Memo

Date:	Tuesday, February 15, 2022
Project:	Heber Valley Corridor EIS
To:	UDOT
From:	HDR
Subject:	Preliminary Road Tunnel Feasibility Analysis

Purpose

The study area for the transportation needs used for the Heber Valley Corridor Project is focused on U.S. Highway 40 (U.S. 40) (Heber Main Street) from its intersection with State Route (S.R.) 32 to its junction with U.S. Highway 189 (U.S. 189) in Heber City. It also includes U.S. 40 to the southeast and U.S. 189 to the southwest. During the public comment period for the initial scoping phase of the project, members of the public suggested UDOT consider a tunnel under or a viaduct bridge over Main Street. UDOT presented a tunnel or bridging conceptual alternative (alternative 40D) at the alternative concepts public meetings held in October 2021. The intention is that through-traffic (with no destination in Heber City) could use the road tunnel or bridge to bypass Main Street.

UDOT screened out bridging over U.S. 40 alternative because it did not meet the purpose and need of the project. A bridge over Main Street would not allow Heber City to meet their vision for the historic town center. It would result in severe visual impacts and adversely affect the setting for numerous historic buildings. Also, any bridge over businesses, homes, or public areas used for events presents numerous operational, safety, and liability issues. Debris from uncovered loads or errant vehicles could fall from the bridge onto adjacent buildings, parking areas, or public spaces. Snow removal would be costly and difficult because snow could not be pushed off the sides of the bridge due to safety considerations, requiring snow to be plowed long distances, piled up, loaded into a truck, and hauled away. This would require road closures that would disrupt traffic. A large-span structure with inefficient snow removal would also increase the likelihood of icing, which further decreases safety.

The purpose of this memorandum is to conceptually define and evaluate the feasibility and reasonableness of a potential road tunnel alternative for the Heber Valley Corridor Environmental Impact Statement (EIS).

Methodology

Planning for modern tunnels requires complex multidisciplinary assessments. HDR reviewed several references for general design and operational considerations for a tunnel and for determining the general tunnel configuration that might be needed for the unique transportation needs in the study area.

In its National Tunnel Inspection Standards, the Federal Highway Administration (FHWA) defines a road tunnel[1] as "an enclosed roadway for motor vehicle traffic with vehicle access limited to portals, regardless of type of structure or method of construction, that requires, based on the owner's determination, special design considerations to include lighting, ventilation, fire protection systems, and emergency egress capacity." The following data sources define these design elements. The references below are not a comprehensive list and, in fact, the code and manuals reviewed list several other applicable references, which were not reviewed in detail for preparing this memo. However, fire and life safety and tunnel inspection subject matter experts within HDR were consulted, and this memo provides general information about the additional requirements and considerations for constructing a tunnel under Main Street.

Data Sources

Civil Engineering Design Criteria. FHWA, in coordination with the American Association of State Highway and Transportation Officials (AASHTO),[2] developed the *Technical Manual for Design and Construction of Road Tunnels – Civil Elements*[3] and their *Road Tunnel Design Guidelines*.[4] These documents provide the general information for tunnel design including lane and shoulder widths, vertical clearances, and drainage requirements. The FHWA document also provides considerations for the tunnel type: cut and cover, mined, or bored tunnels.

Guidance suggests that UDOT adopt the same general standards (lane and shoulder widths and vertical clearance) as surface roads and bridges where practical.[5] Additional design considerations include the following:

- Except for maintenance or unusual conditions, two-way traffic in a single tunnel tube should be discouraged for safety reasons. However, tunnels should be designed to be capable of handling bidirectional traffic in one tube during maintenance work in the other tube.
- To avoid the need for climbing lanes, maximum grades should not exceed 4%. For economic and ventilation reasons, climbing lanes should be avoided within tunnels.
- The horizontal alignment for a tunnel should be as short as practical and maintain as much of the tunnel length on tangent (straight line) as possible. This will limit the number of curves, minimize the length of tunnel, and improve operating efficiency.
- It is also preferable for the traffic tubes for the two directions to be constructed within a single structure so that, during an emergency, vehicle occupants can exit the tube into a neighboring tube. National Fire Protection Association (NFPA) 502 requires that the two tubes be divided by a minimum of 2-hour rated fire door to facilitate cross passageways between the tunnel tubes to be used instead of numerous (about every 1,000 feet) emergency egress points to the surface.

---

1 23 Code of Federal Regulations (CFR) Part 650, *Bridges, Structures, and Hydraulics*, Subpart E, *National Tunnel Inspection Standard*, Section 505, *Definitions*

2 AASHTO, *LRFD [Load and Resistance Factor Design] Road Tunnel Design and Construction Guide Specifications*, 2017

3 FHWA-NHI-10-034, December 2009

4 FHWA-IF-05-023, July 2004

5 FHWA, *FHWA Road Tunnel Design Guidelines*, December 2009

- In long tunnels, wider doors connecting the tunnel tubes should also be considered to help vehicles turn around and exit the other tube after an emergency.
- Also see the *Fire and Life Safety Design Criteria* section below.

Figure 1 presents the conceptual tunnel cross section for this project. This cross section is wider than the one presented at the public meetings in October 2021 because research into standards (listed above) occurred after the meetings. This cross section is about 100-feet-wide, which is wider than existing Main Street. Main Street is currently about 92 feet measured from back of curb to back of curb; the existing right-of-way is about 115-feet wide, measured from back of sidewalk to back of sidewalk. Variances to the standard design elements shown could be considered after an economic study is performed weighing cost and safety benefits of the various design elements, as well as a detailed engineering analysis (for both structure integrity and fire and life safety) and associated comprehensive risk analyses.

