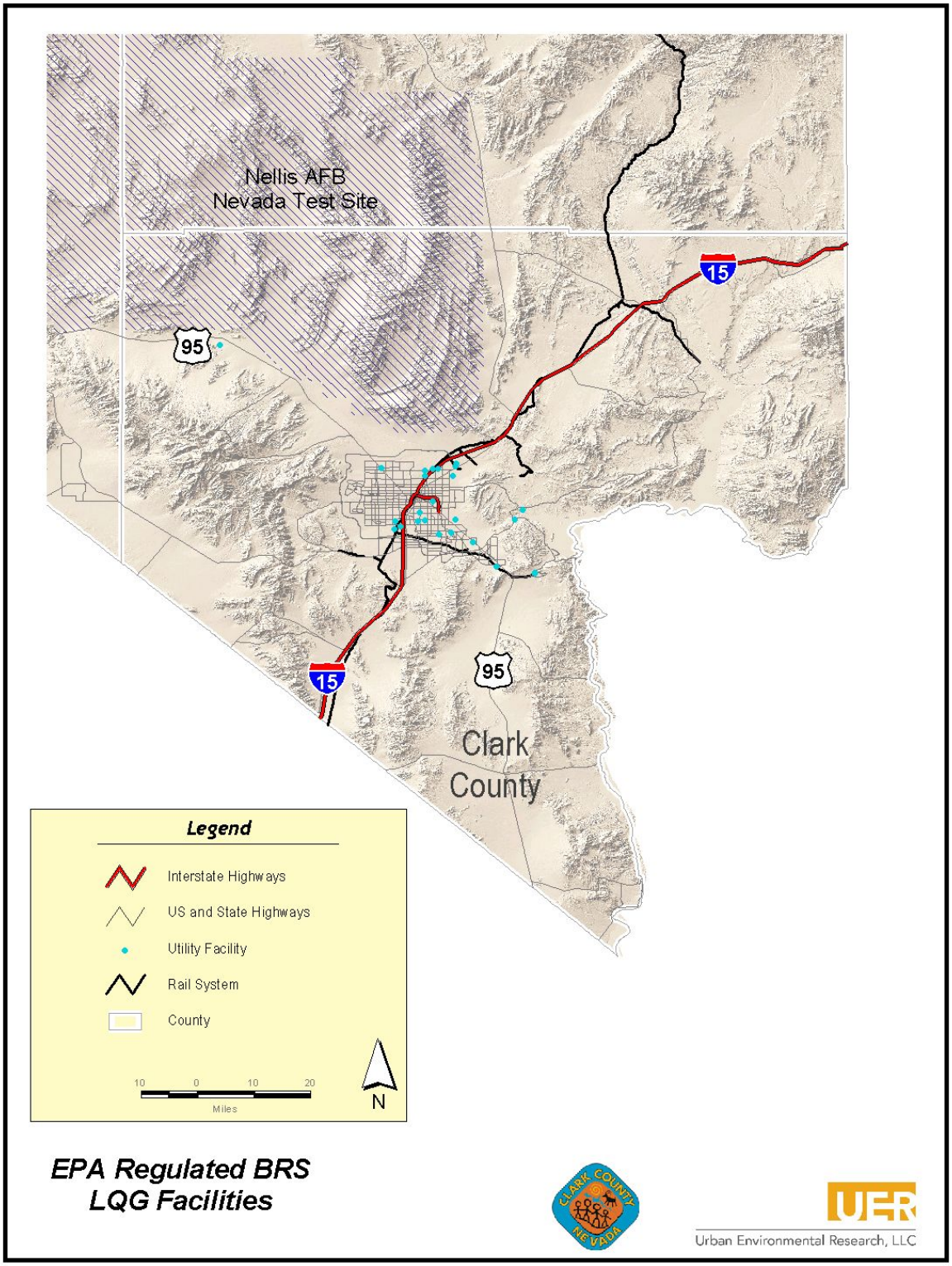
Las Vegas is renowned for entertainment and casino gaming, but is not an important center for manufacturing or the production of raw materials. However, Clark County is the location for some transformative economic activities. For locations and information pertaining to these activities, EPA regulates and maintains numerous databases for facilities and chemicals that are potentially harmful to the public.

The Resource Conservation and Recovery Act (RCRA) is the law regulating hazardous substances (EPA, 2007). Under RCRA Subtitle C, the hazardous waste program follows these materials from when they are generated to their ultimate disposal, the now well-known “cradle to grave” cycle. Large Quantity Generators (LQG) are regulated facilities of a threshold size that must report their use and handling of toxic substances in the Biennial Reporting System (BRS).

The BRS database also includes information on the quantities and types of each substance on which it reports, handling and storage information on these substances, and information on releases of any of these substances. In 2005, there were 73 LQG facilities located in the State of Nevada. Of these facilities, 26 are located in Clark County. The list includes defense operations; metal finishing operations; and other miscellaneous operations such as stores, hospitals, and drycleaners. Several are federal government environmental restoration projects. None use any particularly dangerous substances that would cause any specific increase in vulnerability.

Figure 25 shows the locations of these facilities in Clark County. Virtually all are located relatively close to either the US-95 corridor and rail infrastructure through Henderson, or the I-15 corridor through Las Vegas. Las Vegas and Clark County do not experience any elevated vulnerability to concentrations of chemicals at this time. When and if DOE adds shipments of spent nuclear fuel and high-level nuclear waste to the transportation infrastructure, Las Vegas and Clark County will certainly experience elevated levels of hazardous commodities flowing into and through the County, elevated risk from these flows, and elevated vulnerability to natural disasters and terror attacks.

Figure 25: Large Quantity Generators, Clark County: 2005



4.12 Postal and Shipping

In today's digital age, traditional mail is not the critical infrastructure it once was. However, all of the consumer goods from across the globe that are available at the click of a mouse still require physical delivery. While the U.S. Postal Service (USPS) still delivers bulk and personal mail, market share in the handling of packaged freight has long ago eroded in favor of commercial competitors such as United Parcel Service (UPS) and Federal Express.

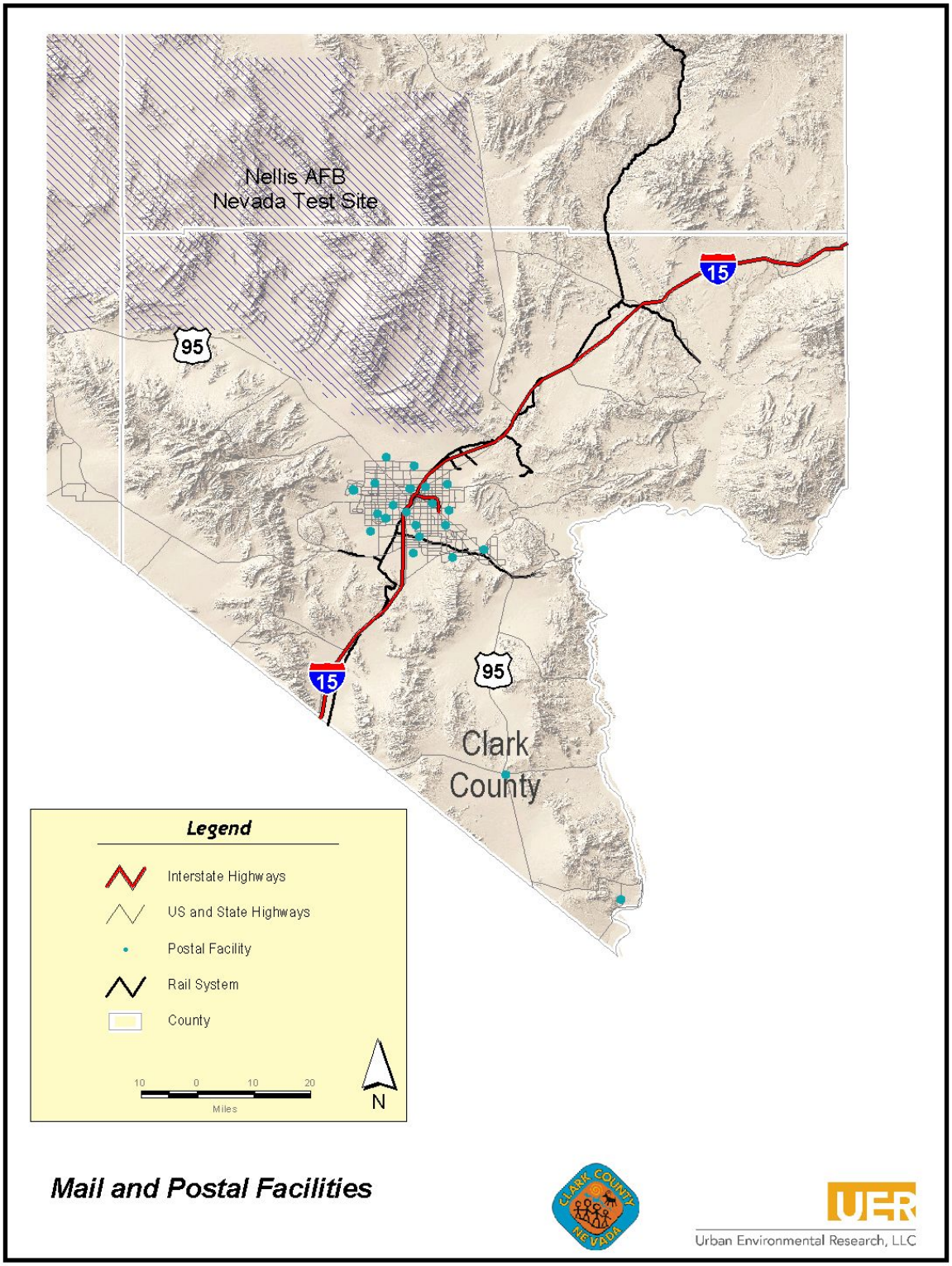
Traditional mail service in the United States primarily involved exchange of personal communications between individuals, and exchange of bills and payment for services. International mail exchanges and rates for those services evolved over an extended period of time, and involved international service agreements between governments with little competition from the private sector (USPS, 2004). However, by the late 1990s, competition from the private sector and a shift to digital rather than paper exchange for communication produced a structurally different postal industry. According to USPS market research from 2000, the total US international market for delivery service totaled approximately $10 billion, with expedited mail and parcel delivery accounting for 83 percent and rising (USPS, 2004). However, the USPS share of this total was only 17 percent, with private industry accounting for the majority of this service. Of total revenues for USPS, letter revenues capture 75 percent, but the volume of this delivery service continues to decline because of substitution by alternative digital communication options.

More recent market analysis (Logistics Today, 2006) shows USPS gaining share in the domestic air cargo market with package volumes for the first six months of 2005 rising 2.8 percent, air freight up 2.2 percent, and revenues up 3.9 percent. Overall market share in air cargo shipments for USPS was 37.6 percent, with Federal Express second with a 30.1 percent share, followed by UPS and DHL.

Vulnerabilities in the postal and delivery sector are intertwined with the air and highway transportation infrastructure. Any interruption in transportation services would impact postal deliveries. As noted in other sectors dependent on transportation infrastructure, transportation infrastructure is vulnerable to both natural hazards and disruptions by human agents.

