GRANTSVILLE

CITY COUNCIL

September 27th, 2023

City Council and Planning Commission Work Meeting

Information Packet

AGENDA ITEM #1

Legislative Update

AGENDA ITEM #2

Discussion regarding West Bank Study updates

GRANTSVILLE
INCORPORATED 1867

WEST BANK & NORTHWEST AREA MASTER DEVELOPMENT PLAN & CAPITAL FACILITIES PLAN



PSOMAS

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DRAFT - JUNE 2023

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Survey and Public Engagement Participants

Thank you to all the residents, workers, property owners, and employers that participated with the interviews, interactive map, and surveys. We appreciate the feedback and have incorporated it into all aspects of this project.

01

EXISTING CONDITIONS

"I like that it's a small community, yet you have access to almost every store you could possibly need "

- SURVEY PARTICIPANT

Executive Summary

The purpose of the West Bank and North West Area Master Plan and Capital Facilities Plan is to establish a community vision and sustainable plan for the future growth of the City in this study area. The development time horizon of this plan is greater than 30 years for full build-out of the study area. This time horizon is based on the data gathered for the Grantsville General Plan, Tooele County 2022 General Plan and the Kem C. Gardner Population Projections for Tooele County as a whole [*gardner.utah.edu/demographics/population-projections/*].

This document is organized into six sections which help the City, its residents, and the development community better understand the process and inputs used to craft this plan. These sections include Existing Conditions, Master Development Plan Process, Alternative Options, Community Engagement, Preferred Plan, and Capital Facilities Plan.

Throughout the process of this Master Development (MDP) and Capital Facilities Plan (CFP) it became apparent that the prevailing sentiment of the various community stakeholders was to preserve and enhance the historic culture, open space, and natural resources of Grantsville, while establishing a guiding development pattern which maintains the character of the City. This study area incorporates approximately 10,600 acres west of SR-138 and Mormon Trail and area north of Vegas Street. The emphasis of this plan was to create a cohesive development pattern for future growth to follow, establishing a sustainable path forward. Land use and transportation patterns were created by focusing on the public feedback received, sustainable best practices, UDOT and UTA plans, and the City's updated Transportation Master Plan.

This MDP reviews existing conditions and studies and analyzes that information with collected data from public engagement and other sources to establish community-centric sustainable growth practices. Best practices and emerging trends are also outlined in the Preferred Plan section.

Existing Plans & Codes

Several City studies and documents have been completed that impact this area of Grantsville. The project team reviewed a variety of these studies and other data to further understand the vision, needs, and desires of City residents. Those existing studies and plans for the focus area were reviewed and synthesized as follows:

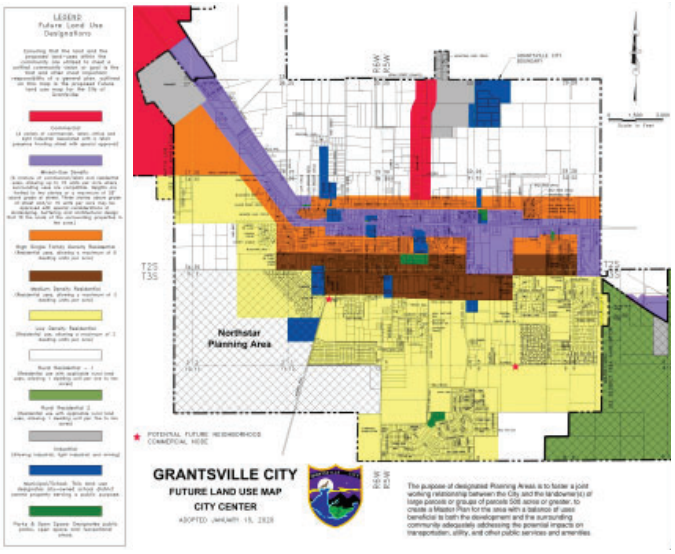
Grantsville General Plan (2019)

The Grantsville General Plan update was completed in 2019. The plan focuses on the land use, community design, economic development, transportation, housing, recreation and open space, and infrastructure and public facilities elements and its guiding vision is for Grantsville to be "a community that preserves values and provides an improved quality of life for residents." The core values of the plan are:

- Retain the feel and atmosphere of a small community
- Offer an increased quality of life for residents, regardless of age or socioeconomic status
- Attract and retain necessary amenities or services to encourage residents to shop locally
- Support development of the local tax base
- Provide affordable housing options that meet local needs and local socioeconomic characteristics for residents
- Support business development for local employment opportunities.

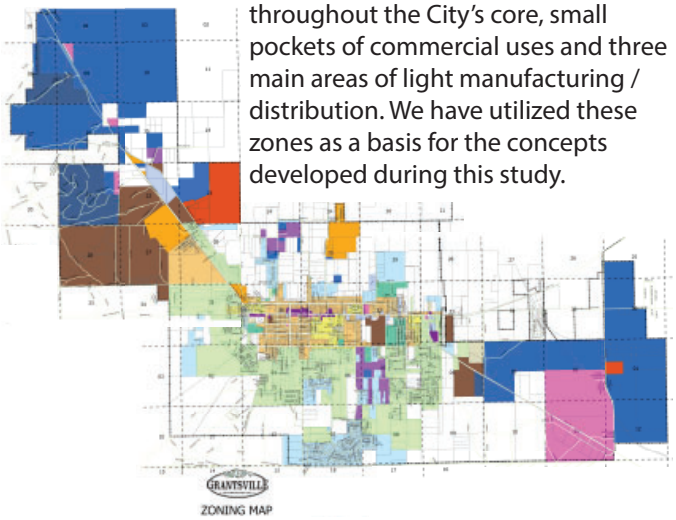
Grantsville City Future Land Use Map (2020)

The existing future land use map shows a band of mixed-use development along Main Street and SR-138 with bands of high (6 dwelling units / acre), medium (3 dwelling units / acre), and low density residential (2 dwelling units / acre) decreasing in intensity as it move out from the mixed-use designation. There is a commercial band along Burmester Rd and a large area of commercial north and west of the Walmart distribution center. See the map below for more detail.



Grantsville Zoning Map

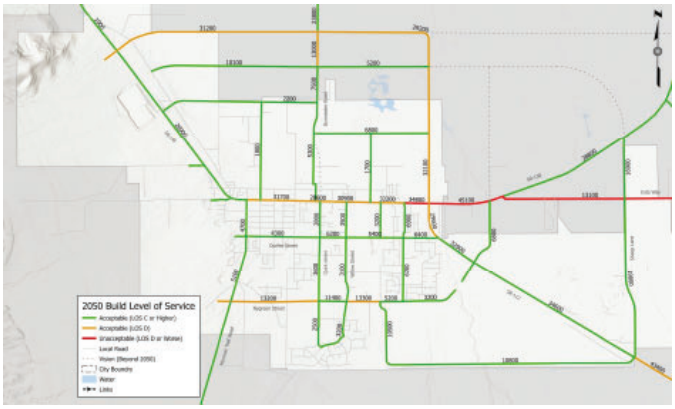
The Zoning Map adds increased detail to the various land uses, with significant areas of general manufacturing on the north and east of the City, a range of residential uses throughout the City's core, small pockets of commercial uses and three main areas of light manufacturing / distribution. We have utilized these zones as a basis for the concepts developed during this study.