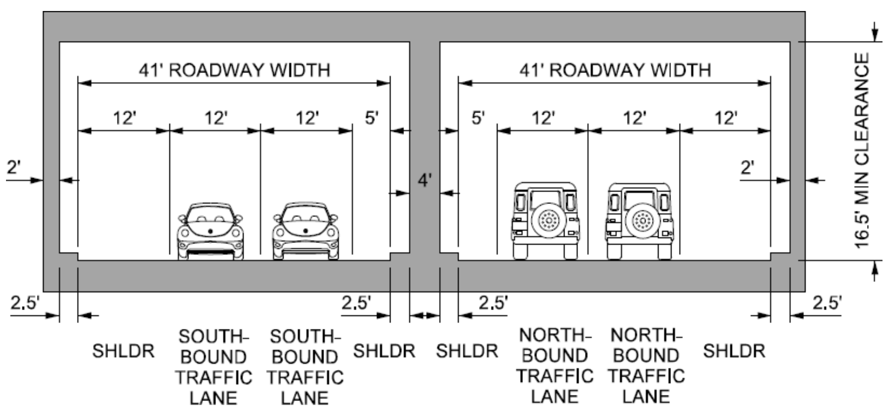


Figure 1. Conceptual Tunnel Cross Section for the Heber Valley Corridor Project

The conceptual tunnel cross section in Figure 1 is a "cut-and-cover" type tunnel, which would be the likely method of tunnel construction. Note that no structural analysis was completed to define the approximate roof or wall thicknesses needed to support a surface roadway (Main Street) on top of the tunnel. Similarly, design-level utility location (horizontal or vertical) data collection was not performed to estimate the required depth of a tunnel or utility conflicts. However, an effort was made to identify major utilities that could be affected based on available mapping. Cut-and-cover tunnel construction could require that all utilities under Main Street to be relocated or protected in place. Sanitary sewer is the deepest utility, typically in the 6 to 10-foot-deep range.

The need and feasibility for the use of a tunnel boring machine(s), because of the presence of major utilities and culverted streams or to minimize business disruptions, to construct a dual-tube tunnel could also affect the required depth. Typically, bored tunnels are about 30 feet deep, measured from the top of the tunnel, to miss most utilities and maintain required roadway grades. Twin bored tubes would likely be required. Constructing cross connections between tubes becomes more difficult in bored tunnels. Therefore, some surface disturbance would still be required to construct the cross connections.

Fire and Life Safety Design Criteria. The National Fire Protection Association 502, *Standards for Road Tunnel, Bridges, and Other Limited-access Highways* (NFPA 502), establishes the minimum criteria for the fire protection and fire life safety requirements of road tunnels. The minimum provisions of NFPA 502–specific design features are as follows:[6]

- Ventilation would be required to maintain acceptable air quality in the tunnel during normal operations and to control and evacuate noxious emissions to maintain a "tenable environment" for people in the event of a fire.
- A means of egress needs to be provided with exits (to the surface or into an adjacent traffic tube) spaced about every 1,000 feet.
- Traffic-control devices at the approaches to the tunnels and within the tunnels are needed to manage traffic entering the tunnel.
- Portable fire extinguishers in cabinets, placed at intervals, are required.
- Fire-detection and alarm systems are required.
- A two-way communication system to an integrated or remote tunnel command center is required.
- A connection to a water system capable of providing adequate fire-suppression flows is required.
- A pipeline to the tunnel would be needed to supply adequate fire-suppression flows.
- Standpipes within the tunnel would be needed to provide a location for connecting fire hoses.
- A fixed water-based fire-fighting system (overhead sprinklers) would be needed.
- A tunnel drainage system is required to minimize the spread of spilled fuels and other flammable materials.
- Lighting, electrical systems, and emergency power are also necessary.

NFPA 502 requires a detailed engineering analysis, which was beyond the scope of this preliminary analysis, to size the water suppression, the required ventilation system, the distance between points of emergency egress to an adjacent tube and to the surface, and the ability of structural members to resist a fire. Integral to the engineering analysis is selecting the design fire to estimate the heat release rate and smoke generation. The design fire must also consider the types of vehicles expected to use the tunnel.[7]

NFPA 502 also requires that UDOT adopt rules and regulations that would apply to the transportation of hazardous materials ("regulated and unregulated cargoes") through the tunnel. The design and planning must address the risks presented by these cargoes and must consider population densities, the type of highway, the types and quantities of hazardous materials, emergency response capabilities, and alternative routes, among other considerations.[8] UDOT did

---

[6] A detailed engineering analysis would be needed to size these design features and might introduce other fire and life safety considerations.

[7] NFPA 502, Section 11.4.2

[8] NFPA 502, Section 7.14 and Chapter 14

not conduct a detailed risk analysis for this preliminary tunnel evaluation. However, see the *Hazardous Materials Transportation Considerations* section below for initial conclusions regarding hazardous material transport.

Operational Considerations. The operating requirements for the tunnel would be defined by the level of traffic, the availability of emergency responders, and other conditions specific to the tunnel location. UDOT would need to employ the appropriate personnel for 24-hour monitoring and maintenance of the tunnels to provide safe operation and reliable levels of service.[9] Emergency response plans are required for all road tunnel lengths and must be submitted for acceptance and approval by the authority(ies) having jurisdiction.[10] The outcome of preparing and reviewing the emergency response plan, which would include coordinating with many participating agencies, would define the required tunnel staff, their roles and qualifications, and their ongoing training needs. The emergency response planning process would also determine whether a standalone operations and control center near the tunnel would be needed or whether remote monitoring is feasible.

An effective maintenance program helps reduce costs, decrease the number of tunnel closures, increase public safety, and ensure adequate levels of service. Maintenance activities include routine activities such as removing snow, ice, and debris; regularly scheduled preventative maintenance such as checking portable fire extinguishers, washing tunnel surfaces, flushing drain systems, and servicing equipment; and corrective maintenance such as repairing pavement or addressing the sudden failure of functional equipment.

FHWA developed the National Tunnel Inspection Standards; the *Tunnel Operations, Maintenance, Inspection, and Evaluation (TOMIE) Manual*; and the Specifications for National Tunnel Inventory to help safeguard tunnels and to ensure reliable levels of service on all public roads. The general requirements of these programs are as follows:[11]

- Performing regularly scheduled tunnel inspections
    - Routine inspections every 24 months
    - In-depth inspections at a frequency determined by the program manager[12]
    - Damage inspection after a seismic event, fire, collision, avalanche, rockslide, etc.
- Maintaining tunnel records and inventories
- Submitting tunnel inventory and inspection data to FHWA
- Reporting critical findings and responding to safety and/or structural concerns
- Maintaining current load ratings on all applicable tunnel structures
- Developing and maintaining a quality control and quality assurance program
- Establishing responsibilities for the tunnel inspection organization and qualifications for tunnel inspection personnel

---

9 FHWA, *Tunnel Operations, Maintenance, Inspection, and Evaluation (TOMIE) Manual*, 2015

10 NFPA 502, Chapter 13, *Emergency Response*

11 Refer to footnote 9.

12 The individual in charge of tunnel inspections in Utah.

- Training and national certification of tunnel inspectors

A tunnel evaluation should be performed after an inspection to evaluate risks and prioritize repairs. In addition, a periodic review of the fire and life safety engineering analysis and an emergency response plan is recommended. Lessons learned from the training exercises and drills should also be considered and plans updated accordingly.