Figure 26 shows locations of postal delivery services in Clark County. Air cargo deliveries must also take into account movements from the airport cargo terminals to distribution sites. Because these postal facilities are dispersed throughout the metro area, disruptions in any given location could be shifted to unaffected areas.

Figure 26: Postal Facilities, Clark County



In addition to the USPS post offices disbursed throughout the County, contract vendors operate numerous satellite offices and many mail services are provided by the private sector. As population growth exploded in recent years, expansion of USPS facilities could not keep up and the private sector stepped in to provide mailbox, packaging, collection, and other postal services.

Mail service is most efficient from dispersed locations across neighborhoods, save for the economies of scale for the large-volume flows at regional handling centers. All jurisdictions enjoy numerous outlets for the purchase, collection, and packaging of postal products (see Figures 27 through 30). The only local vulnerabilities in the postal sector are related to potential disruptions involving the transportation infrastructure.

Figure 27: Postal and Mail Facilities, Unincorporated Metropolitan Clark County

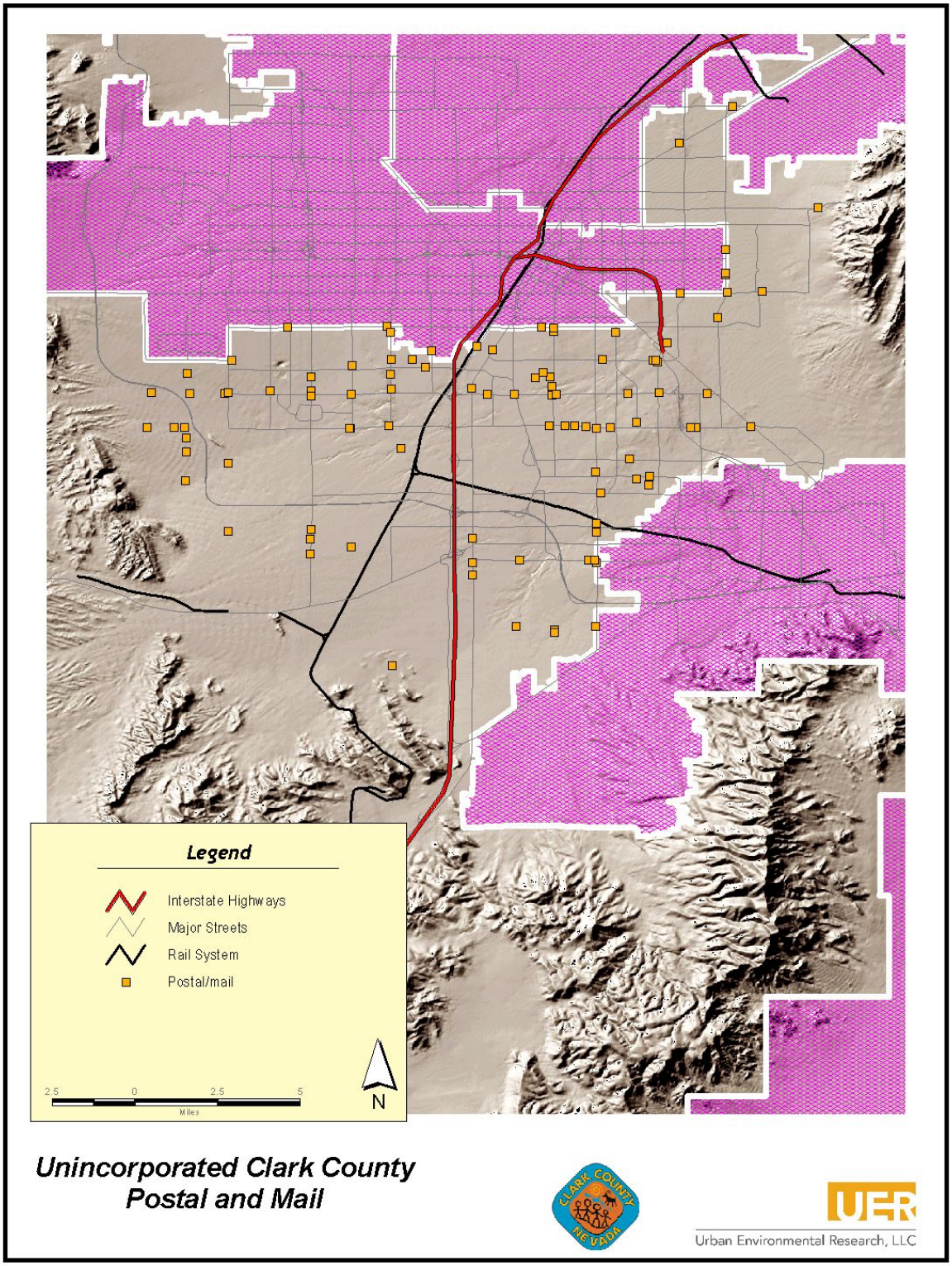


Figure 28: Postal and Mail Facilities, City of Las Vegas

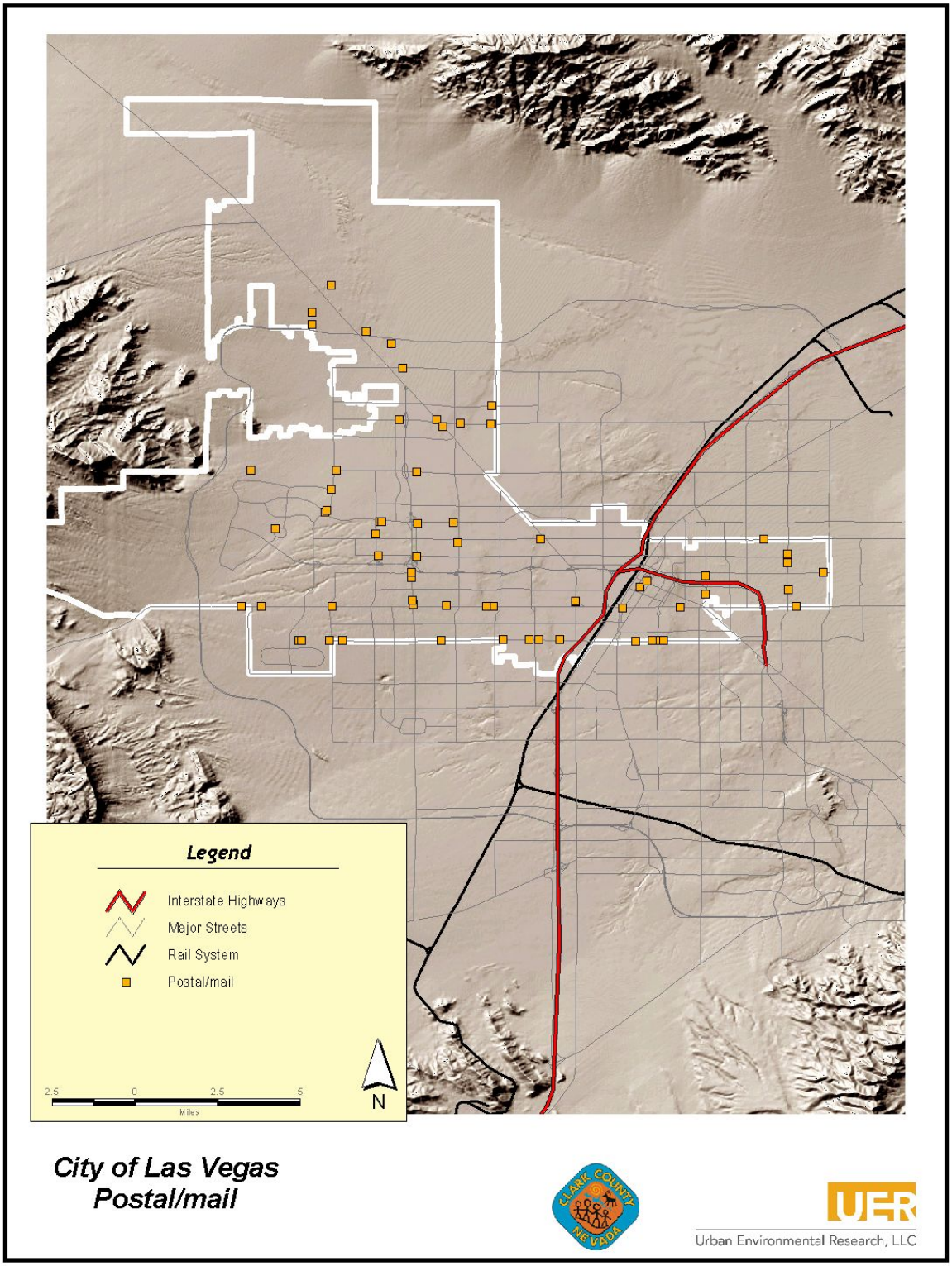


Figure 29: Postal and Mail Facilities, City of Henderson

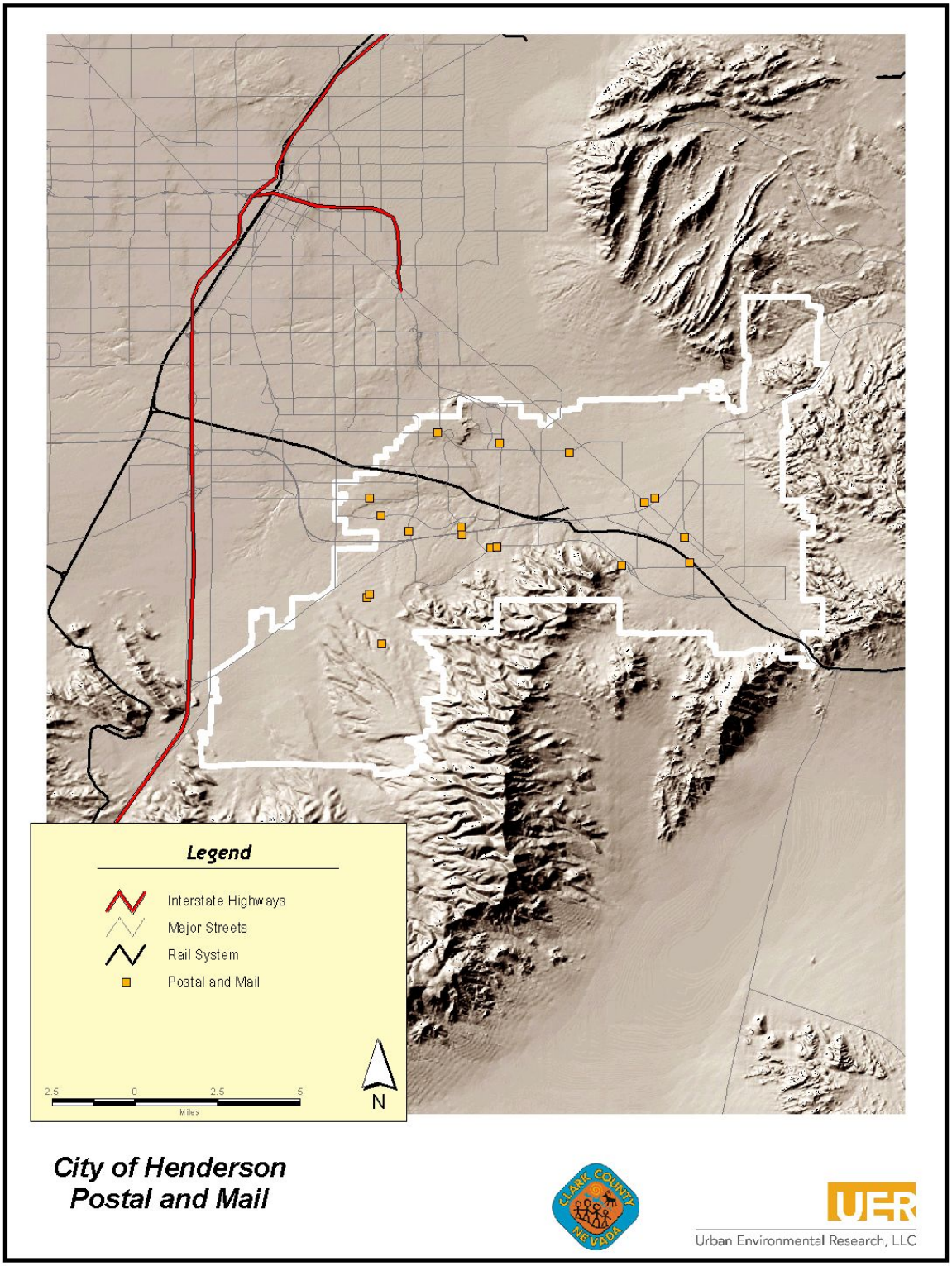
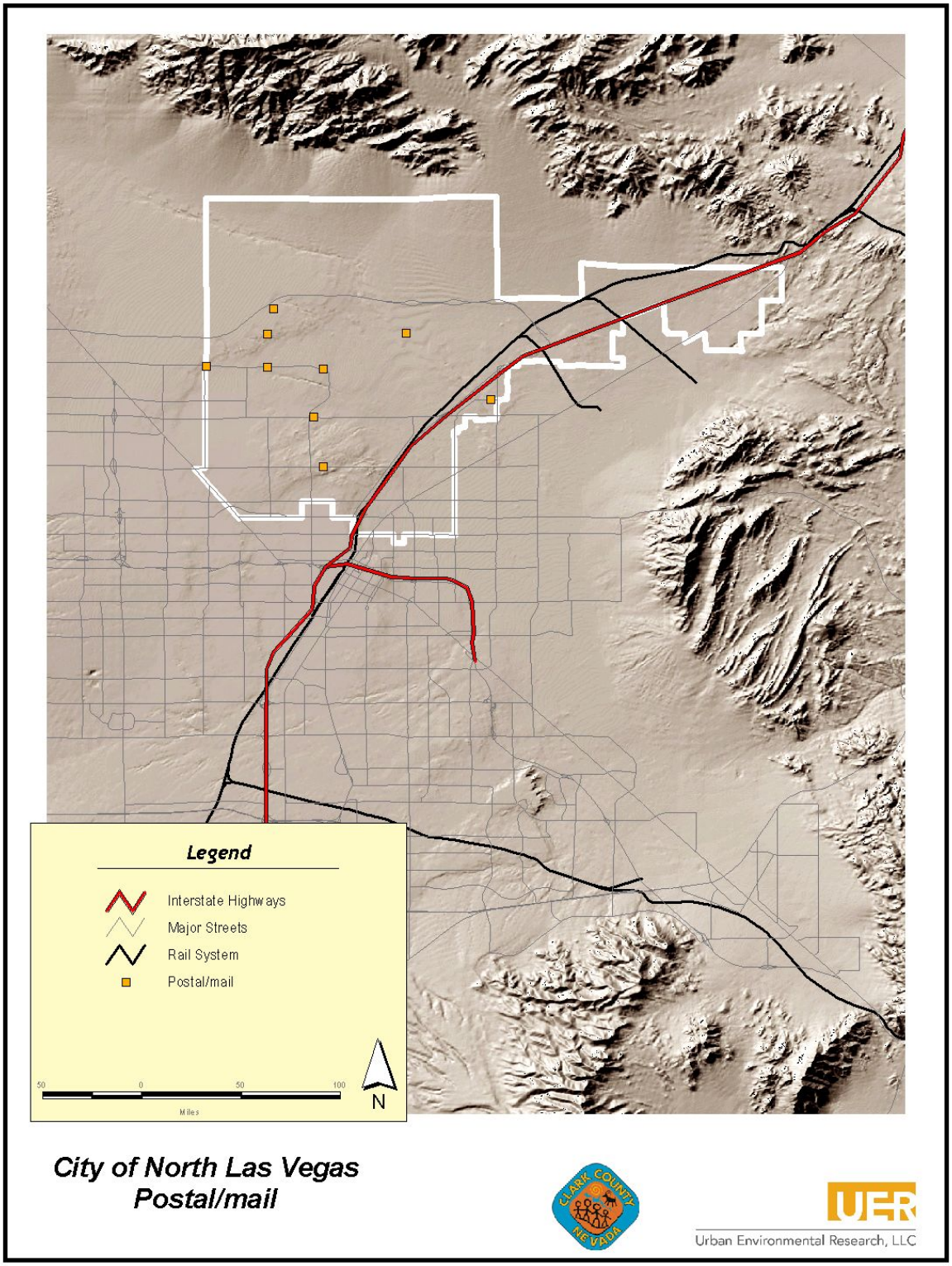


Figure 30: Postal and Mail Facilities, City of North Las Vegas



5.0 Key Assets

In addition to the critical infrastructure sectors identified by DHS for evaluation, certain key geographic assets are specifically identified for evaluation in this report. There are no National Monuments in Clark County, though Hoover Dam is administered by the National Park Service and is certainly an important icon as well as an infrastructure asset. There are no nuclear power plants in or near Clark County, and there are no particularly notable government facilities. However, the Las Vegas Strip and the opulent casinos there certainly qualify as commercial key assets. We also identify the schools as a key asset within Clark County.