Grantsville Transportation Master Plan (TMP)

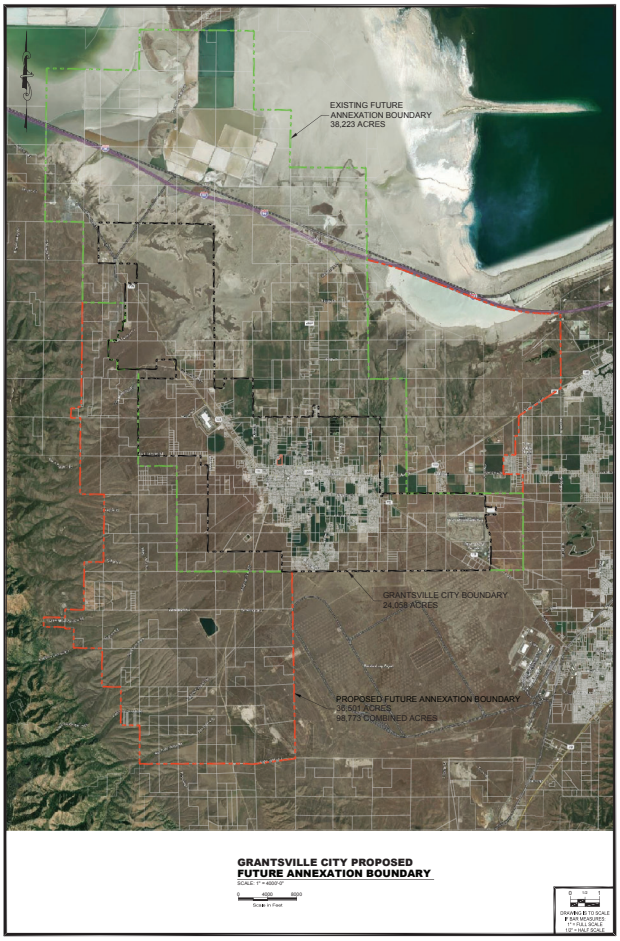
The TMP analyzes the existing transportation network and conditions, with itemized deficiencies in the existing network. It also establishes a proposed future transportation network to accommodate the potential for doubling the Grantsville City population by 2060. One of the major concerns is traffic on Main Street in Grantsville and alternative ways to circulate traffic without adding burden to the existing network. The figure below show the future "Build Level of Service" indicating larger circulator with increased capacity outside of the City core.

Figure 17: 2050 Build Level of Service



Grantsville Future Annexation Expansion Map

The annexation map shows a proposed future annexation combined boundary of 98,773 acres. The City's existing boundary is 24,058 Acres. Approximately 40% of this study is within the existing Grantsville City boundary with the remaining portion in the proposed future annexation boundary.



02
MASTER DEVELOP PLAN PROCESS

"Keep Grantsville the rural community that it is."

- SURVEY PARTICIPANT

Introduction & Background

Grantsville City is historically a rural agricultural community with a great quality of life. As the City's General Plan states, it "is known for providing a community comprised of open space, convenient access to the natural environment and a strong sense of community." This small town character and feel of the City is what makes it so special, and a place where residents want to live. The public feedback received for this study confirmed the City's desire to keep a small town feeling alive. Great places like Grantsville inevitably retain and attract more residents, and with that comes more development. A productive mindset for the community then, is not to debate whether growth should occur, but rather where and how growth should occur. Creating a cohesive plan for the "where and how" development will occur provides a far more desirable outcome than if left up to individual property owners alone.

One of the key concerns from the City staff and elected officials was that there was no established vision for the study area. Development projects were being submitted without a clear plan for how the overall development should occur. In order to hold the development community to a standard, a standard must first be set and approved by City Council to have any ability of being enforced. Transportation connections, open space, agricultural preservation, and other elements were reactionary to development plans that were being submitted. In response, the City prepared a request for proposals to craft a master development and capital facilities plan for this area given a longer-term development time horizon.

Project Process Overview

This project has been sectioned into five major phases which are: kick-off and existing conditions, public visioning process, alternatives analysis, preferred scenario, and public hearings. These phases help the City, its residents, property owners, stakeholders, and the project team work together to best understand the needs of the community in terms of culture, vision, development potential, fiscal and infrastructure needs, and best practices for rural sustainable development.

Kick-Off & Existing Conditions

The process for this project began with meetings with elected officials and City staff to better understand some of the opportunities, constraints, and vision for the project area. In addition to this meeting, stakeholder interviews were held to further detail this vision. An initial analysis was then conducted for the projected study area land use absorption rates (or the yearly rate at which certain land uses could be developed given internal and external market conditions).

Following this, the project team compiled and analyzed relevant plans, existing and approved development, City Code, existing zoning and future land use maps, UDOT roadway plans, utility and infrastructure files, aerial photography, demographics, property ownership, existing land uses, sensitive land, and topography to better understand the opportunities and constraints provided in the kick-off and stakeholder interview meetings information.



Alternatives Analysis

Based on the findings and vision established in the first phase, three concept scenarios were developed. These were established without major distinction for open space, schools, or other civic uses to better focus on the right street network and mix of land uses. These were submitted to the steering committee for review, then public feedback was gathered in reference to the alternatives.

Public Visioning

During this phase of the Plan, we gathered input on how the various stakeholders (including residents, staff, elected officials, property owners, and businesses) would like the area to develop, what they would like to see happen, and any other feedback. This incorporated the opportunity to see potential development scenarios and leave specific feedback for what is desired for this area.



Preferred Scenario & Capital Facilities Plan

Portions of each of the three scenarios were selected by the public and steering committee, and a preferred scenario was then developed with a supportive Capital Facilities Plan. The Capital Facilities Plan shows the infrastructure needs based on the preferred scenario.

Public Hearings

Public hearings were held for the Planning Commission and City Council to consider official adoption of the Master Development Plan and Capital Facilities Plan.

Preliminary Concepts

The most fundamental decisions in crafting a master development plan (MDP) begin with land use, or in other words, what to put where. Land use planning envisions the future of an area and interacts with the transportation, demographics, economic vitality, and community character. The purpose of a MDP is to reflect a community's vision and promote thoughtful, equitable, and accessible distribution of different land uses, including residential, commercial, office, industrial/manufacturing, agricultural, and open space. The MDP is a tool that can address issues and concerns specific to its location and resolve those while preventing future issues.