Hazardous Materials Transportation Considerations. Crude oil from the Uinta Basin is a key commodity frequently hauled on U.S. 40 through Heber City to refineries in Salt Lake City area. Uinta Basin black waxy crude oil is classified as a hazardous material because it is a flammable liquid that also presents various health hazards and risks.

Utah does not have state-specific regulations governing the transportation of hazardous materials. Under Utah Administrative Code R909-75, *Safety Regulations for Motor Carriers Transporting Hazardous Materials and/or Hazardous Wastes*, the State of Utah adopted federal regulations that apply to offering, accepting, and transporting hazardous materials related to operating a motor carrier within the state. Specifically, UDOT incorporates by reference Safety Regulations for Motor Carriers Transporting Hazardous Materials or Hazardous Wastes.[13]

Utah designates all interstate highways as National Hazardous Material Routes (NHMR). Because U.S. 40 and U.S. 189 are not interstate highways, they are not designated NHMRs. Therefore, a motor carrier carrying hazardous materials that are required to be placarded or marked in accordance with 49 Code of Federal Regulations (CFR) Section 177.823 and that are not subject to NHMR routing designations <u>shall operate the vehicle over routes [that] do not go through</u> or near heavily populated areas, places where crowds are assemble<u>d, tunnels</u>, narrow streets, or alleys, except where the motor carrier determines that there is no practical alternative or a reasonable deviation is required by emergency conditions, such as a detour that has been established by highway authority or law enforcement.[14]

Environmental Considerations. The construction impact of a tunnel on the community and the environment is important and must be addressed. Issues such as impacts to traffic, and disruptions to businesses and institutional facilities, hospitals, utilities, and residences, should be addressed. Heavy civil construction can also cause noise, dust, vibration, water quality, and aesthetics issues. Construction and operation of a tunnel can affect hydrologic conditions of the shallow groundwater and result in indirect impacts to water resources in the study area.

One specific area of concern during subsurface construction is related to vibration (from pile driving, equipment operation, drilling, compaction, or tunnel boring) and surface settlement (due to disruptions to the shallow groundwater table) and the potential impacts to the large number of historic buildings along Main Street. These construction impacts could impair the integrity of a historic site and could constitute an adverse impact under Section 106 of the National Historic Preservation Act

Utility Considerations. HDR contacted utility providers to determine the approximate location of utilities under Main Street. Power and telecommunication are a mixture of both aerial and underground, both of which are behind the curb. Gas, Culinary Water, Sanitary Sewer, and Storm Drain appear to be along the western and/or eastern edges of the roadway, likely in the shoulder.

---

[13] 49 CFR, Subchapter C, Parts 107, 171, 172, 173, 177, 178, 179, and 180 (October 1, 2019)

[14] 49 CFR Section 397.67 (b)

There are also utilities that cross Main Street at most of the intersections. It can be estimated that the utilities are in the 3–5-foot depth range, except for the Sanitary Sewer, which is typically in the 6-10-foot-deep range.

A cut-and-cover tunnel would be the most disruptive to utilities. The tunnel could be wider than the existing road so utilities that parallel the road and are currently located behind the curb might have to be relocated and likely all utilities that cross under the roadway would likely have to be relocated or protected in place to allow for tunnel construction and maintain future accessibility to the utility. The following utilities are noted in the study area:

- Lake Creek - Culvert crossing at 51 South (5-8 feet to the bottom of culvert)
- Sanitary sewer – A sewer line runs from 400 South to 600 South, from 785 South to 1200 South, and there is a crossing at each intersection.
- Central Utah Water Conservancy District – There is a canal crossing at 740 North
- Gas – A 4” to 6” steel main the entire length from 800 North to 1200 South. A 2” steel main from 500 North to 100 North, 100 South to 200 South, and 300 South to 900 South. A crossing at every intersection from 750 North to 1200 South
- Water – A water Main the entire length from 750 North to 1200 South. There is an additional line from 750 North to 500 North. There is also a crossing at every intersection from 750 North to 1200 South
- Storm drain – a trunk line from 750 North to 200 South, 600 South to 1200 South. There are also crossings at each intersection
- Power – An overhead transmission line runs from 700 North to 571 North. There are underground lines from 800 North to 570 North, and 300 North to 4000 South.
- Communication - Multiple lines run the entire length of Main Street from 800 North to 1200 South

Analysis and Findings

The following presents analysis findings.

Engineering Feasibility and Construction Risk. Tunnels of the length and operation needed for the project would be unusual in Utah. The longest modern tunnels in Utah are the Wildwood Tunnels in Provo Canyon. At 368 and 294 feet, these tunnels did not require the fire and life safety elements described above. In contrast, a tunnel to bypass Main Street would be about 7,900 feet, measured from only 1200 South to 500 North. The final design length would need to consider the portal location considering and, due to grade limitations, the relatively long transitions from the main stem of the tunnel to the surface. For conceptual planning proposes, UDOT should assume needing another approximately 1,000 feet (500 feet on each end) for the tunnel. See Figure 2.