5.1 Dams

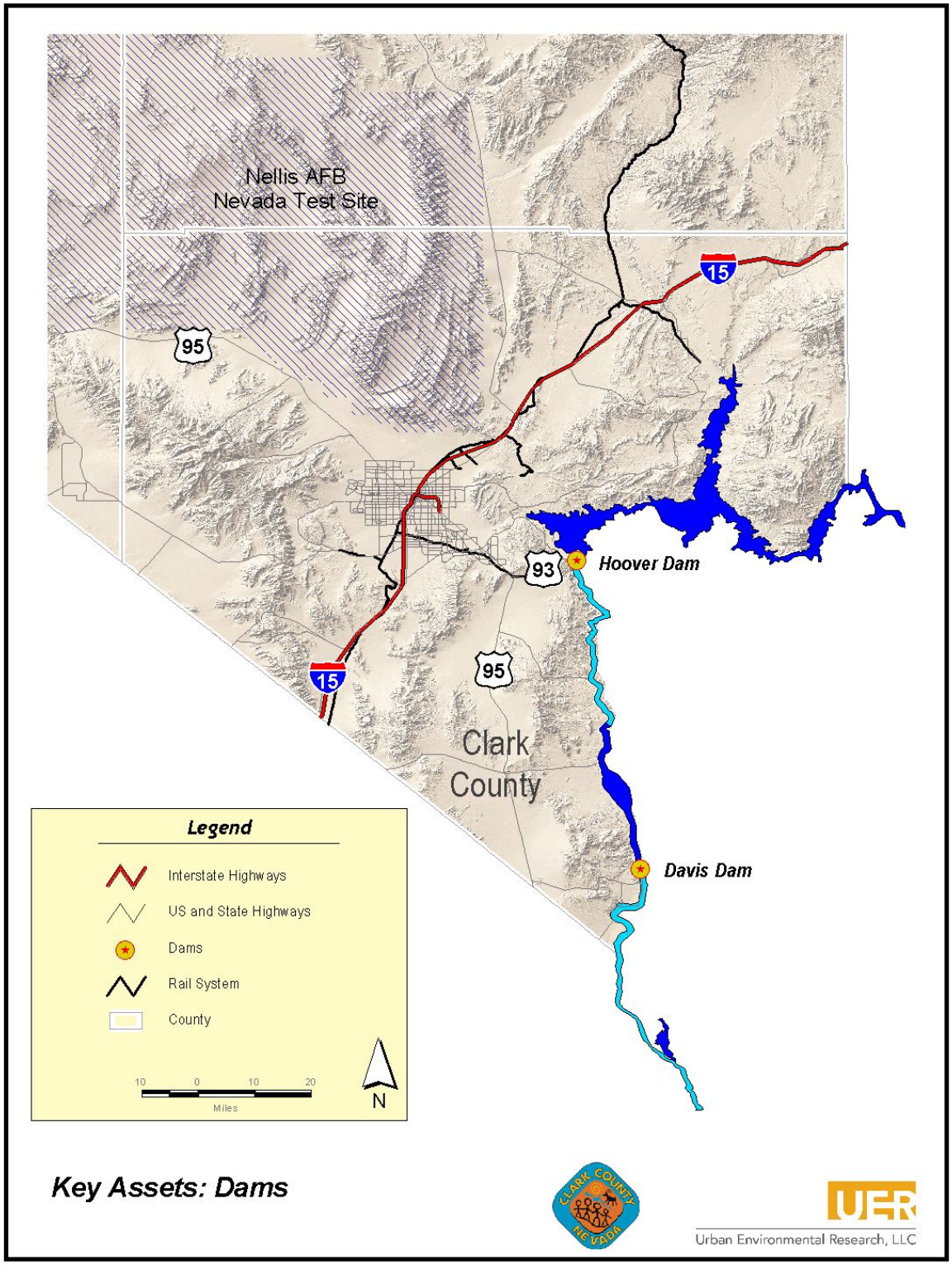
Las Vegas is closely linked with Hoover Dam and Lake Mead. The first Las Vegas population boom accompanied the construction activities at Hoover Dam. Casino gaming grew to prominence after construction of the dam, and is the primary revenue source for Nevada and Clark County. Schools represent another key asset.

Hoover Dam was the first major flood control project to attempt to tame the Colorado River. There were no individual companies capable of taking on such a massive project at that time. However, a consortium (Six Companies, Inc.) formed to bid on the project, won the bid and constructed the world's largest dam (Reisner, 1993). Members of this consortium, such as Bechtel, Morrison-Knudson, and Kaiser, became household names in many circles. Hoover Dam is perhaps the world's most recognizable dam.

A peculiar vulnerability of Hoover Dam involves the traffic it carries. U.S. Highway 93 crosses the Arizona-Nevada border over the dam. Following the attacks on September 11, commercial traffic over the dam was restricted and inspection of vehicles was initiated. Construction of a bypass across the narrow canyon below the bridge will minimize traffic on the bridge and reduce this vulnerability.

Davis Dam is located downriver from Hoover Dam, and impounds Lake Mohave just upriver from Laughlin. This earth and rock dam with concrete spillway and power generating facilities re-regulates Colorado River flows below Hoover Dam. While Laughlin also hosts considerable recreation and gaming activities, its significance pales before that of Las Vegas. With a much lower profile, this portion of Clark County is less vulnerable to terrorism than the inviting target of Las Vegas. Figure 31 shows the dams within Clark County that are included in this study as key assets.