Preliminary Concept Land Use Designations

There were 10 land use designations utilized for these preliminary concepts and an eleventh category for growth boundary. Growth boundaries are typically set to help control development over a certain period of time. These boundaries delineate where growth can and can not occur, thus preserving area outside of the boundary to remain in a natural or agricultural state. The 10 land use designation are described below with their equivalent zoning distinctions:

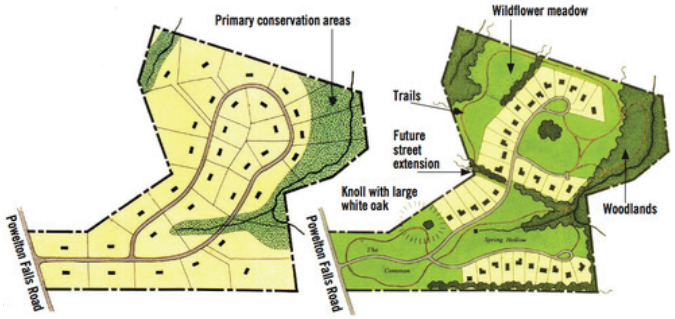
- **Commercial –** This land use is restricted for a range of commercial uses and includes the following Grantsville City Zones: CN, CS, CG, CD, and MU*
- **Mixed-Use –** This land use is featured in concept 1 of the alternative scenarios only, and is meant to contain an integrated mix of commercial, office, and residential uses. If a development clearly distinguishes uses with little to no integration, this land use designation should not be utilized. The mixed-use land use corresponds with a range of City Zones: R-1-12, R-1-8, RM-7, RM-15, CN, CS, CG, CD, and MU
- **Office –** The office land use is restricted for professional offices varying in size, height, and trade. The Grantsville Zones associated with this use are: CS*, CG*, CD*, MD*, & MG*
- **High Intensity Residential –** The high intensity residential land use is reserved for locations supporting commercial, office, and mixed-use areas. It helps satisfy the state requirements for moderate income housing and typically takes the form of smaller lot detached or attached housing product types. The land use corresponds with the following Grantsville City Zones: RM-7** and RM-15**

(*Dedicated for the land uses' primary restricted use.
(**Zoning shall be designated by the City Council based on the project's designated land use and development context at the time of submittal.)

- **Medium Intensity Residential –** The medium intensity residential land use is typically used to support commercial, office, and manufacturing land uses as well as buffer high and low intensity residential land uses. Residential product types typically come in the form of medium to small lot detached and larger attached units (ex. duplexes, triplexes, and fourplexes). This land use category relates to City Zones: R-1-12**, R-1-8**, and RM-7**
- **Low-Intensity Residential –** Low intensity residential is reserved for medium to large lot detached units, and is used to buffer medium and very low intensity residential uses, manufacturing, and existing lower intensity residential development. The corresponding zones are: R-1-21**, R-1-12**, and R-1-8**



- **Very Low-Intensity Residential –** Very low intensity residential is typically used to buffer the growth boundary and in hillside areas with larger slopes. It may also be used in agricultural areas to preserve larger farmable areas. In these cases, residential units should be clustered to help with efficiency of the land utilized for farming purposes. The related Grantsville City Zones are: A-10, RR-5**, RR-2.5**, RR-1**, R-1-21**
- **Open Space –** The open space land use is restricted for active and passive recreational and farming purposes. Regional parks, trails, agricultural ground, and sensitive land areas all fall within this land use. Although, there is no existing zone that aligns perfectly for the recreational use, the SA* and A-10* zones may be used.
- **Agriculture –** Agricultural land uses are important for the preservation of the character of Grantsville. The existing Grantsville zone is A-10. Although, this land use is found sparingly in the preferred scenario plan additional agricultural area could be designated through a number of preservation methods. These methods include:
    - **Land Use Regulation –** Land use regulation is often utilized to preserve lands for near- and medium-terms and has the ability to grow and adapt to the ongoing changing environment. Often this is only utilized as a temporary solution.
    - **Conservation Subdivision / Cluster Development** – Conservation subdivisions encourage clustered housing and other development while preserving the majority of the remainder of the "developed" land as open space under a conservation easements. (Ex. On a five-acre parcel you could develop five one-acre lots with no public open space; five half-acre lots, eight third-acre lots, or 10 quarter-acre lots with approximately 2.5 acres of conserved land each.)



    - **Conservation & Farmland Preservation Easements** – Are voluntary legal (easement) agreements that permanently limit the use of land for agricultural and open space purposes. These must be entered into by the land owner and the legal governing body.
    - **Agriculture Conservation Easement Purchase Program (ACEP)** – This federal program provides funding to help protect sensitive lands, working farms, and ranches through conservation easements.
    - **Greenbelts, Greenways, & Green Wedges** – Are sections of undeveloped land which encircles cities, townships, or major areas of development. They are typically used as growth boundaries and also serve the residents by providing large natural open spaces within close proximity. (Stansbury Park currently maintains a Greenbelt Service Area.)



- **Transfer of Development Rights (TDR) Program –** TDR programs limit development in key locations transferring that potential development to other targeted locations where development is more appropriate. Once the development rights have been transferred that land is placed under a conservation easement. Development potential is not reduced only transferred.



- **TDR Bank –** Allows for a municipality to control the transfer of development by purchasing the development rights and reallocating them when and where they desire. The TDR bank typically is created in tandem with a TDR program.
- **Private Land Trusts and Easements** – A land trust is a legal entity formed by an individual or group to purchase and manage property for the intent of preserving the land for a particular use. That use may be recreation, agricultural, or to buffer from other development.
  - **Utah Open Lands Program** – The Utah Open Lands program is a land trust designed to permanently protect land in Utah, by acquiring the title or trust of a conservation easement. They maintain stewardship of these properties for public use.
  - **Bureau of Land Management (BLM)**– Their "mission is to sustain the health, diversity, and productivity of public lands for the use and enjoyment of present and future generations." BLM owns thousands of acres within Tooele County.
  - **United States Forest Service (USFS)** – Is a federal agency that owns and maintains national forests, grasslands, and mountain range land. USFS owns over 67,000 acres in west of Grantsville.
- **Flex-Use/Manufacturing** – Flex Uses consist of light and general manufacturing, research, and distribution uses. This land use is typically paired with major roadways as larger volumes of truck traffic can be present. Corresponding Zoning designations are MD, MG, and MG-EX.