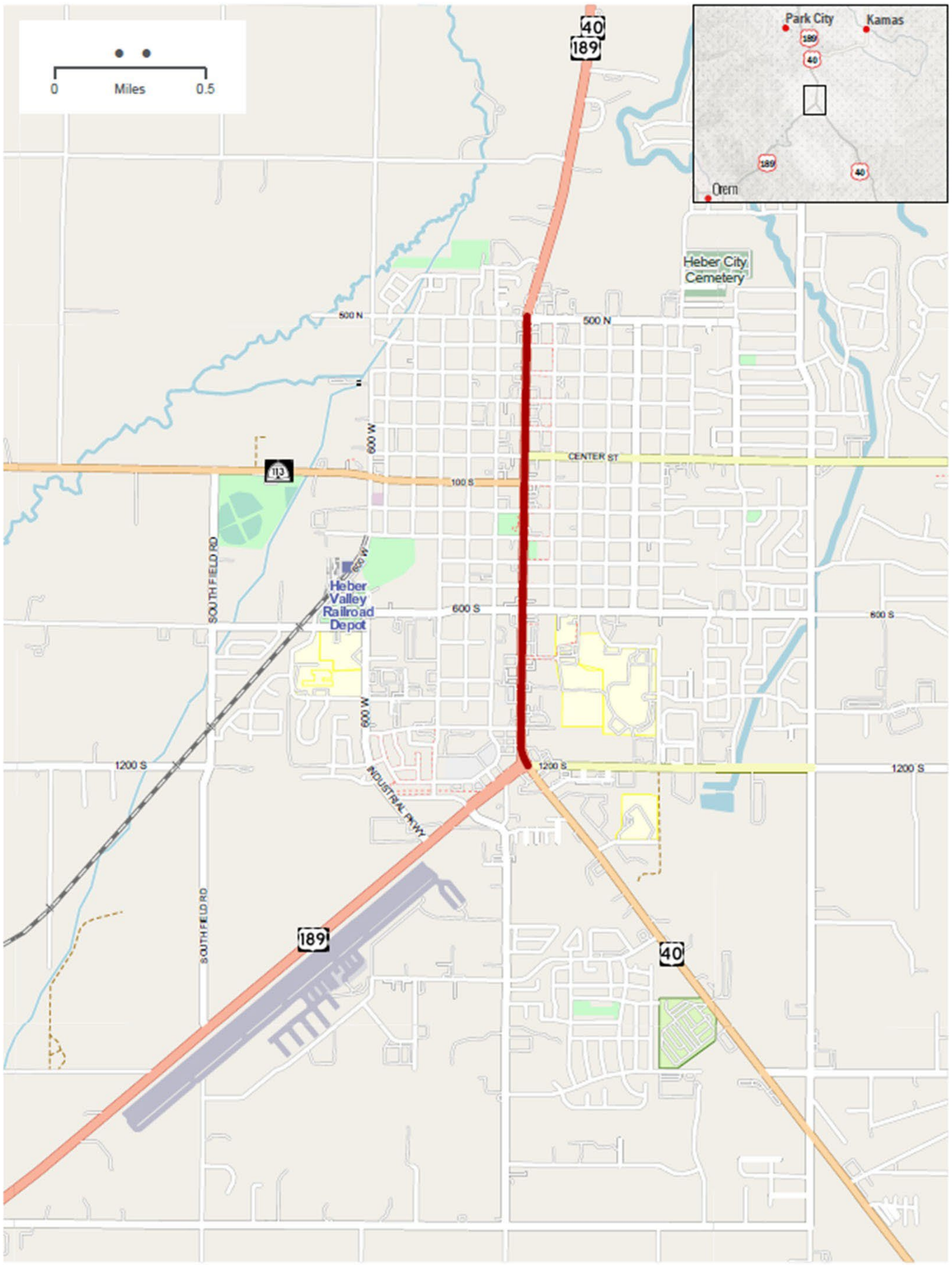


Figure 2. Approximate Tunnel Location

If the tunnel is ultimately about 8,900 feet (1.6 miles) long, it would be the fourth- or fifth-longest tunnel in the United States. Table 1 presents information from the National Tunnel Inventory regarding tunnel length and average annual daily traffic (AADT) for the 10 longest tunnels in the United States.[16]

Table 1. Ten Longest Existing Tunnels in the United States

Rank	Tunnel Name	State(s)	Approximate Length (feet)	Approximate AADT	Year AADT Measured
1	Anton Anderson Tunnel (Whittier Access)	AK	13,300	838	2018
2	Alaskan Way Viaduct	WA	12,200	45,100	2018
3	Hugh Carey Tunnel	NY	9,140	55,500	2016
4	Johnson/Eisenhower Tunnel	CO	8,900	37,000	2018
5	Holland Tunnel	NY/NJ	9,550	89,000	2019
6	Lincoln Tunnel	NY/NJ	8,200	108,000	2019
7	Baltimore Harbor Tunnel	VA	7,650	77,230	2016
8	Ft. McHenry Tunnel	MD	7,209	123,000	2016
9	Harano Tunnel	HI	6,340	47,400	2013
10	Queens Midtown Tunnel	NY	6,270	79,500	2016

Tunnel construction, even if technically feasible, presents a high-risk activity to both the schedule and budget. Engineering experience worldwide shows that tunnel construction generally requires making real-time adjustments to design and engineering specifications, since variations in the subsurface materials and groundwater conditions cannot be known with certainty until tunnel construction is underway. Such unknown conditions, as described below, frequently result in schedule delays and substantially increased costs.[17]

Economics. A tunnel would have a substantially higher capital cost compared to a surface road. Tunnels cost about $500 million to $600 million per mile to construct, at a minimum. The Alaskan Way Viaduct in Washington State costs about $1 billion per mile (in 2021 dollars[18]). In comparison, a surface highway would cost $50 million to $100 million per mile depending on the number of lanes, location (right-of-way costs and utilities), and number of structures. Assuming $500 million per mile and a tunnel that is about 1.7 miles long, a tunnel through Heber City would cost at least $850 million. For comparison, at $50 million per mile (the approximate cost of UDOT's West Davis Corridor highway), a surface road that is about 17 miles long, or combination of roads, could be constructed for the same cost as a 1.7-mile-long tunnel. An ordinary paved highway(s) that is about 10 times longer could be constructed for the same cost as a tunnel.

With the requirement for 24-hour monitoring, the operations and maintenance (O&M) cost for tunnels are much higher per lane mile than ordinary paved highways. Based on the cost for the Mt. Baker and Merced Island Tunnels in Washington, the O&M costs for an approximate 1.7-mile tunnel would be about $1,000,000 to $1,200,000, annually.[20]

---

[16] FHWA, National Tunnel Inventory dataset, updated 2020, accessed January 11, 2022

[17] Washington State Department of Transportation, I-90 Snoqualmie Pass East Project Final EIS, July 2008

[18] $780 million per mile in 2012 dollars inflated by an ENR Construction Index (1.34) to determine equivalent 2021 cost. Prices and indexes from the Natural Resources Conservation Service.