Figure 31: Key Assets, Clark County Dams



5.2 Gaming & Casinos

In the evaluation of critical assets in Las Vegas, Nevada, the most important assets are clearly the casinos and glitter of the Strip (Figure 32). Large numbers of tourists eager to spend their money in the casinos are the main source of capital driving the economy. Any disruption in travel impacting the ability of these tourists to travel to and from Las Vegas has a tremendous downside to the local economy.

Figure 32: Key Assets, Clark County Casinos and Resorts

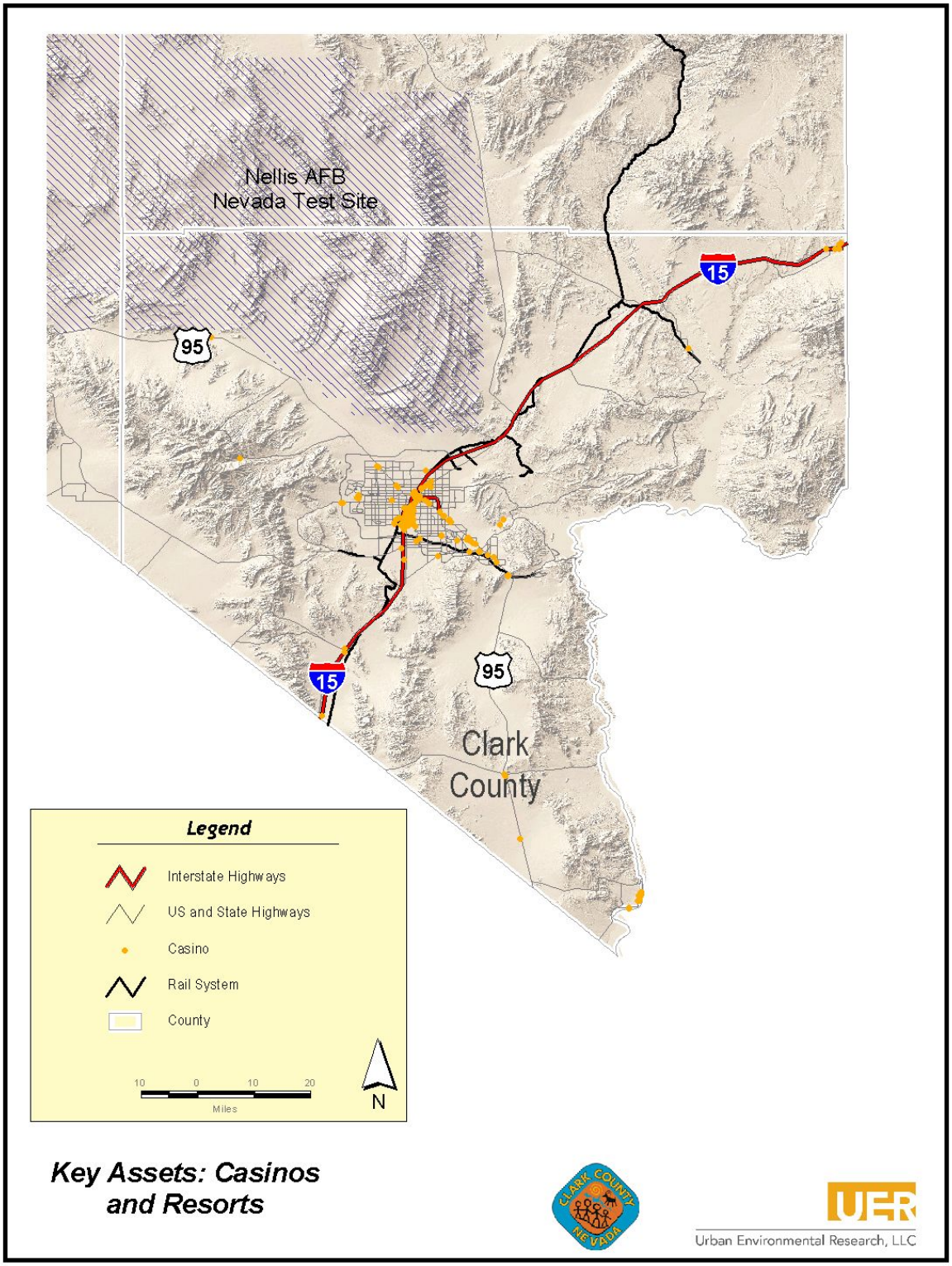


Figure 33: Gaming Facilities, Unincorporated Metropolitan Clark County

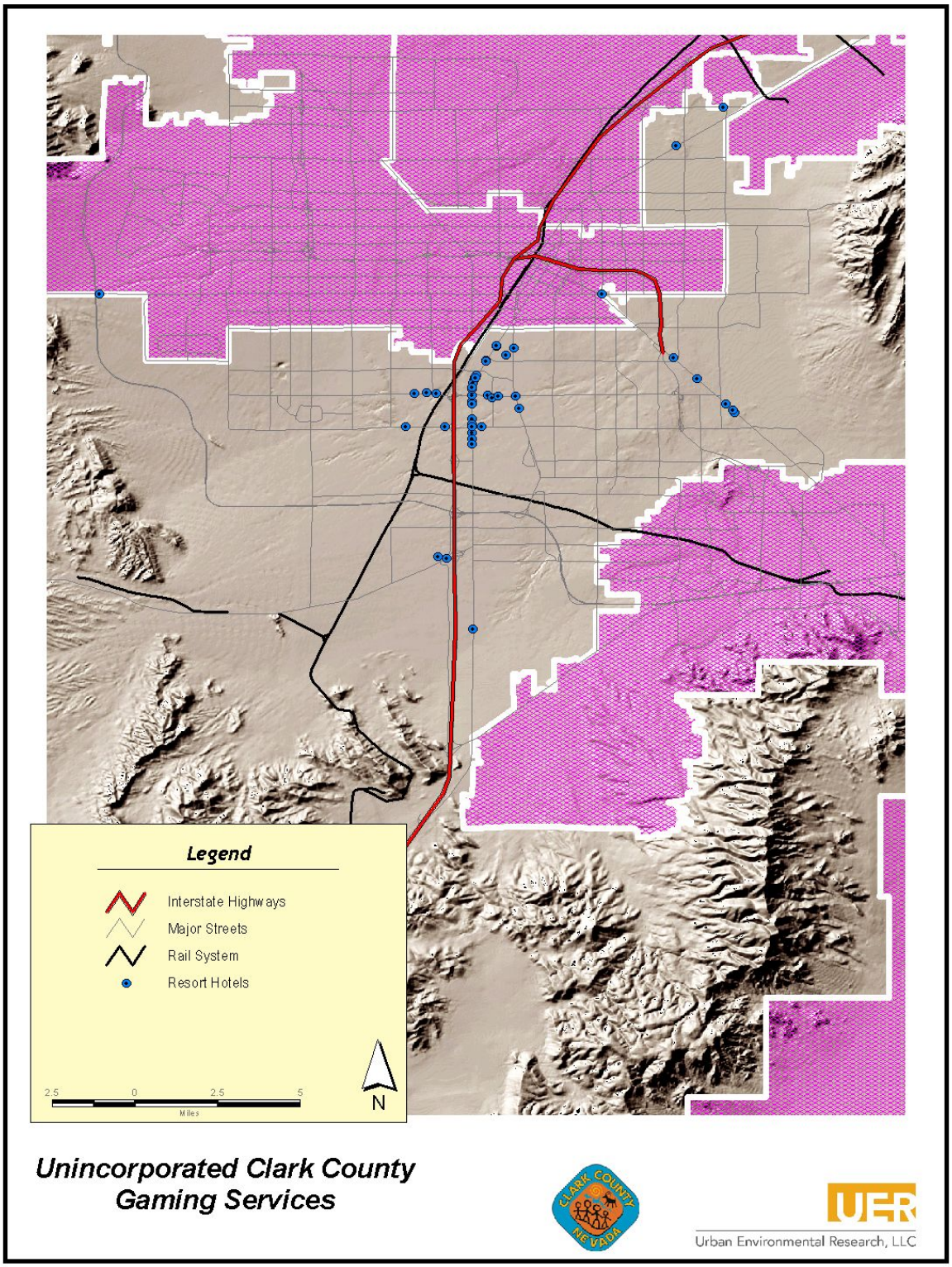


Figure 34: Gaming Facilities, City of Las Vegas

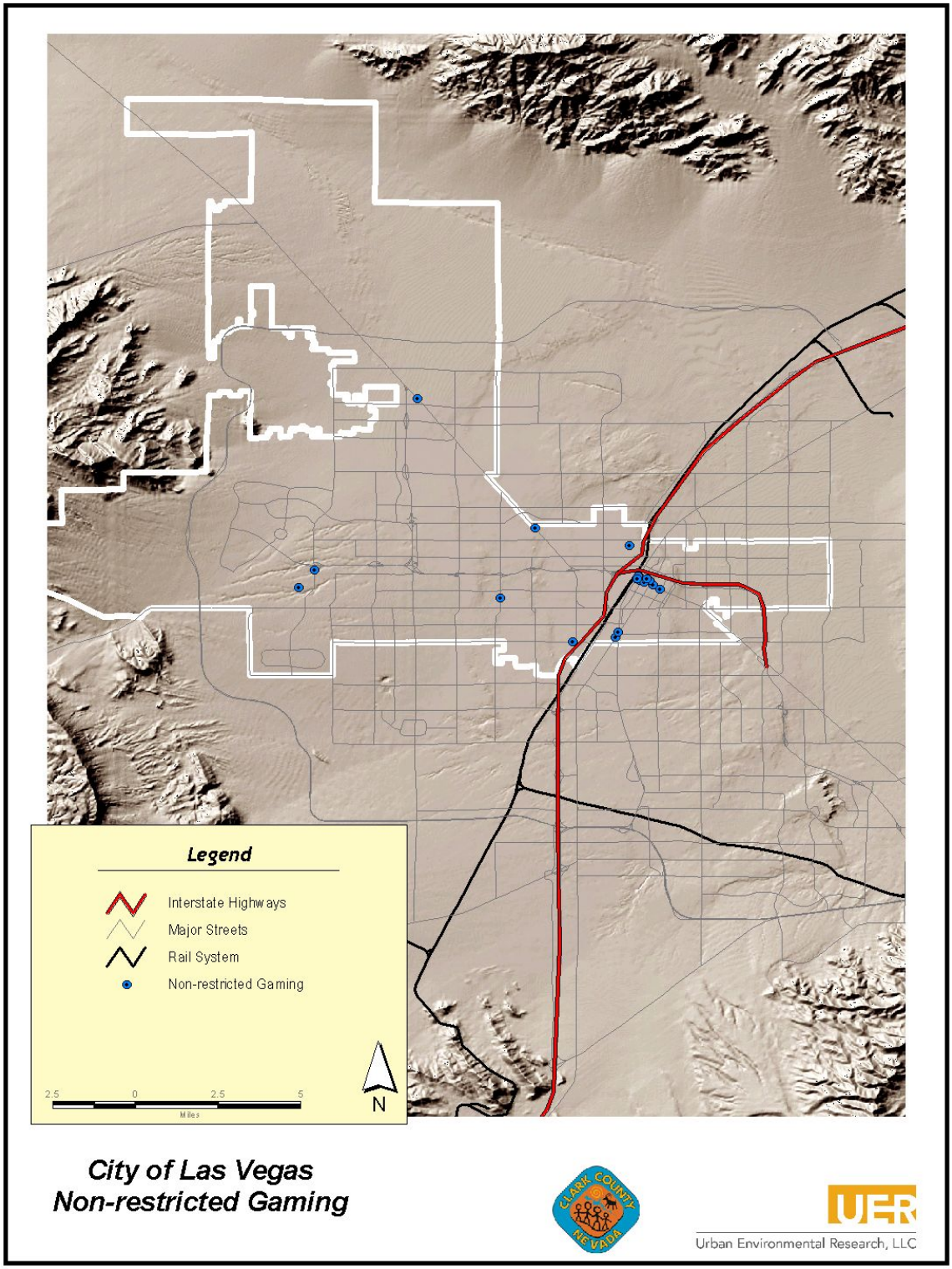


Figure 35: Gaming Facilities, City of Henderson

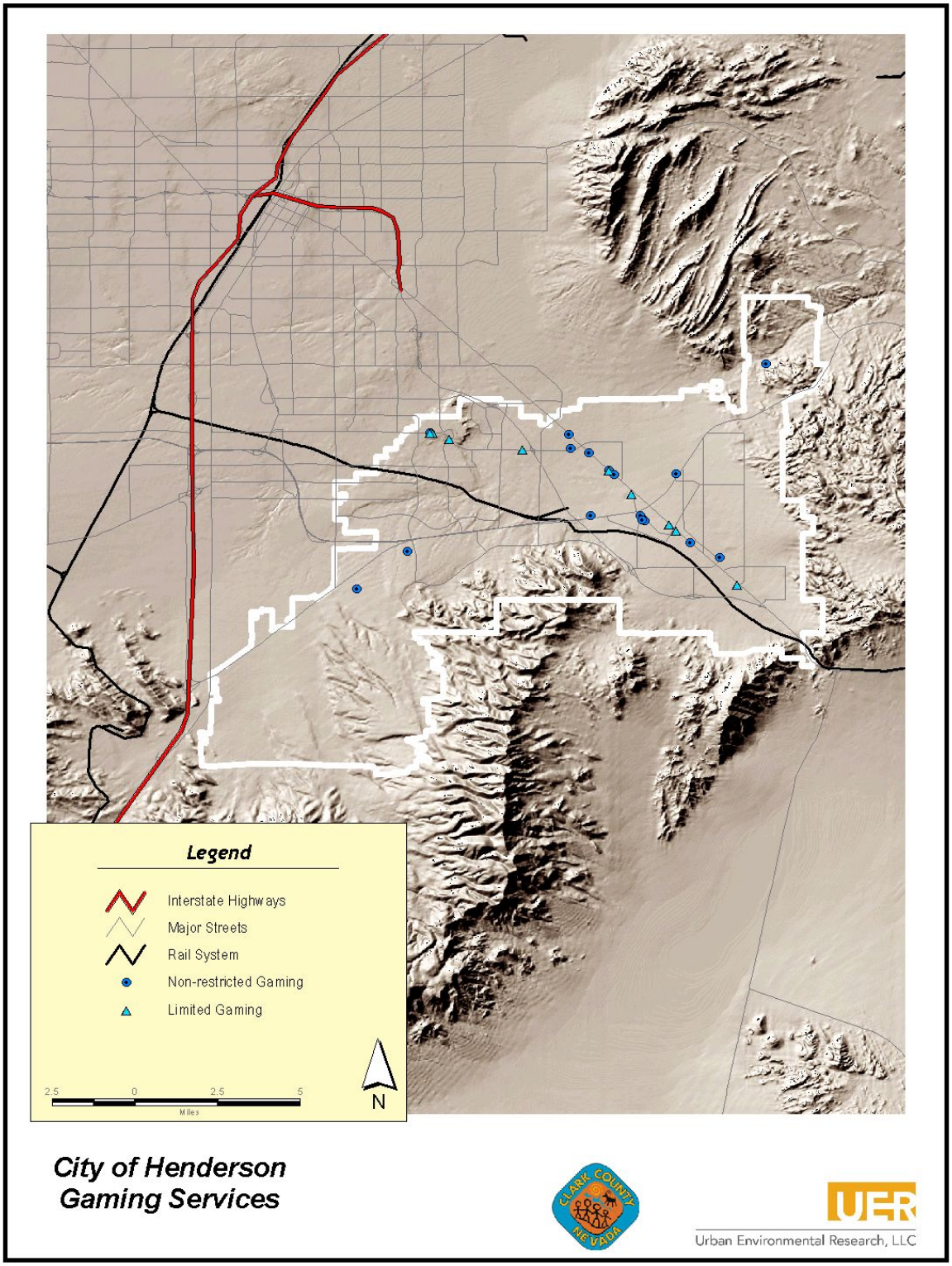
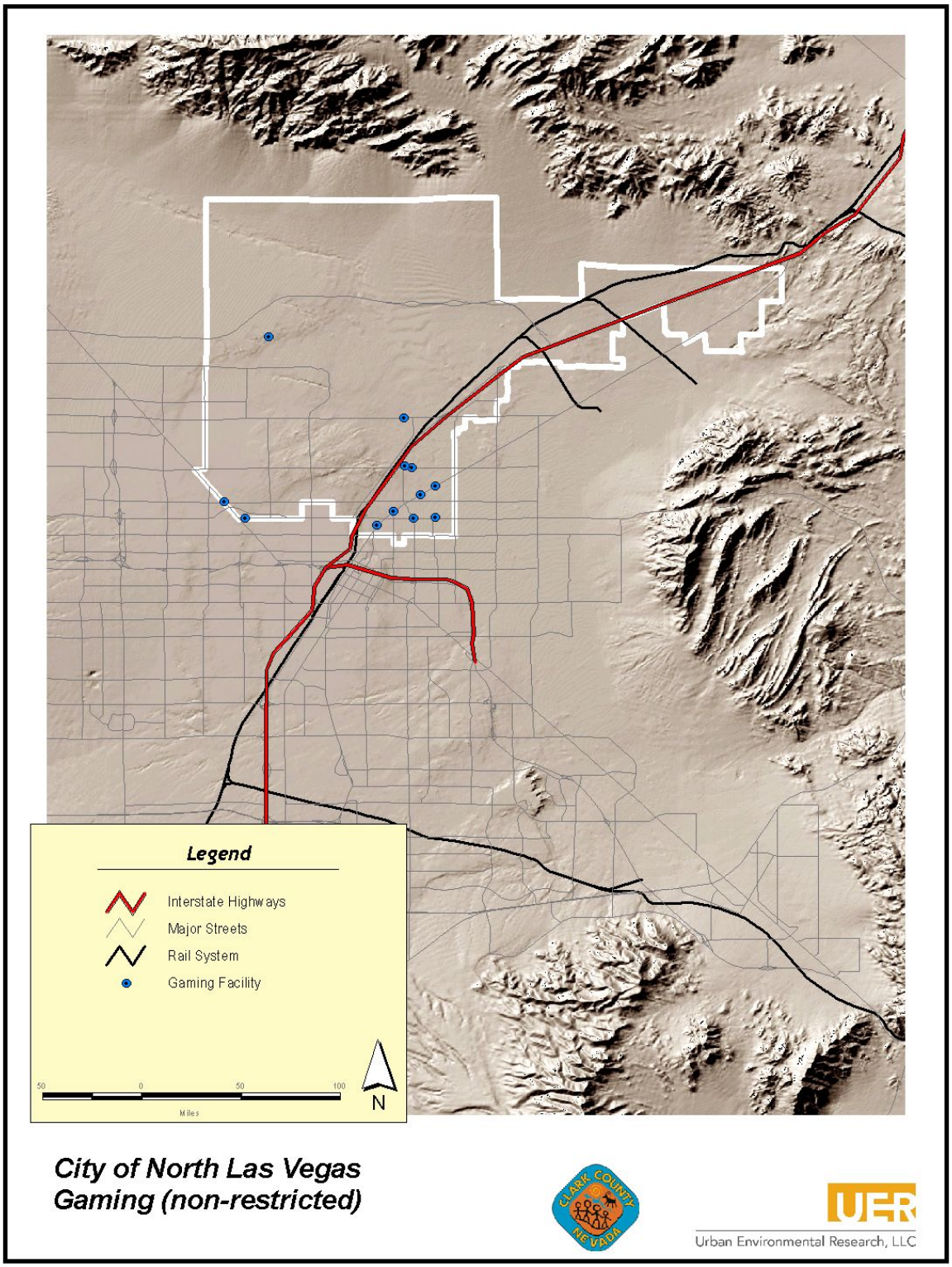