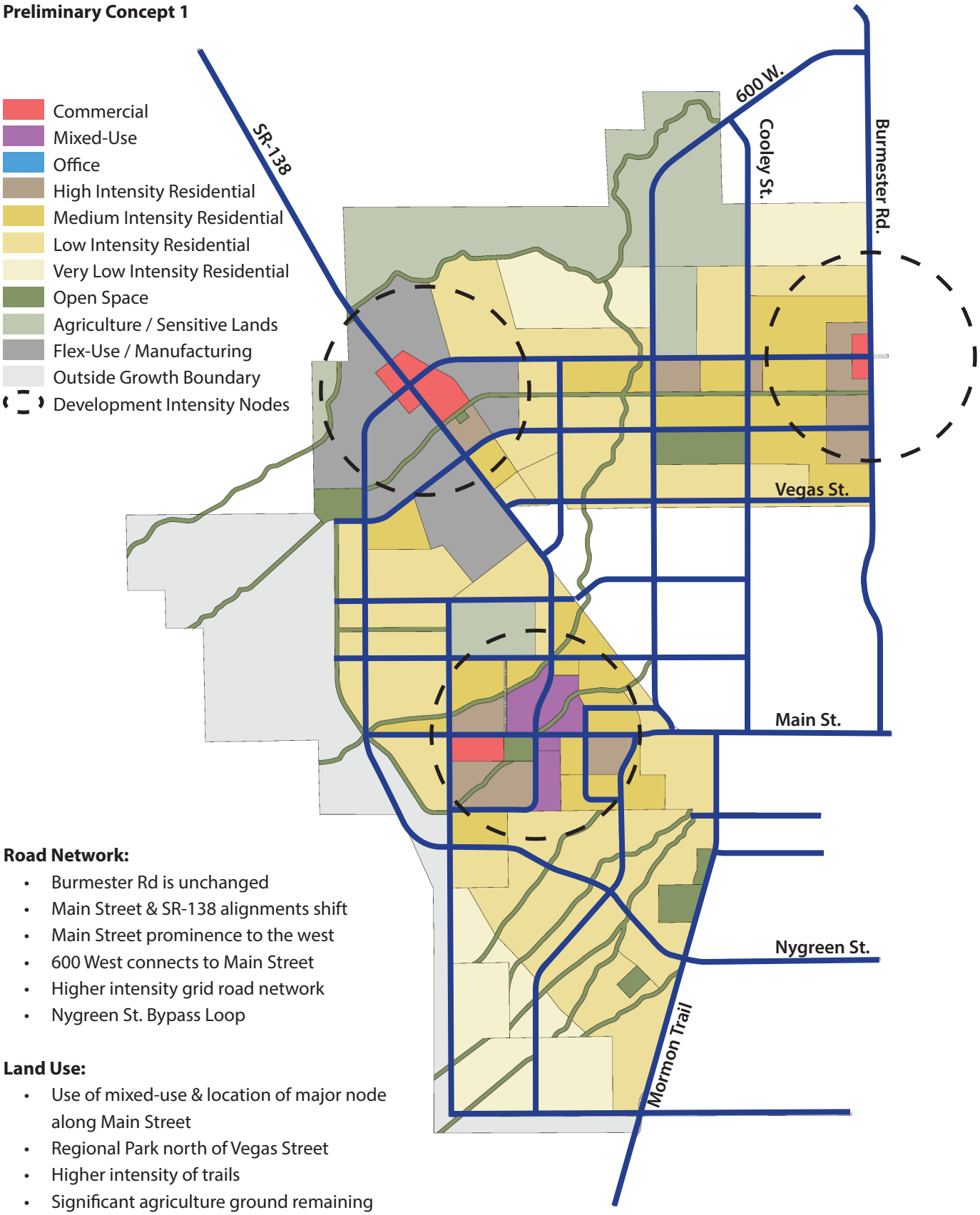
(*Dedicated for the land uses' primary restricted use.
(**Zoning shall be designated by the City Council based on the project's designated land use and development context at the time of submittal.)

Preliminary Concepts

The following pages contain the preliminary concepts for the West Bank and North West Area. These concepts focused on a range of transportation networks, and land use scenarios that would balance the long-term development and financial needs and vision of the city with the projected growth of Grantsville. Each concept took a unique approach to major nodes, land use distribution, transportation connections and network, and distribution of residential intensities.



Preliminary Concept 1



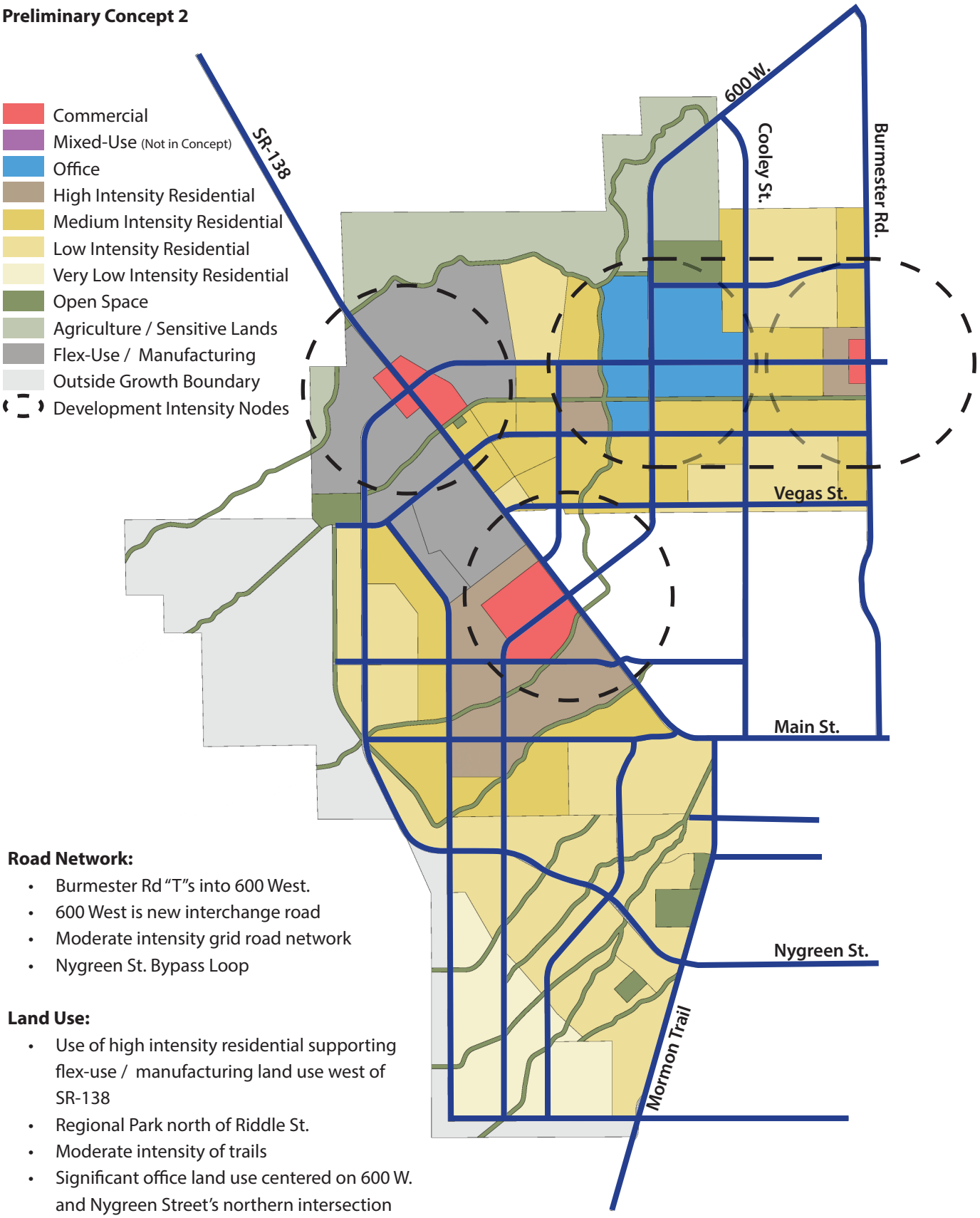
Road Network:

- Burmester Rd is unchanged
- Main Street & SR-138 alignments shift
- Main Street prominence to the west
- 600 West connects to Main Street
- Higher intensity grid road network
- Nygreen St. Bypass Loop

Land Use:

- Use of mixed-use & location of major node along Main Street
- Regional Park north of Vegas Street
- Higher intensity of trails
- Significant agriculture ground remaining
- Higher intensity node along Burmester Rd.