[20] Washington State Department of Transportation, I-90 Snoqualmie Pass East Project Final EIS, July 2008.

A tunnel for U.S. 40 would have an estimated AADT of about 16,000 vehicles, or about 35% of the total number of vehicles (45,000 vehicles) projected to travel along Main Street in 2050. As evidenced by Table 1, a much higher AADT is likely needed to justify the high cost of a tunnel. However, there are other reasons to construct tunnels. For example, the Anton Anderson (Whittier Access) tunnel in Whittier, Alaska, has a low AADT of only 883. However, this one-lane tunnel is the only vehicle access to Whittier from Alaska's road network. As another example, the Johnson/ Eisenhower Tunnel in Colorado, which is 11,000 feet in elevation, runs along Interstate 70, which is a major freight route from southern California ports. Although this tunnel's measured 2018 AADT of 37,000 vehicles is similar to 2050 projections for U.S. 40, the Johnson/Eisenhower Tunnel accommodates traffic as high as 52,000 vehicles per day today.[21] Without this tunnel, an additional 200 miles of interstate haul route length between Los Angeles and Denver would be required.

Whether drivers use a tunnel or remain on surface streets, the travel time savings for the main types of vehicles that would receive the greatest economic benefit—commercial vehicles—consist of a small fraction of the projected total 2050 traffic volumes. About 6% to 8% of the projected AADT consists of multi-unit trucks (primarily oil tankers), semitrucks, box trucks, and private work vehicles with trailers, which are the types of vehicles that frequently want to pass through the study area and not stop. (See the *Safety* section below for more information about why some of these truck types would be excluded.) Another 2% to 3% of trips are recreation-based; these individual vehicles also pass through the Heber Valley and pass through less frequently than residents of the area and commercial vehicles. The anticipated low economic benefit of improved travel times for a small number of private vehicles, which would make up 90% of the 16,000 total vehicles anticipated to use a tunnel (about 15,000 private vehicles per day which is 33% of total projected AADT of 45,000), is unlikely to offset the extremely high cost of constructing the tunnel and the negative economic impacts of construction to area businesses.

Safety. The project team coordinated with the UDOT Motor Carrier Division[22] and the Utah Trucking Association.[23] Both parties agree that hauling hazardous materials under Main Street would not be safe and that trucks hauling crude oil should not be allowed in a tunnel. This opinion is reinforced by the NFPA-required design fire, which for these types of cargo would have a heat release rate exceeding 100 megawatts. A fire of this intensity and resulting fumes can endanger the lives of all people in the tunnel. In addition, because ceiling temperatures within several hundred feet of the fire would approach 2,000 degrees Fahrenheit, such a fire could cause structural damage to the tunnel. For comparison, a fire from a bus or truck, which has a heat release rate of about 20 megawatts, would endanger lives due to the fire and toxic fumes but would likely not cause structural damage.[24,25]

Without the ability to use the tunnel, a considerable number of oil tanker trucks would continue to use the surface route on U.S. 40/Main Street through downtown Heber City (about 600 to 700 oil

---

21 Colorado Department of Transportation, Eisenhower/Johnson Memorial Tunnels High Counts

22 Kris Kesley, UDOT, email communication with Vern Keeslar, Parametrix, December 20, 2021

23 Rick Clasby, Executive Director of the Utah Trucking Association, email communication with Vern Keeslar, Parametrix, January 20, 2022

24 FHWA, *FHWA Report: Prevention and Control of Highway Tunnel Fires*, in TRB State-of-the-Art Report 3, *Recent Advances in Hazardous Materials Transportation Research: An International Exchange*, 1985

25 NFPA 502, Annex H

tanker trucks per day were observed in 2020). These findings call into question the reasonableness of using a tunnel to satisfy the project's purpose and need. A key reason for the project, as expressed in public comments and adopted plans, is to move heavy truck traffic off Main Street (in particular, trucks hauling heavy crude oil from the Uinta Basin). The Heber City *Envision 2050 General Plan* identifies oil tanker trucks as an impediment to meeting the City's vision for the historic town center.

> *The traditional feel of Heber's Main Street has been disrupted by increases in traffic volume and especially by the impact of oil tanker trucks. It is difficult to hear conversations while trying to enjoy restaurants and gathering areas along the street, and pedestrian crossings feel unsafe due to traffic and wide street width. (p. 36)*
>
> *When a western bypass route is finalized and constructed, Main Street will see a significant reduction in large trucks and a reduction in vehicle traffic. A western bypass, where UDOT responsibility is shifted from Main Street to the new bypass, creates opportunities for Main Street to become a destination for business to grow and for placemaking to foster a pleasant street atmosphere. (p. 62)*

Based on this research, it appears that a tunnel would not support Heber City's vision for the historic town center, which is part of the project's purpose and need.

Community Disruptions. Construction of a tunnel, which would last at least 2 years, would create substantial community disruptions. There are two possible approaches for cut-and-cover tunnel construction: 1) close Main Street entirely and construct the entire tunnel, both tubes, at one time, or 2) shift the traffic to one side of the road, construct one tunnel tube and then transition and construct the second tube. Either way, there would be a massive surface disruption for two years or longer. All utilities would need to be moved or supported in place. Groundwater inflow would need to be managed and could drive up costs. Area businesses, that are not relocated would likely suffer severe economic impacts from access disruptions as well as the dust and noise generated by the construction zone. People might simply shop and dine elsewhere and there is risk that adjacent businesses go out of business. Therefore, the risk of litigation is amplified for a tunnel.

In addition, there would be a high risk of utility interruptions to the broader community from shutting down and then having to reconnect the high number of relocated utilities. The biggest challenge for open cut would be dealing with the sanitary sewer. For gravity flow systems like the sanitary sewer (and Lake Creek, canals, and storm drains) the impacts could extend well past the limits of the tunnel. A new hydraulic grade could be required or, if the utility is relocated below the tunnel, constructing a pump station(s) or lift station(s) would be needed to reconnect to the facility downstream of the tunnel.