Figure 36: Gaming Facilities, City of North Las Vegas



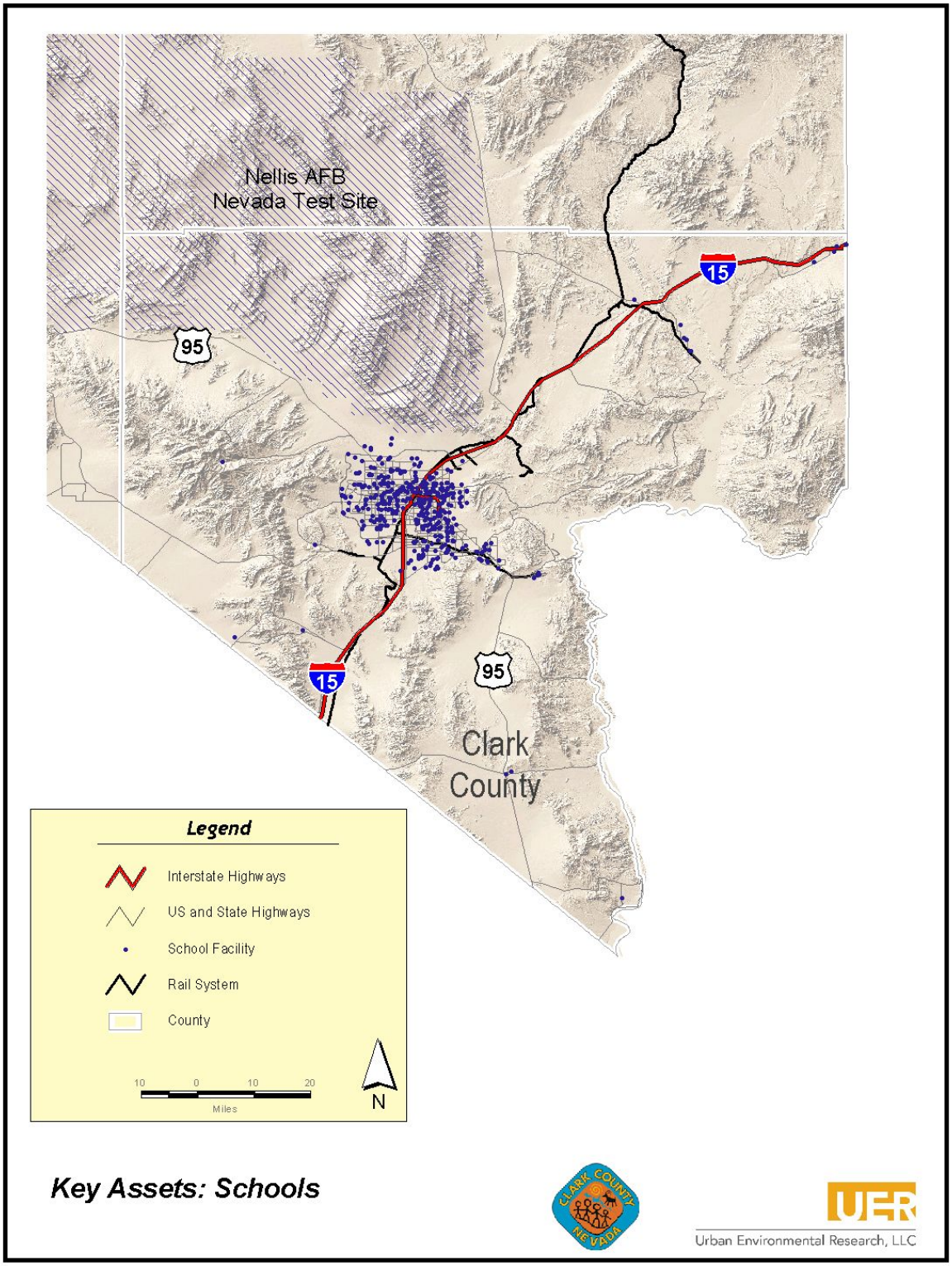
5.3 Schools

In the post-industrial societies of the Information Age, knowledge is power. Schools are an important component in the distribution of knowledge to future generations of workers and citizens. Schools not only impart knowledge to our children and adults in higher education, but also are a strong component of the social process of instilling values and learning to work with others. The safety of our children and students is entrusted to those administering the schools they attend.

Schools are distributed according to population with elementary schools generally distributed within easy access of all neighborhoods, but often becoming more concentrated in fewer locations in upper grades and higher levels of instruction. The hierarchy of education level is one way to stratify school distribution. Figure 37 shows the distribution of schools throughout Clark County.

While schools may not be considered critical infrastructure from the standpoint of day-to-day economic activity, they can be considered critical infrastructure from several other aspects. Every parent would agree that the safety of their children is one of, if not the most important, concern in their responsibilities as parents. As a society, our long-term competitiveness in the global economy is intimately tied to the knowledge of future generations and their ability to compete in the global economy.

Figure 37: Key Assets, Clark County Schools



6.0 Conclusion and Recommendations

This initial effort at assembling information regarding the critical infrastructure elements in Clark County, Nevada gathers information in a very broad swath. Further refinement of the broad elements assembled in this report will result in more detailed analysis of the more important critical infrastructure components of the local economy. While this study provides initial identification and stratification, scoring the importance of each sector and elements within these sectors will be a task for a diverse group of experts.

A general approach for the coming tasks is presented in this report in the form of the CARVER+SHOCK methodology. This tool has been used effectively in other locations, but is hardly the only tool available or the most appropriate in all circumstances and for all sectors. Other tools and methodologies can supplement this approach as appropriate.

Tiering has also been suggested as a method to prioritize the most important tasks. An exhaustive evaluation of risk and vulnerability for every site in every sector is not required by legislation or decree, and would not be a cost-effective approach for any level of government. Determining the most important facilities, sectors, and functions is required and stratification is aided by the tiering concept.

Federal guidance for local government in this type of investigation is both broad and flexible. This guidance outlines what must be done, but does not dictate how to accomplish the task. This flexibility allows unique circumstances, such as the local economy of Las Vegas, to be designed with local needs in mind while at the same time contributing to the security of the region and nation.

An additional emerging concern not addressed in the critical infrastructure sectors, but a very important component of the local economy, is the construction sector and the stability in the housing market. While declining home values and the glut of product on the market locally are certainly of grave concern to many citizens, operations of the primary economy are not impacted at this time. However, if the national trend in foreclosures continues and accelerates, impacts on the credit market and the national economy may alter the impact from this phenomenon. Housing and the availability of capital and credit are components of the broader economy, and volatility in this arena at a minimum constitutes a vulnerability to the smooth function of the economy.

In conclusion, this report presents an initial identification of the critical infrastructure and key assets in Clark County, Nevada. Potential disruptions and vulnerabilities are also presented. A comprehensive listing of potential elements is assembled for future prioritization by a group or groups of stakeholders and knowledgeable experts. A general approach is outlined for further effort and additional refinement. Upon completion, this careful evaluation process should enhance the protection of these assets and contribute to continuing gains to local security and enhancement to the quality of life in the Las Vegas Valley and Clark County as a whole.

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Appendix A: Clark County Assessor Land Use Codes

Source Code Index

Source Codes are broken down into the following basic categories:

Source Code 0 - Vacant
-Parcels of land on which no improvements are built. This code will exist on a parcel until the land use has been ascertained.

Source Code 1 - Residential
-Parcels of land on which the improvements are used as a residence.

Source Code 2 - Industrial
- Parcels of land on which the improvements are used for manufacture or storage of materials, products, or mining processes.

Source Code 3 - Commercial
- Parcels of land on which the improvements are used for wholesale or retail sales of goods or merchandise; repair of a product, to render personal or professional services. (Hotels, Motels, etc.)

Source Code 4 - Non-profit Community Facilities
- Parcels of land that are utilized to contribute to the educational, recreational, spiritual, or general welfare of the community.

Source Code 5 - Agricultural, Ranching, Wildlife, and Natural Resources
- Parcels of land used in farming, ranching, wildlife, or natural resources related activities.

Source Code 6 - Transportation, Communication, and Utilities
- Parcels of land used for transportation or communication related activities and public utilities.

Source Code 7 - Minor Improvements
- Parcels that have miscellaneous improvements not coded in the above source codes.

Source Code #1 – Residential

Use Code	Description
*10	**Single Family Residence**: Including condominium owned detached residences.
*20	**Duplex:** Two separate dwelling units within a single structure.
*30	**Triplex:** Three separate dwelling units within a single structure

*40 **Four-Plex:** Four separate dwelling units within a single structure.

*50 **Apartments:** Five or more household units within a single structure.

*60 **Townhouses:** Single family attached residences including condominium owned townhouses.

*70 **Multi-Family Structure:** This includes low rise and high-rise units, typical of condominium owned residences.

*80 **Manufactured Home Parks:** Manufactured homes are individually owned. Lots are rented.

*85 **Manufactured Home Estates:** Manufactured home and lots are individually owned.

*88 **Manufactured Homes:** On privately owned land (not in manufactured home estates).

95 **Common Area:** Parcels of land developed in conjunction with P.U.D's, townhouses and manufactured home estates. Improvements include clubhouses, pools, laundry rooms or other facilities developed for the exclusive use of property owners.

*99 **Other:** Parcels with a residential use not fitting in any of the above categories.

** Requires capacity count in land use code*

Source Code #2 - Industrial

General Definition: Improvements on industrial parcels are normally designed for manufacturing, mining processes, sales, service, or rental of heavy equipment to general contractors or warehousing. (NOTE: Not normally used for small businesses engaged in the manufacturing and on premise retail sales of such items as ceramics, jewelry, or leather goods. These parcels would normally be coded as Source Code #3 - Commercial.)

Use Code	Description
10	**Manufacturing:** Producers of food and beverage products such as large bakeries and bottling companies.
20	**Mining:** Mining sites for extraction of minerals, ore, metallic or non-metallic materials

21 **Mining:** Mining sites for extraction of stone, gravel or sand (i.e., quarries, gravel pits)

30 **Heavy Equipment:** Business involved in the sale, service, or rental of large heavy equipment to jobbers or general contractors. Services that normally require operators for such equipment

40 **Storage Facilities:** Warehouse for storage of perishable and non-perishable materials or products; bulk plants for storage of refined fuel, oil or other bulk products

*50 **Mini-Warehouse:** Warehouses for or with small storage capacities. Usually rented out by the month

*60 **Industrial Condominiums:** Condos used for an industrial use and not as a residence

** Requires capacity count in land use code*

Source Code #3 - Commercial

General Definition: Improvements on commercial parcels are normally designed for wholesale or retail sales of a product; repair of a product, or to render personal or professional services. Examples: Hotels, Motels, Retail Stores, Shopping Centers, Service Stations, Auto Repair Shops, Medical, Professional and Office Buildings, Restaurants, Cocktail Lounges, Banks, and Hospitals.

Use Code	Description
*10	**Hotels - Class 1 Resort:** Hotel accommodations with elaborate grounds. May have some or all of the following: shops, gaming, restaurants, bars, pools, tennis courts, golf course, or other facilities normally associated with resort hotels.
*11	**Hotels - Class 2:** Hotels with some resort facilities like class-1. Normally would not have elaborate grounds. Example: Four Queens.
*12	**Hotels - Class 3:** Hotels with no resort facilities. May have a pool and a restaurant.
*20	**Deluxe Motels:** Motels, which may have some gaming, pools, shops, restaurants, or other resort facilities.
*21	**Motels:** Small motels having sleeping accommodations only. May have a pool.

25 **Casinos:** Gaming only. May have restaurant or other minor facilities.

30 **General Services:** Includes such business as Laundromat, cleaners, locksmith, plant nurseries, parking lots, printers, barber and beauty shops, tailor shops, catering services, mortuaries, photography, or other services.

35 **Professional and Business Services:** Medical, dental, nursing homes, veterinarian, dance, acting and art schools, hospitals, office, professional or medical office buildings, accountants, attorneys, insurance, title and escrow companies, advertising, and etc.

38 **Financial:** Banks, savings and loan companies, credit unions, financing firms, stockbrokers.

40 **Entertainment:** Theaters, movie houses, drive-ins, race books, licensed horse/dog race betting, auto, cycle race tracts and other non-participant sports, and boxing rinks.

45 **Recreational:** Pool parlors, athletic courts, swimming pools, target ranges, ice or roller-skating, gun clubs, and other participation sports.

46 **Golf Course:** Public

47 **Golf Course:** Private

48 **Golf Course:** Semi-private

49 **Golf Course:** Resort

50 **Regional Shopping Center:** Large centers containing many varied retail shops and stores which cater to buyers from all areas (Contains at least 3 major stores).

55 **Neighborhood Shopping Centers:** Similar to shopping centers (Use Code 50) but contains fewer retail sales outlets, and cater primarily to local residents.

58 **Retail Stores and Shops:** Department stores dealing in a full line of merchandise, drug stores, food and meat markets, specialty shops, shoe and wearing apparel shops, and hardware stores.

59 **Miscellaneous Wholesale and Retail Sales:** Cycles, recreational vehicles, mobile homes, boats, feed stores, etc.

60 **Restaurants and Cocktail Lounges:** Cafes, restaurants, drive-ins, take-out facilities, ice cream parlors, liquor stores, cocktail lounges.

65 **Food and Beverage Businesses:** Distributors of food and/or drink items or other

retail or wholesale business relation to consumable items.