Preliminary Concept 2



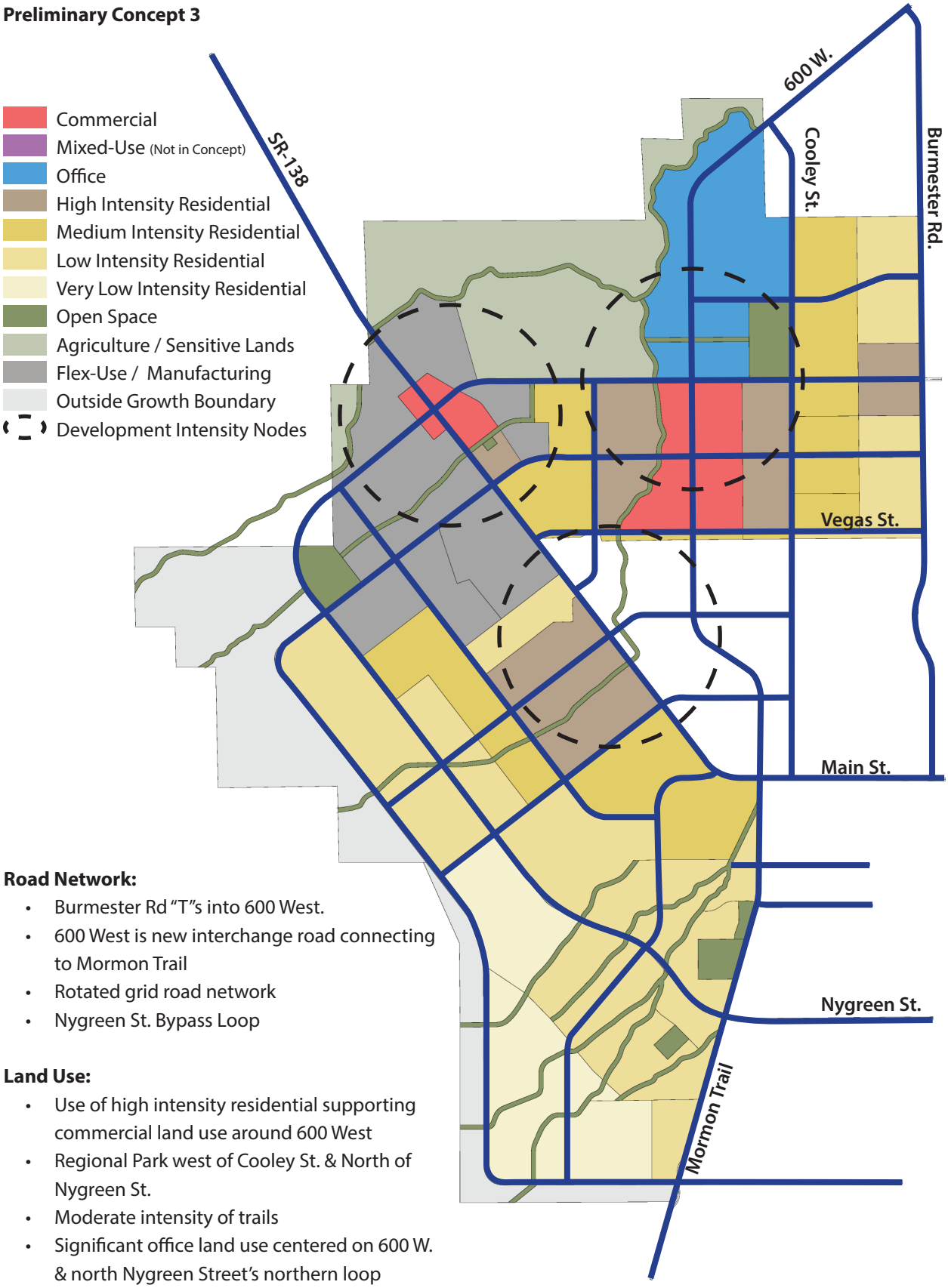
Road Network:

- Burmester Rd "T"s into 600 West.
- 600 West is new interchange road
- Moderate intensity grid road network
- Nygreen St. Bypass Loop

Land Use:

- Use of high intensity residential supporting flex-use / manufacturing land use west of SR-138
- Regional Park north of Riddle St.
- Moderate intensity of trails
- Significant office land use centered on 600 W. and Nygreen Street's northern intersection
- More low intensity residential

Preliminary Concept 3



Road Network:

- Burmester Rd "T"s into 600 West.
- 600 West is new interchange road connecting to Mormon Trail
- Rotated grid road network
- Nygreen St. Bypass Loop

Land Use:

- Use of high intensity residential supporting commercial land use around 600 West
- Regional Park west of Cooley St. & North of Nygreen St.
- Moderate intensity of trails
- Significant office land use centered on 600 W. & north Nygreen Street's northern loop
- More high and very low intensity residential

Land Use Model

Land use models are simplifications of existing and future built environment conditions. They take into consideration a wide range of uses and needs based on the current and projected population and that population's distribution. The purpose of these models is to establish metrics for the feasible makeup of land uses. These models do not dictate where land uses go but rather how much should be included based on market data in the study area and similar locations.

The model utilized for this development takes into account a number of inputs from existing Grantsville conditions and similar rural communities as well as larger communities which have transitioned from a more rural nature. Among these inputs are current and projected distribution and needs of parks, open spaces, and trails; retail, office, industrial and other employment uses, schools, churches, and other civic uses; and roads, utilities, and other city facilities.

To correctly calibrate this model to Grantsville, a vision first needed to be established. This was completed during the public engagement and existing conditions review portions of the project. As previously stated many residents wanted to keep the rural character of the City, but add specific elements which increased the quality of life and access to amenities and services. Given this vision, a baseline density was established to guide the model and create a max population.

LAND USE MODEL - MAX RESIDENTS INPUTS

TYPE	EXISTING	FUTURE
Study Area Acreage	10,635	10,635
Grantsville Dwellings / Acre	1.5 - 3.9	2.5*
Residents / Dwelling	3.7	3.5**
POPULATION	**14,209*** **	**93,056**** **

* - Current Average Dwellings / Acre in Grantsville
** - Projected Residents / Dwelling at Full Build-Out (2089+ assuming 400 permits issued / year - based on Grantsville & 10 similar rural communities.)
*** - Number based on 2020 U.S. Census, Kem C. Gardner 2017-2021 Population Projections: *gardner.utah.edu/wp-content/uploads/HousingUnits-FS-May2022.pdf?x71849*. U.S. Grantsville 2020 Census Population - 12,617; Kem C. Gardner Estimated Population 2017 - 11,000 | 2018 - 11,568 | 2019 - 12,064 | 2020 - 12,617 | 2021 - 13,574; Population change over last 5 years - 4.68%. (Grantsville 2022 population = 13,574 x 1.0468 = 14,209)
**** - Projected Population for Study Area at Full Build-Out = 10,635 x 2.5 x 3.5.