Environmental – Water Resources. There is shallow groundwater in the northern portion of the study area. Figure 3 shows the near-surface groundwater conditions in the study area. As shown in Figure 3, the area abutting U.S. 40 (Main Street) generally north of Center Street has groundwater that is <u>less than 3 feet deep</u>.[26] This shallow groundwater appears to reach the surface and is a hydraulic source to Rock Creek, Spring Creek, and several freshwater emergent wetlands in this

[26] Mike Lowe and Matthew D. Butler, *Ground-water Sensitivity and Vulnerability to Pesticides, Heber and Round Valleys, Wasatch County, Utah*, 2003

area. See Attachment 1, which contains an overview map of recently delineated Aquatic Resources.[27]

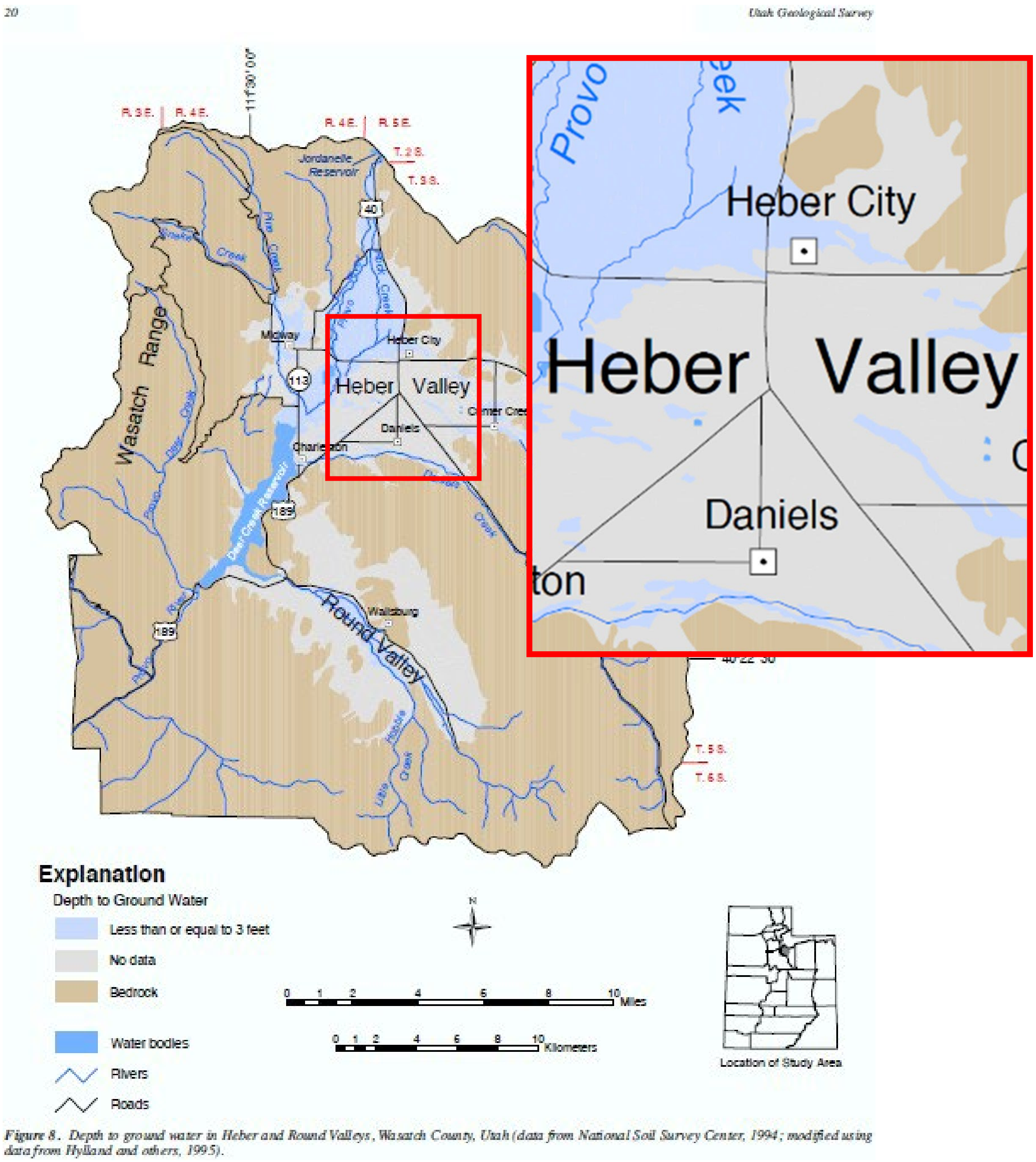


Figure 3. Groundwater Conditions in the Heber Valley

[27] Aquatic Resources Delineation Report, Heber Valley Corridor, EIS. HDR, January 18, 2022

In the study area, groundwater generally moves from bedrock areas toward the Provo River. A tunnel could create a conduit for conveying shallow groundwater, potentially lowering the water table and removing a water source to area wetlands and other waters of the United States. A detailed hydrogeologic study would be needed to definitively describe the groundwater flow conditions. Nevertheless, there are risks of impacts to jurisdictional waters that extend beyond the immediate limits of excavation, or tunnel bore, and to resources that are spatially removed from the project footprint.

Environmental – Water Quality. Shallow groundwater presents additional construction-related concerns and groundwater management can be a significant factor on construction duration and costs. Contractors would need to find a location to discharge groundwater that infiltrates the tunnel excavation or tunnel bore. Discharge could be to a surface water, sanitary sewer, or land applied. Both the quantity and quality of discharged water would dictate feasible disposal methods and the need for pre-treatment. Because water supplies come mainly from a deep principal aquifer, little information exists on the quality of the shallow groundwater.[28] Because of the agricultural history of the area, pollutants of concern include nutrients (phosphorous and nitrogen), pesticides, herbicides, as well as anthropogenic markers (personal care products, pharmaceuticals, and bacteria) from septic systems. Due to the sensitive nature of the surface waters, including the Provo River, the need for treatment prior to discharge should be assumed and the resulting additional costs considered.

Environmental – Cultural Resources. In addition to the potential for direct impacts to cultural resources, tunnel construction has a higher potential to affect resources a distance away from the footprint. Tunnel construction requires prolonged, intensive ground-disturbing activities such as demolitions, deep excavations, material hauling, compaction, drilling, pile driving, and blasting. These activities cause vibrations that could affect the integrity of adjacent structures. Also particularly important would be the prompt installation of shoring to prevent the excavation from collapsing and to control the infiltration of groundwater. Disruptions to shallow groundwater can cause settlement in the area adjacent to the excavation and also affect the integrity of sensitive structures.