70 **Automotive:** Garages, repair shops, auto accessories, new and used sales of automobiles, showrooms, wrecking yards.

75 **Service Stations:** Selling gas and oil, with or without service facilities.

78 **Building and Construction:** Supplies and Services.

*80 **Recreational Vehicle Parks:** Parks renting space to transients. Example: KOA parks, Stardust Motor Lodge.

*85 **Commercial Condominiums:** Condo's used as offices and not as residences.

99 **Other:** Commercial activities that don't fit in any of the above categories.

** Requires capacity count in land use code*

Source Code #4 - Non-Profit Community Facilities

General Definition: Community facilities normally encompass those parcels, which are utilized as cultural, religious, educational, entertainment, or recreational related activities. These include, but are not limited to, churches, libraries, museums, parks, fraternal, and social organizations, labor unions, and athletic facilities, such as golf courses, swimming pools, etc.

Use Code	Description
10	**Schools:** Public and private elementary, middle, and high schools. Universities and colleges; business, professional, vocational, trade schools, preschools, nurseries, and other facilities which may be considered as educational. Excluding dance, acting, art, or the other various types of specialized schools in which one may choose to enroll.
20	**Religious:** All facilities used for religious worship or non-profit charitable and welfare services.
30	**Library and Museums:** Public libraries and sub-stations and historical monument buildings and sites.
40	**Parks:** Public parks, picnic grounds, and non-commercial camping grounds, amusement parks, fairgrounds open to the public.

50 **Labor, Fraternal, and Social Organizations:** YMCA, youth camps, Red Cross United Fund, or other community organizations.

60 **Government Facilities:** Animal control, civil defense, correctional institutions, judicial or legislative facilities, military training bases, or other facilities under jurisdiction of armed forces. Postal facilities, fire and police protection, public roads and highway departments.

70 **Non-profit Entertainment and Recreational Facilities:** Golf courses, swimming pools, and other public facilities.

Source Code #5 - Agriculture, Ranching, and Wildlife

General Definition: Used to identify those parcels of land used in farming, ranching, wildlife, or natural resource conservation.

Use Code	Description
10	**Agriculture:** Raising of crops from the soil and other related activities.
20	**Ranching:** Raising of livestock, poultry, bees, and dairy related activities.
30	**Wildlife:** Fish hatcheries, ranger facilities. Wildlife or plant conservation, or conservation of natural resources.

Source Code #6 - Transportation, Communication, and Utilities

Use Code	Description
10	**Communication:** Radio and television stations, relay stations, micro-wave stations, telegraph transmittal and receiving; telephone offices, exchange plants, newspaper, publications, their business offices, or other related facilities.
20	**Transportation:** Aircraft, railroad, bus, taxicab, truck and marine terminals and depots; freight docks, storage compound and other related facilities.

30 **Utilities:** Water, gas, and power plants, sub-stations, reservoir, storage areas, generating and transmitting sites, their business offices, and other related facilities. Rubbish disposal and dump site; sewage and treatment plants.

Source Code #7 - Minor Improvement

General Definition: Minor improvements include those improvements such as fences, barns, shed, obsolete structures having minimum allowable value, or small sub-standard structures.

Use Code	Description
10	Use for all minor improvements with a residential use.
20	Salvage values.
30	Use for all minor improvements with a commercial use.

Auxiliary Codes

X-	XX-	X-	X-	X	XXXX
1	**2**	**3**	**4**	**5**	**6**

3 = Auxiliary Code
4 = Secondary Auxiliary Code

General Definition: Auxiliary codes are used to give additional pertinent information, which cannot be defined with source and use codes alone. Auxiliary codes are one-digit codes and appear as the third and fourth series of digits in the land use code. The first auxiliary code is a one-digit number used when only one code is needed. The secondary auxiliary code is a one-digit number used when more than one auxiliary code is applicable to a parcel. The first auxiliary code is the third series of digits in the land use code and secondary auxiliary code is the fourth series of digits in the land use code.

Auxiliary Code #1:

Situs Complex: If more than one use code within a single source code is applicable to a parcel, that parcel will be designated with the use code having the highest assessed value. Auxiliary code #1 used in the third or fourth series of digits in the land use code will denote the multiple use codes.

Example: A five-unit apartment complex and a single-family residence with one swimming pool.

Written as:
1-50-1-0-1 5

Note: When there is more than one use, the capacity count should reflect that of the land use code being used.

Auxiliary Code #2:

Secondary Parcels: Parcels of land used in conjunction with a main parcel are considered to be secondary parcels. The main parcel is coded with applicable source and use codes. The secondary parcel is coded with the same source and use codes as main parcel with auxiliary code #2 added as the third series in the land use code. A portion of the major improvement may be situated on the secondary parcel.

Example: The main parcel is a major hotel and the secondary parcel is a parking lot.

Written as:
3-10-0-0-3 900 For the main parcel
3-10-2-0-0 For the secondary parcel

Auxiliary Code #3:

Multiple Source Code: If more than one source code is applicable to a single parcel of land, the parcel will be assigned the source code of the portion with the highest assessed value. Auxiliary code #3 in the third or fourth series of digits in the land use code will denote that there are multiple sources for that parcel.

Example: A single-family residence with a pool, a small tailor shop and a dentist's office. Assuming that the dentist's office has the highest assessed value.

Written as:
3-35-3-0-0 1

Note: When there is more than one use, the capacity count should reflect that of the land use code being used.

Auxiliary Code #4:

Improvements Billed on the Unsecured Tax Roll: This parcel would be coded with applicable source and use codes followed by auxiliary code #4 in the third series of digits in the land use code, to denote taxes on the improvement are billed through personal property.

Example: A leasehold improvement situated on a parcel of land not owned by the lessee and taxes on the improvement are paid on the unsecured tax roll.

Written as:
3-35-4-0-0

Auxiliary Code #5:

Combination: If three or more auxiliary codes are applicable to a parcel, auxiliary code #5 should be used in the third or the fourth series of digits in the land use code.

Written as:
3-35-5-0-0

Auxiliary Code #6:

Manufactured Home Conversion: Manufactured homes converted to real property and no longer taxed through personal property on the unsecured tax roll. #6 is used in the third or fourth series of digits in the land use code.

Written as:
1-10-6-0-0

Auxiliary Code #7:

Well Sites: Any parcel having a well and/or septic tank has a #7 in the third or fourth series of digits in the land use code. If a well and/or septic is being added at the same time that a RAR is being added, the auxiliary code for wells and septic tanks will update automatically.

However, if the RAR already exist and a well and/or septic is being added or removed, it is necessary to update the land use code manually using AOIN.

Written as:
1-10-7-0-0

Auxiliary Code #8:

Condominium Ownership: Any type of property that is condominium ownership.

Examples:

1-10-8-0-0 Single family detached residence that is condominium ownership.

1-50-8-0-0 Apartments parceled as individual multi-family residences that are condominium ownership.

1-60-8-0-0 Townhouse/Single family attached house that is condominium ownership.

1-70-8-0-0 Multiple residence, condominium ownership.

Auxiliary Code #9:

New Manufactured Home that is real property: A new manufactured home placed on a permanent foundation, meeting all zoning requirements that is considered real property, with no 'conversion' process (from unsecured property) necessary.

Examples:

1-10-9-0-0 New single family manufactured home permanently attached to permanent foundation.

Appendix B: CARVER+SHOCK Methodology Details

CARVER PLUS SHOCK METHOD FOR FOOD SECTOR VULNERABILITY ASSESSMENTS

Overview

The CARVER plus Shock method is an offensive targeting prioritization tool that has been adapted for use in the food sector. This tool can be used to assess the vulnerabilities within a system or infrastructure to an attack. It allows you to think like an attacker by identifying the most attractive targets for attack. By conducting such a vulnerability assessment and determining the most vulnerable points in your infrastructure, you can then focus your resources on protecting your most vulnerable points.

CARVER is an acronym for the following six attributes (discussed in further detail later) used to evaluate the attractiveness of a target for attack:

- **C**riticality - measure of public health and economic impacts of an attack
- **A**ccessibility – ability to physically access and egress from target
- **R**ecuperability – ability of system to recover from an attack
- **V**ulnerability – ease of accomplishing attack
- **E**ffect – amount of direct loss from an attack as measured by loss in production
- **R**ecognizability – ease of identifying target

In addition, the modified CARVER tool evaluates a seventh attribute, the combined health, economic, and psychological impacts of an attack, or the **SHOCK** attributes of a target.

The attractiveness of a target can then be ranked on a scale from one to ten on the basis of scales that have been developed for each of the seven attributes. Conditions that are associated with lower attractiveness (or lower vulnerability) are assigned lower values (e.g., 1 or 2), whereas, conditions associated with higher attractiveness as a target (or higher vulnerability) are assigned higher values (e.g., 9 or 10). Evaluating or scoring the various elements of the food sector infrastructure of interest for each of the CARVER-Shock attributes can help identify where within that infrastructure an attack is most likely to occur. Federal agencies, such as the Food Safety and Inspection Service (FSIS) and the Food and Drug Administration (FDA), have used this method to evaluate the potential vulnerabilities of farm-to-table supply chains of various food commodities. The method can also be used to assess the potential vulnerabilities of individual facilities or processes.

Steps for Conducting a CARVER + Shock Analysis

Step 1 – Establishing Parameters

Before any scoring can begin, the scenarios and assumptions you wish to use in the analysis must be established in order to guide all further steps. That is, you need to answer the question of what you are trying to protect and what you are trying to protect it from. Those parameters include:

- what food supply chain you are going to assess (e.g., hot dog production versus deli meat production versus chicken nugget production, overall assessment based on generic process from farm to table versus post-slaughter processing in a specific facility, etc.);
- what is the endpoint of concern (e.g., foodborne illness and death versus economic impacts, etc.);
- what type of attacker and attack you are trying to protect against. Attackers could range from disgruntled employees to international terrorist organizations. Those different attackers have different capabilities and different goals. For example, a major assumption used by FSIS and FDA in their vulnerability assessments is that one of the goals of terrorist organizations is to cause mass mortality by adding acutely toxic agents to food products. That assumption has a major impact on the scoring of the various parts of the supply chain and the scales for the attributes (see below) have been developed with that in mind;
- what agent(s) might be used. The agent used in your scenario will impact the outcome of the assessment. Potential agents include biological, chemical or radiological agents. Different agents have different properties—potency, heat stability, pH stability, half-life, etc.—that will determine the impact of an intentional contamination incident.

Step 2 – Assembling Experts

A team of subject matter experts should be compiled to conduct the assessment. The team should consist, at a minimum, of experts in food production (specifically for the food process being evaluated), food science, toxicology, epidemiology, microbiology, medicine (human and veterinarian), radiology, and risk assessment. The team will apply the CARVER-Shock method to each element of food system infrastructure and come to a consensus on the value from one to ten for each attribute, using the scenario and assumptions established in Step 1.

Step 3 – Detailing Food Supply Chain

The analysis begins by developing a description of the system under evaluation. A graphical representation (flow chart) of the system and its subsystem, complexes, components and nodes (its smaller structural parts) should be developed to facilitate this process. For example, if you are evaluating hot dog production, the food system is hot-dog production, which can be broken down into subsystems (production of live animals subsystem, slaughter/processing

subsystem, distribution subsystem). Those subsystems can be further broken down into complexes (e.g., slaughterhouse facility and processing facility) Those can be broken down into components and would include the raw materials receiving area, processing area, storage area, shipping area, etc.), and to the smallest possible nodes (e.g., individual pieces of equipment).