With the max population established, specific acreages for commercial, office, residential, flex use, manufacturing, and civic uses could be established. These were again calculated based on existing conditions for Grantsville and similar communities, market data, and state requirements for moderate income housing. The inputs for this land use model are as follows:

LAND USE MODEL - OPEN SPACE INPUTS

INPUT	DATA
Study Area Acreage	10,635
Future % Open Space	30%
Open Space % Breakdown	55% Community Open Space 45% Local Open Space
Max Distance to Dwellings	1/4 Mile

Open space is undeveloped land, a naturally landscaped area, or a formal or human-made landscaped area that provides an aesthetic, recreational, environmental, historical use; or a connective link or buffer between other resources. Open space can further be broken into two classifications, specifically public and private. These classifications denote the nature of who has access to use the space.

With this in place, understanding the difference between community open space and local open space becomes critical. Community open space refers to larger public open spaces (Ex. Regional trail networks or native or formal parks two acres or greater). Local open spaces may still be public (native or formal two acre parks or less) but typically are privately owned or home owners association HOA maintained (Ex. Agricultural land, private undeveloped property, improved park strips and pocket parks).

Inputs for distance to parks comes from a range of project team and outside research that has been done on park proximity and planning across the United States [*smartcitiesdive.com/ex/sustainablecitiescollective/pedestrians-and-park-planning-how-far-will-people-walk/24937/#:~:text=The%20quarter-mile%20standard%20is%20also%20supported%20by%20park,a%20park%-20for%20everyday%20outings%20and%20playground%20opportunities.%22*, and *nrpa.org/our-work/partnerships/initiatives/park-access/*].



LAND USE MODEL - EMPLOYMENT INPUTS			
COMMERCIAL / RETAIL			
SF / Resident	**Floor Area Ratio (FAR)**	**Capture Rate**	**Jobs / 1K SF**
20	.30	110%	1.67
FLEX / MANUFACTURING / INDUSTRIAL			
SF / Resident	**FAR**	**Capture Rate**	**Jobs / 1K SF**
--	.40	85%	1.33
OFFICE			
SF / Resident	**FAR**	**Capture Rate**	**Jobs / 1K SF**
--	.30	80%	2.86

The projected population for the study area at full build-out is 93,056. Approximately 54% or 50,000 residents of that population is estimated to fall between the ages of 18 - 65 (or typical working age) [*census.gov/quickfacts/grantsvillecityutah*, and *worldpopulationreview.com/us-cities/grantsville-ut-population*]. As of 2019, more than 70% of Tooele County commuted outside of the County for work each day [*tooeleco.org/wp-content/uploads/2022/05/tooele-county-general-plan-2022.pdf*]. If this rate were to continue this would add an additional 35,000+ trips in and out of the City each day during rush hour times. Not planning for a larger workforce in the City would cause significant impacts to current and proposed transportation networks.

The floor area ratios (FAR), commercial sf per resident, capture rates, and jobs per 1,000 sf came from research in commercial, retail, flex, manufacturing, industrial, and office developments located in Grantsville, Tooele Valley; and Salt Lake, Davis, Weber, and Utah Counties. Hundreds of properties were evaluated based on property ownership, parking provided, building coverage, jobs provided, commercial capacity, and code requirements of the project's respective jurisdictions.



LAND USE MODEL - SCHOOL INPUTS			
HIGH SCHOOL (HS)			
Population % (5 - 10)	**Existing Students / HS**	**Future S / HS**	**AC / School**
8.4%	1,434	1,890	8
MIDDLE SCHOOL (MS)			
Pop. % (11 - 13)	**Ext. S / MS**	**Future S / MS**	**AC / School**
8.1%	637	870	12
ELEMENTARY SCHOOL (ES)			
Pop. % (5 - 10)	**Ext. S / ES**	**Future S / ES**	**AC / School**
14.9%	483	575	50

A critical first step in establishing base requirements that generate the need for additional elementary, middle, and high school facilities, is understanding existing demographics and population projections.
Taking into consideration the existing and projected ages for elementary, middle, and high school kids for the study area mixed with projected school capacities is essentially how this component of the land use model is calculated.

The inputs for schools come from a range of data sources. These data sources include background information on existing and projected school population sizes, school acreages, and Grantsville demographics. Existing data came from the Tooele School district's school population averages over the last five years based on school designations, with supportive existing and projected data coming from the Alpine, Canyons, Davis, Nebo, and Provo School Districts [*greatschools.org/utah/tooele/tooele-district/*, *niche.com/k12/d/tooele-school-district-ut/*, *schooldigger.com/go/UT/district/01050/search.aspx*, *LandVision – digitalmapcentral.com/*].

In addition to public schools, several charter school exist throughout the valley. Although the population for these schools is growing, consistent or projected data was not available. Given this issue, we did not discount the student population and projected school requirements for these facilities.



LAND USE MODEL - CIVIC INPUTS	
LIBRARY	
Population / Facility	**AC / Facility**
10,000 Residents / 1 AC	2
MUSEUM / HISTORIC SITE	
Population / Facility	**AC / Facility**
10,000 Residents / 1 AC	Facility Size Varies
POLICE STATION	
Population / Facility	**AC / Facility**
20,000 Residents / 1 AC	1.5 - 5
FIRE STATION	
Population / Facility	**AC / Facility**
8,000 Residents / 1 AC	1.2
CEMETERY	
Population / Facility	**AC / Facility**
1,500 Residents / 1 AC	10
HOSPITAL	
Population / Facility	**AC / Facility**
3,000 Residents / 1 AC	10 - 30

The inputs for civic uses come from a wide range of sources including Utah communities observational research, *aha.org*, *wbdg.org*, *statista.com/topics/1469/libraries*, *nfpa.org/*, *governing.com/*, and *nfda.org/*. Information and input was received from Tooele, Davis, Salt Lake, Uintah, Utah, Wasatch, and Weber County Library systems as well as various police and fire departments in the same counties for typical facility needs. In addition to contacting these agencies, a catalog of civic uses is kept to determine average facility sizes, and facility acres per resident in Utah, Arizona, Idaho, Colorado, New Mexico, and Nevada. As for the historic and museum sites, this information has a higher level of variability. The sample size for baseline data was pulled from over 50+ Utah communities varying in size, scale, and rural nature. Existing demographics and existing facility acreage was gathered offering a statistically valid level of confidence.

Placement, spacing, and response times for civic uses were also gathered from first hand information, best practices, and extensive visual surveys.



LAND USE MODEL - CHURCH INPUTS			
CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS			
Population %	**Members/ Congregation**	**Congregations/ Facility**	**AC / Facility**
70.2%	400	3	3.7
CATHOLIC			
Pop. %	**Members/ Congregation**	**Congregations/ Facility**	**AC / Facility**
19.3%	600	1	5
OTHER RELIGIOUS FACILITIES			
Pop. %	**Ext. S / ES**	**Future S / ES**	**AC / Facility**
2.8%	600	1	3.5

An additional element of the operational needs of these facilities also comes from activity rates within the various religious institutions. Facility and congregation sizes come from church representatives as well as property search data from Tooele, Davis, Salt Lake, Uintah, Utah, Wasatch, and Weber Counties. Congregation and population information comes from church representative contacts and the following sources *bestplaces.net/religion/county/utah/tooele*, *census.gov*, *usreligioncensus.org*, *churchofjesuschrist.org*.