Part of the project's purpose and need is to allow Heber City to meet their vision for the historic town center. There are numerous historic properties immediately adjacent to Main Street. Based on a desktop inventory, there are 12 eligible/significant buildings, 16 eligible/contributing buildings, and 36 buildings that are within the historic period but have not yet been evaluated for eligibility. See Attachment 2 for the distribution of historic buildings.[29] These properties could be impacted by construction through vibration or changes to hydrostatic pressure which could create settlement, thereby affecting foundations or crack walls. Adverse effects to historic buildings within the historic town center are inconsistent with the purpose and need.

---

[28] *Characterization of Groundwater Quality in Wasatch County, Utah, with Recommendations for Septic System Development Regulations*, SWCA, September 2020

[29] From Memorandum Re: Cultural Resources Scoping for Heber Valley Parkway Project, Certus Environmental Solutions, July 2020.

Vibrations are often measured as peak particle velocity (PPV). Damage criteria range from PPVs of about 0.5 inch per second for reinforced concrete, steel, or timber structures to about 0.2 inch per second for nonengineered buildings. A PPV of about 0.1 inch per second is the threshold that can cause damage to sensitive historic structures.[30] Large bulldozers, loaded trucks, pile driving, and vibratory compactors can all generate vibrations well over 0.1 inch per second PPV. The ground will dampen, or attenuate, vibration energy as the energy moves away from the vibration source. The rate of damping depends on the frequency of the vibration (hertz), soil types, and composition. On the other hand, steady-state operations from multiple sources can amplify vibrations and increase PPV at distance.

Therefore, in order to estimate the risks to sensitive structures, a detailed quantitative assessment would be needed to characterize each structure, the soil condition and its damping effects, the construction equipment anticipated to be used, and the location of the sensitive structures in relation to the specific-construction equipment. However, considering the potential disruptions to shallow groundwater and vibration impacts, the structural integrity of some structures could be at risk. UDOT should anticipate the need to characterize the structural makeup of these historic buildings, identify at risk historic sites, and then monitor for vibrations that approach threshold values. Construction could then be adjusted if specific activities, or a combination of activities in different locations, are generating excessive vibrations. Construction costs and schedule could be affected by variations in the planned construction means and methods.

Recommendations

Placing a roadway in a tunnel does not constitute a practical or reasonable alternative to a standard surface roadway for the Heber Valley EIS. As mentioned above, Heber City's vision for Main Street is for Main Street to become the heart of the community and this is an important part of the project's Purpose and Need. Because oil tanker trucks would be excluded from the tunnel, these vehicle types would continue to use Main Street through Heber City, which is inconsistent with the purpose and need to allow Heber City to meet their vision for the historic town center. An alternative that does not meet the purpose and need is, by definition, unreasonable, and can be eliminated.

A tunnel is not a reasonable alternative from an economic standpoint. Transportation facilities in this semi-urban environment cost between $50M to $100M per mile. When a roadway is driven underground, substantial cost increases of between 10 to 20 times the cost of a normal surface roadway can be expected. This difference is due to the overall increase in construction intensity and complexity and the need to relocate utilities. A roadway cost of between $500M to $1B would be substantially higher and is not practical from a NEPA standpoint.

Considering the expected low AADT in 2050 (16,000 vehicles), a low-end rough-order-of-magnitude total cost of $850M is an unreasonable expenditure of public funds. Compared to similar tunnels in the US, the low expected AADT and low, theoretical, economic benefit of travel times savings would likely not justify or compensate for the high cost of tunnel construction and the cost of community

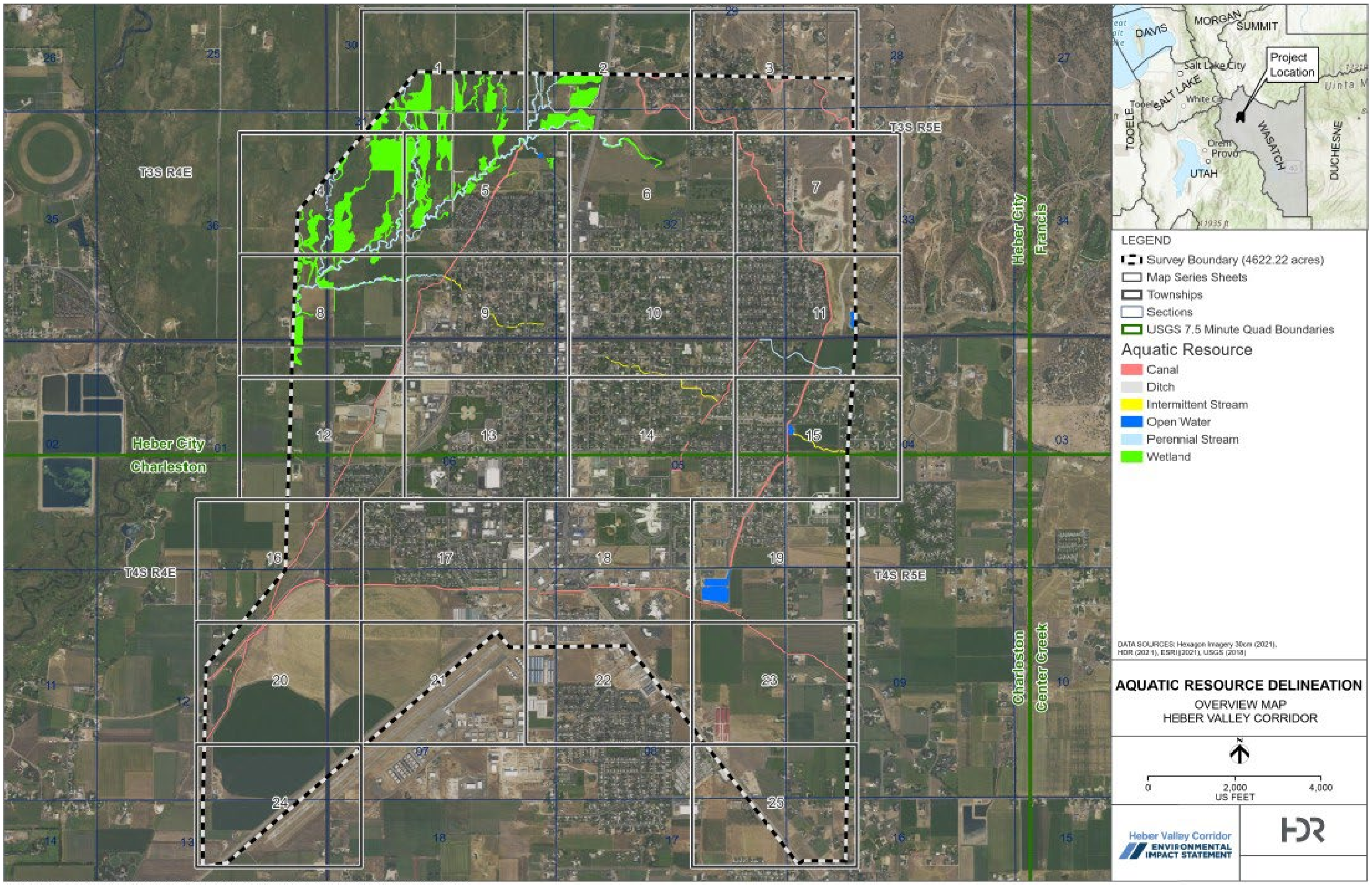
[30] Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Manual*, September 2018