Step 4 – Assigning Scores

Once the infrastructure has been broken down into its smallest parts (i.e., components and nodes), these can be ranked or scored for each of the seven CARVER-Shock attributes to calculate an overall score for that node. The nodes with the higher overall scores are those that are potentially the most vulnerable nodes (i.e., most attractive targets for an attacker). The rationale for a particular consensus score should be captured.

Step 5 – Applying What Has Been Learned

Once the critical nodes of the system have been identified, a plan should be developed to put countermeasures in place that minimize the attractiveness of the nodes as targets. Countermeasures might include enhancements to physical security, personnel security, and operational security that help to minimize aggressor access to the product or process.

Description of Attributes and Scales

The following section defines the attributes used by FDA and USDA to conduct their vulnerability assessments and provides the scales used by the agencies for scoring each attribute. These scales were developed with the mindset that mass mortality is a goal of terrorist organizations. It is important to remember, however, that any intentional food contamination could also have major psychological and economic impacts on the affected industry. Tables to assist in calculating the public health impacts and the overall CARVER+Shock scores can be found in Appendix A and B, respectively.

Criticality: A target is critical when introduction of threat agents into food at this location would have significant health or economic impact. Example metrics are:

Criticality Criteria	Scale
Loss of over 10,000 lives OR loss of more than $100 billion	9 – 10
Loss of life is between 1,000 – 10,000 OR loss between $10 billion and $100 billion	7 – 8
Loss of life between 100 and 1000 OR loss between $1 and $10 billion	5 – 6
Loss of life less than 100 OR loss less than $1 billion	3 – 4
No loss of life OR loss less than $100 million	1 – 2

Accessibility: A target is accessible when an attacker can reach the target to conduct the attack and egress the target undetected. Accessibility is the

openness of the target to the threat. This measure is independent of the probability of successful introduction of threat agents. Example metrics are:

Accessibility Criteria	Scale
Easily Accessible (e.g., target is outside building and no perimeter fence). Limited physical or human barriers or observation. Attacker has relatively unlimited access to the target. Attack can be carried out using medium or large volumes of contaminant without undue concern of detection. Multiple sources of information concerning the facility and the target are easily available.	9 – 10
Accessible (e.g., target is inside building, but in unsecured part of facility). Human observation and physical barriers limited. Attacker has access to the target for an hour or less. Attack can be carried out with moderate to large volumes of contaminant, but requires the use of stealth. Only limited specific information is available on the facility and the target.	7 – 8
Partially Accessible (e.g. inside building, but in a relatively unsecured, but busy, part of facility). Under constant possible human observation. Some physical barriers may be present. Contaminant must be disguised, and time limitations are significant. Only general, non-specific information is available on the facility and the target.	5 – 6
Hardly Accessible (e.g., inside building in a secured part of facility). Human observation and physical barriers with an established means of detection. Access generally restricted to operators or authorized persons. Contaminant must be disguised and time limitations are extreme. Limited general information available on the facility and the target.	3 – 4
Not Accessible. Physical barriers, alarms, and human observation. Defined means of intervention in place. Attacker can access target for less than 5 minutes with all equipment carried in pockets. No useful publicly available information concerning the target.	1 – 2

Recuperability: A target's recuperability is measured in the time it will take for the specific facility to recover productivity. The effect of a possible decrease in demand is not considered in this criterion. Example metrics are:

Recuperability Criteria	Scale
> 1 year	9 – 10
6 months to 1 year	7 – 8
3-6 months	5 – 6
1-3 months	3 – 4
< 1 month	1 – 2

Vulnerability: A measure of the ease with which threat agents can be introduced in quantities sufficient to achieve the attacker's purpose once the target has been reached. Vulnerability is determined both by the characteristics of the target (e.g., ease of introducing agents, ability to uniformly mix agents into target) and the characteristics of the surrounding environment (ability to work unobserved, time available for introduction of agents). It is also important to consider what interventions are already in place that might thwart an attack. Example metrics are:

Vulnerability Criteria	Scale
Target characteristics allow for easy introduction of sufficient agents to achieve aim.	9 – 10
Target characteristics almost always allow for introduction of sufficient agents to achieve aim.	7 – 8
Target characteristics allow 30 to 60% probability that sufficient agents can be added to achieve aim.	5 – 6
Target characteristics allow moderate probability (10 to 30 %) that sufficient agents can be added to achieve aim.	3 – 4
Target characteristics allow low probability (less than 10%) sufficient agents can be added to achieve aim.	1 – 2

Effect: Effect is a measure of the percentage of system productivity damaged by an attack at a single facility. Thus, effect is inversely related to the total number of facilities producing the same product. Example metrics are:

Effect Criteria	Scale
Greater than 50% of the system's production impacted	9 – 10
25-50% of the system's production impacted	7 – 8
10-25% of the system's production impacted	5 – 6
1-10% of the system's production impacted	3 – 4
Less than 1% of system's production impacted	1 – 2

Recognizability: A target's recognizability is the degree to which it can be identified by an attacker without confusion with other targets or components. Example metrics are:

Recognizability Criteria	Scale
The target is clearly recognizable and requires little or no training for recognition	9 – 10
The target is easily recognizable and requires only a small amount of training for recognition	7 – 8
The target is difficult to recognize or might be confused with other targets or target components and requires some training for recognition	5 – 6
The target is difficult to recognize. It is easily confused with other targets or components and requires extensive training for recognition	3 – 4
The target cannot be recognized under any conditions, except by experts.	1 – 2

Shock: Shock is the final attribute considered in the methodology. Shock is the combined measure of the health, psychological, and collateral national economic impacts of a successful attack on the target system. Shock is considered on a national level. The psychological impact will be increased if there are a large number of deaths or the target has historical, cultural, religious or other symbolic significance. Mass casualties are not required to achieve widespread economic loss or psychological damage. Collateral economic damage includes such items

as decreased national economic activity, increased unemployment in collateral industries, etc. Psychological impact will be increased if victims are members of sensitive subpopulations such as children or the elderly.

The metrics for this criterion are:

Shock	Scale
Target has major historical, cultural, religious, or other symbolic importance. Loss of over 10,000 lives. Major impact on sensitive subpopulations, e.g., children or elderly. National economic impact more than $100 billion.	9-10
Target has high historical, cultural, religious, or other symbolic importance. Loss of between 1,000 and 10,000 lives. Significant impact on sensitive subpopulations, e.g., children or elderly. National economic impact between $10 and $100 billion.	7-8
Target has moderate historical, cultural, religious, or other symbolic importance. Loss of life between 100 and 1,000. Moderate impact on sensitive subpopulations, e.g., children or elderly. National economic impact between $1 and $10 billion.	5-6
Target has little historical, cultural, religious, or other symbolic importance. Loss of life less than 100. Small impact on sensitive subpopulations, e.g., children or elderly. National economic impact between $100 million and $1 billion.	3-4
Target has no historical, cultural, religious, or other symbolic importance. Loss of life less than 10. No impact on sensitive subpopulations, e.g., children or elderly. National economic impact less than $100 million.	1-2

By definition, terrorists attempt to achieve strong emotional responses from their target audience. Aspects of targets that terrorists view as increasing a target's shock value are symbolism (e.g., the Pentagon), large number of casualties, sensitive nature of facilities (e.g., nuclear facilities), and the ability to strike at core values and primal emotions (e.g., targeting children).

Calculation of Final Values and Interpretation

Once the ranking on each of the attribute scales has been calculated for a given node within the food supply system, the ranking on all of the scales can then be totaled to give an overall value for that node. This should be repeated for each node within a food supply system. The overall values for all the nodes can then be compared to rank the vulnerability of the different nodes relative to each other. The summary table provided in Appendix B can assist in summarizing the rankings. The nodes with the highest total rating have the highest potential vulnerability and should be the focus of countermeasure efforts

Appendix C: Business License Codes by Jurisdiction

Appendix D: Clark County Banks by Total Assets

Cert#	Institution Name	City	Class	Total Assets($000)
7213	Citibank, National Association	Las Vegas	N	1,132,840,000
32633	Washington Mutual Bank	Henderson	SA	311,053,133
26665	First Republic Bank	Las Vegas	NM	12,896,314
34351	USAA Savings Bank	Las Vegas	NM	6,346,252
18113	Nevada State Bank	Las Vegas	NM	3,886,023
33897	Bank of Nevada	Las Vegas	NM	2,921,820
27389	Wells Fargo Financial National Bank	Las Vegas	N	2,268,225
33863	HSBC Bank Nevada, National Association	Las Vegas	N	1,871,165
34043	Community Bank of Nevada	Las Vegas	SM	1,569,682
57833	Beal Bank Nevada	Las Vegas	NM	1,505,827
34194	Silver State Bank	Henderson	NM	1,306,032
28923	M & I Bank FSB	Las Vegas	SA	1,139,064
34785	Sun West Bank	Las Vegas	NM	421,156
34820	Security Savings Bank	Las Vegas	NM	303,847
57969	Town North Bank Nevada, National Association	Las Vegas	N	278,706
57542	Toyota Financial Savings Bank	Henderson	NM	272,210
57312	Town & Country Bank	Las Vegas	NM	167,615
35434	Southwest USA Bank	Las Vegas	NM	155,155
35421	Black Mountain Community Bank	Henderson	NM	147,025
35418	Nevada Commerce Bank	Las Vegas	NM	135,825
35357	Red Rock Community Bank	Las Vegas	NM	108,047
58473	Service1st Bank of Nevada	Las Vegas	NM	102,165
35253	Desert Community Bank	Las Vegas	NM	97,392
25620	Credit One Bank, National Association	Las Vegas	N	84,201
57276	Bank of Las Vegas	Las Vegas	NM	72,737
57933	Bank of North Las Vegas	N. Las Vegas	NM	60,419
58443	First Security Bank of Nevada	Las Vegas	NM	47,597
58499	First Asian Bank	Las Vegas	NM	19,034
58393	Fifth Street Bank	Las Vegas	NM	18,716
58358	1st Commerce Bank	N. Las Vegas	NM	18,006
58418	Nevada National Bank	Las Vegas	N	13,292

Bank Charter Class A classification code assigned by the FDIC based on the institution's charter type (commercial bank or savings institution), charter agent (state or federal), Federal Reserve membership status (Fed member, Fed nonmember)and its primary federal regulator (state chartered institutions are subject to both federal and state supervision).

- **N** = commercial bank, national (federal) charter and Fed member, supervised by the Office of the Comptroller of the Currency (OCC)
- **SM** = commercial bank, state charter and Fed member, supervised by the Federal Reserve (FRB)
- **NM** = commercial bank, state charter and Fed nonmember, supervised by the FDIC
- **SB** = savings banks, state charter, supervised by the FDIC

- **SA** = savings associations, state or federal charter, supervised by the Office of Thrift Supervision (OTS)
- **OI** = insured U.S. branch of a foreign chartered institution (IBA)