Additional modeling inputs for water systems; wastewater planning, stormwater, roadway, parks recreation and trail facilities, and public safety facilities; geotechnical analysis, and other utilities will be further outlined in the Capital Facilities section.

03
COMMUNITY ENGAGEMENT

“Preserve the rural feel that everyone has requested, while so providing trails for being out in nature.”

- SURVEY PARTICIPANT

Introduction

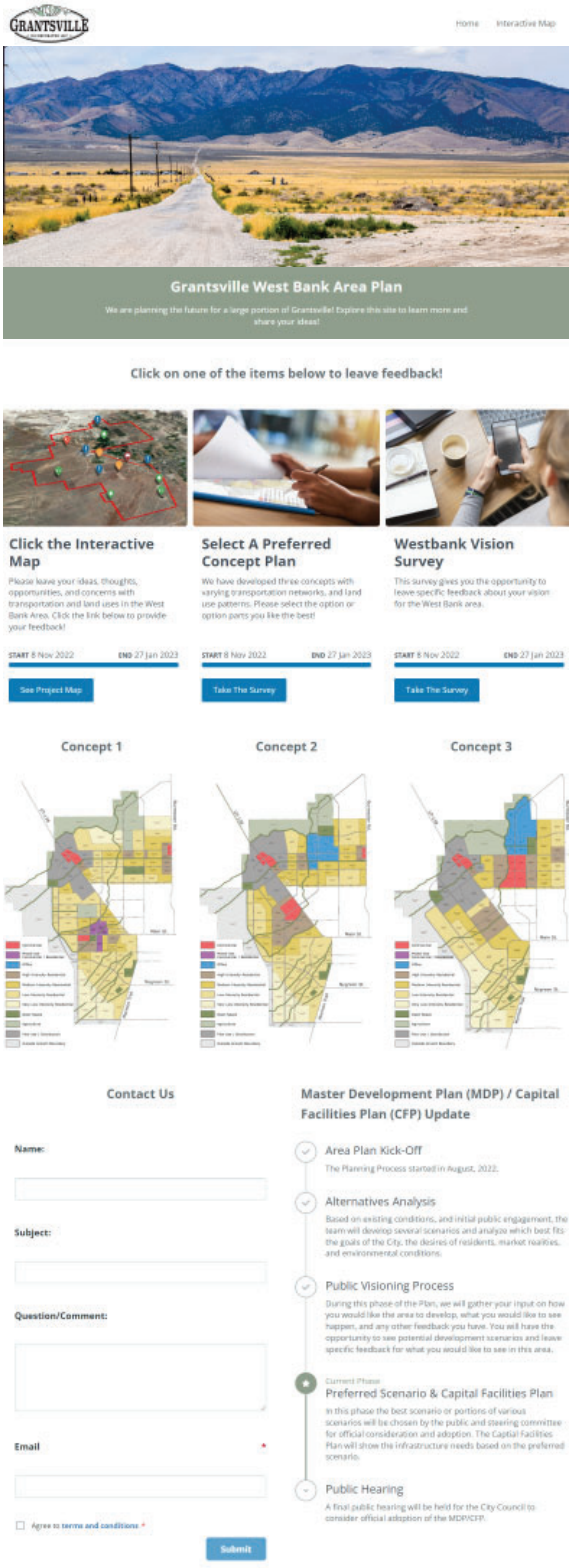
As part of this process the project team was tasked to perform outreach to residents, property owners, employers, City staff, and elected officials. Several stakeholders were interviewed from late October through January 2023. Individuals with a variety of backgrounds were selected, ranging from residents and property owners, to community leaders and City officials.

Social media, and an interactive website were utilized to offer outlets to give feedback, and allow residents the opportunity to share their vision for the study area. The interactive website gave individuals the opportunity to voice their opinions through surveys, a forum, and interactive map. Everyone was asked to share their ideas, goals, concerns, opportunities, constraints, and vision for the future of the area.

Key Takeaways

- Maintain Grantsville's rural small town feel and buffer less intense development from more intense development.
- Higher intensities should be kept along major corridors where it makes sense, thus preserving other areas for lower intensity development.
- Preserve as much agricultural and open space land as possible.
- Provide more entertainment, recreation, employment and commercial opportunities (things to do, grocery stores, restaurants, camping, trails, and other outdoor recreation)
- Make sure there is enough infrastructure and resources including water to support growth in this area.
- Provide a range of housing types.
- Preserve the drainage corridors and natural open space.
- Education is needed on:
  - How property rights work
  - How commercial, retail, office, employment and other land uses are triggered and developed
  - How open space is preserved, built, paid for, and maintained
  - What the State requires for moderate income housing and affordable housing within Cities like Grantsville

Interactive Website



Surveys & Outreach Results

During the public engagement portion of the project, there were over 1,000 visitors to the project website. Below are additional details about the public engagement process:

110 **Unique Survey Users**

180+ **Comments, discussions, & Map interactions**

350+ **Unique Site Users**

20 **Stakeholder Interviews**

Top Feedback

1. **Improved Trails & Trailheads** (Walking, hiking, biking)
2. **Upgraded Recreation Amenities** (Parks, playgrounds, & others)
3. **Commercial Development** (Grocery stores & restaurants)
4. **Agricultural land** (Please preserve it)
5. **Range of Housing Types** (Not enough water)
6. **Natural Drainage Corridors** (Open space & trail preservation)
7. **Entertainment Opportunities** (Not enough water)
8. **Camping, RV Sites & Other Outdoor Recreation Opportunities** (Keep these close access)
9. **Employment District** (Higher paying local jobs)
10. **Office Development** (Office space for rent)



04
PREFERRED PLAN

"I like the orientation of the road network, increased amount of commercial, but would like to see more open space, and a regional park."

- SURVEY PARTICIPANT

Best Practices

The following are best practices for smart and sustainable development:

- Focus intensities around key intersections, major traffic corridors, and where infrastructure is readily accessible.
- Maximize efficiency of existing and planned infrastructure by placing most intense development at major nodes.
- Preserve and enhance cultural and natural amenities.
- Buffer less-compatible land uses and facilitate compatible land uses.
- Optimize land use designations based on opportunities and constraints.
- Step intensities down progressively away from major development nodes and intersections.
- Provide safe and efficient multi-modal access to businesses and residents and consider proximity to other land uses, neighboring jurisdictions, and transportation networks.
- Ensure land uses and intensities are context-appropriate.
- Provide active and passive recreation opportunities within close proximity to residents.
- Balance land uses based on current and projected demographic information and market trends.
- Establish a redundant roadway, walkway, and bikeway network allowing multiple routes of travel.