disruptions. Therefore, it is doubtful the project would ever be built if required to be placed in a tunnel below Main Street.

Constructing a tunnel could introduce impacts that are spatially removed from the project footprint. A tunnel could create a barrier to groundwater movement and/or a conduit to convey groundwater resulting in a lowering of shallow groundwater levels, which are less than 3 feet deep in the northern portion of the study area, and impact to adjacent surface water resources. In addition, historic structures could be at risk of damage from construction vibrations and from settlement due to changes in hydrostatic pressures from shallow groundwater infiltration. Adverse impacts of a tunnel to historic properties and as well as the adverse social impacts to area businesses are possible.

Substantially higher construction, annual O&M costs, and significant social costs during construction would likely not be offset by any economic benefits to travel time savings for the low expected use (measured as AADT). There are serious doubts on whether the project would be constructed if the road was forced below ground. Adverse environmental impacts to historic properties and aquatic resources are not completely avoided with a tunnel. Therefore, due to the totality of the circumstances, a tunnel is not a feasible, reasonable, prudent, or practical alternative.

Attachment 1 – Aquatic Resources



Attachment 2 – Historic Buildings

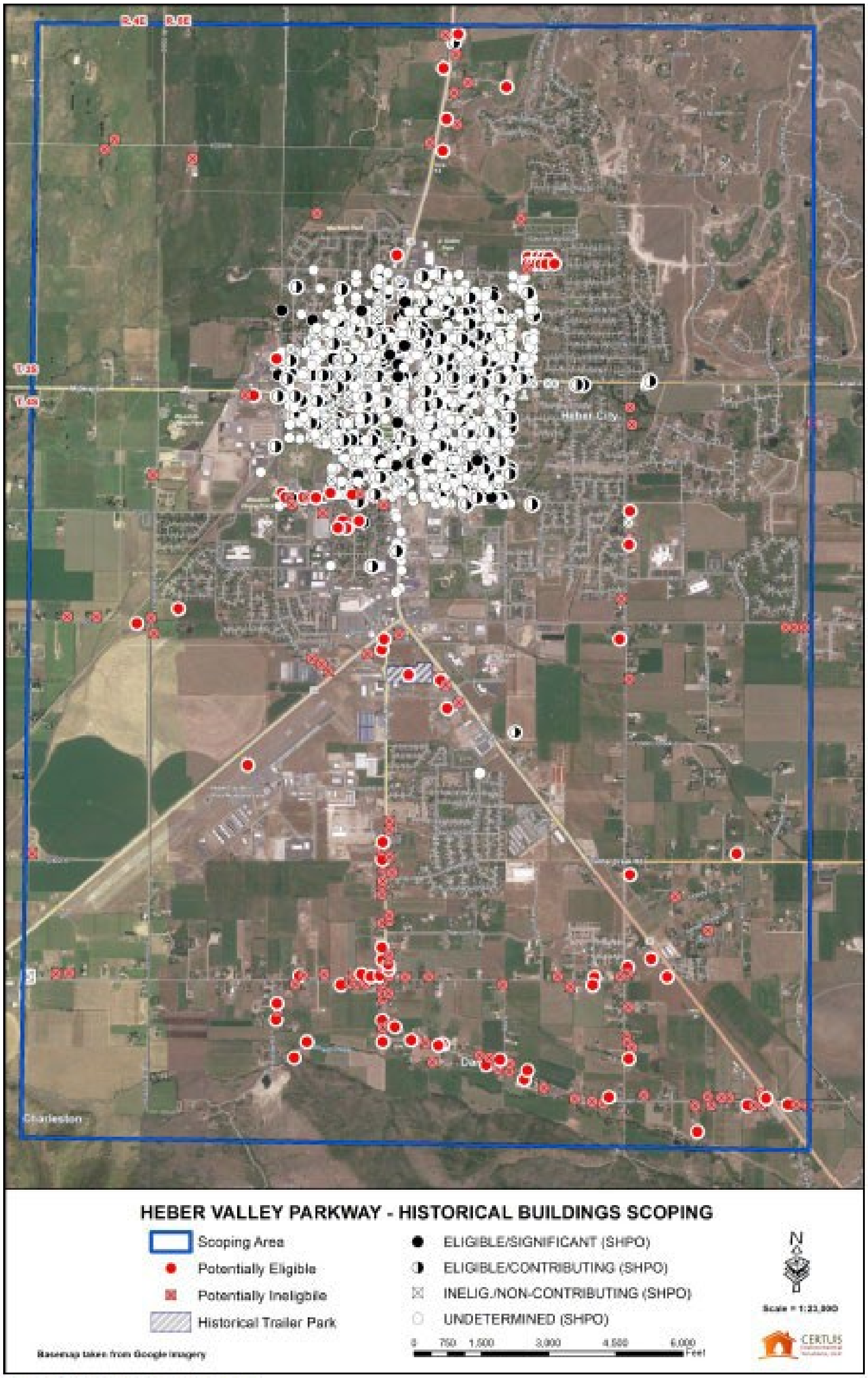


Figure 2. Historical buildings scoping results