The following principles help illustrate what would be required given public sentiments that were expressed during the public engagement process of this study:

Public Sentiment: Open space amenities & more trails

Open spaces are typically paid for in a few different ways. Public open space is generally paid for with property and sales tax and impact fees, or is privately developed then dedicated to the public for use. Typically these spaces are maintained by taxes. Private open space amenities are budgeted into the total cost of a development and are typically maintained by a private Home Owners Association (HOA). These types of open spaces can be naturally landscaped or man-made landscaped areas.

Private open space amenities are normally developed in later phases of a project to ensure enough members in the HOA can reasonably pay for their maintenance. The same applies to public open spaces. The more residents there are paying taxes to maintain open space, the more money there is to develop and maintain increasing amounts of public open space including trails.

Private land or HOA maintained open spaces are for the private exclusive use of the owner or HOA members respectively. Much of the land considered as open space in the Tooele Valley area as, previously mentioned, is privately-owned undeveloped land with some State- Federal- and United States Forest Service-owned land. Several trails in the valley currently used by ATV or horse users are technically on private undeveloped land, which could be shut down at any moment by the land owner. Many residents view these as “public open space“ when in reality they are not. To ensure open space amenities are publicly-accessible and preserved, they need to be incorporated into the governing agencies planning efforts and the land needs to be purchased and improved upon by that City, County, State, or Federal entity. As a rule of thumb larger trail systems are usually constructed by private developers as planned, incorporated, and enforced by government agencies, or as part of a major public facility enhancement (ex. the Midvalley Highway project.).

Provisions should also be added to regulating codes to guide community development to incorporate varying categories of open space. Varying categories of open space are denoted in the community character section below. Individuals seeking to develop an area tend to provide the minimum requirements. If these regulations aren’t included, open space will either not be provided or not be provided in a manner that promotes the health of its residents.

A diverse network of integrated open space is critical to create vibrant healthy and inviting neighborhoods and communities. As such, part of the public engagement process was dedicated to understanding the specific amenities and open space categories residents desired. Existing open space types and classifications were analyzed to see what gaps may exist within the Tooele and Rush Valleys. Missing or insufficient public amenities were added to the Open Space / Recreation Preference Survey. The graph below shows the percentage of resident survey respondents that desired each listed missing or insufficient public amenity.

Public Sentiment: Stop the growth of the City

Most of the population growth in 2021 and 2022 in Tooele County was due to in-migration *https://gardner.utah.edu/wp-content/uploads/UPC-2021-Estimates-Newsmaker-Slides.pdf?x71849* and *https://gardner.utah.edu/wp-content/uploads/Tooele-Proj-Feb2022.pdf?x71849* however, historically (pre 2021) population growth has primarily been due to natural increase. The population change from 2010 to 2020 was just under 4,000 residents with an estimated 70% of that growth coming from natural increase. A productive mindset for the community, then is to discuss where growth should occur, which can be regulated and planned for in the land use plan. Deciding where development makes the most sense, where specific uses should be located, and where areas should be preserved is within the control of the community and should be reflected in the land use plan.

Public Sentiment: Grocery store in Grantsville/more jobs

Retailers and employers require communities to reach certain demographic thresholds in order to open a new location. Municipal incentives can entice these users to develop in one location over another, but that user must already have the location in their growth plan. Municipalities or Counties can incentivize users to come, but can not make up for large gaps in commercial and employment users required demographic metrics for locating their businesses.

Examples:

- Costco requires within a 5-mile trade area radius, 200,000 people and a median income of $75,000. Their target demographic also includes college educated, 2-person+ households.
- Whole Foods requires an even higher population (250,000 within a 3-mile trade area radius with a median income of $75,000).
- A typical medium-sized grocery store requires about 7,000 - 10,000 residents within a 1-mile radius, and 40,000 - 50,000 residents within a 3-mile radius.

Less than half of Grantsville's approximate 13,574 residents fall within a 1-mile radius of Soelberg's Market (Grantsville's existing small-sized grocery store) putting Grantsville outside of the typical medium-sized Grocery store requirements. In order to attract a mid- or large-sized grocer the population would need to grow.

Public Sentiment: Large lots & development costs

Residents have stated the desire for only large lot development throughout the city, but unfortunately this displaces younger generations from being able to raise families where they grew up, and older generations to continue to live in their communities. Many younger generations can only afford to live in small lot, townhome, condo, or apartments homes when they first start out. A lack of variety of housing types puts more demand on a limited supply, which drives prices up and makes communities unaffordable. In addition, older generations need for larger lots diminish as their ability to maintain and get around their property decreases. Only allowing large lots will likely cause you and your children to have to leave your community. Planning for you and your families future in the City, ensures your ability to be a lifetime resident.



As for cost of development within large lot communities, the burden of open space amenities and infrastructure gets pushed to the few, making the large lots even more expensive, and commercial development impossible. The reason for this is, large lot communities increase the distances between properties, adding significant, often unsustainable costs to infrastructure (utilities and road development and maintenance; public services providers like fire and police; water use needs access; etc.). For government agencies to be able to service a community, a mix of unit types is required, with the more intense development often subsidizing less intense development.



To further explain this subsidy we will use general terms to compare typical one-acre lot development with quarter-acre lot development:

LOT COMPARISON		
TYPICAL LOT INFO	**1-ACRE LOT**	**.25-ACRE LOT**
Lot Size	43,560 SF	10,890 SF
Lot Width	200'	100'
Home Size	4,500	2,500
Irrigated Landscaping	24,500	6,500
Water Use (600 gal / 1,000 sf irrigated landscape / week)	14,700 gal / week	3,900 gal / week
Road/Utility Length Need	200'	100'
Market Rate (MR)	Land value (LV) + improved value (IV)	
Taxable Value Calculation (TVC)	MR x 55% (Home taxable value receives a 45% reduction from MR)	
Market Rate (2021)	$700,000	$490,000
Taxable Value (See TVC)	$385,000	$269,500
Approx. Property Tax (.0138 tax rate)	$5,313	$3,719

A one-acre lot pays approximately $.22 per square foot less in property taxes than a quarter-acre lot despite needing twice the amount of roads and utilities, public services, etc. and 10,800 more gallons per week in water use. The more compact the development the lower your property taxes will be to support the maintenance and development of infrastructure. In addition, more intense development requires significantly less water use then less intense development. Comparing multifamily townhome dwellings with one-acre lots, the property taxes for townhomes are approximately $2 more per square foot, the infrastructure needs are 90% less, and the water usage is 14,000+ gallons less per week.

The "Public Sentiment: Large lots & development costs" section is not meant to advocate for all new development to be small lot or multifamily, only illustrate the cost of large lot development and its need for subsidy by mixed residential development types.

Public Sentiment: Water Use/Availability/Efficiency

The majority of water use in residential areas comes from landscape irrigation. Single family homes, townhomes, and apartment homes indoor water use is approximately the same, but their outdoor use is drastically different as shown in the previous public sentiment. The easiest and best solutions for reducing water consumption is to utilize waterwise landscape design, limit non-functional lawn areas or replace with more waterwise lawn options, water landscapes in the early morning or evening, implement water reuse, and use water conservation and low impact development methods.



Public Sentiment: Walkability

Several residents stated the desire for walkability. Walkable communities require more than just trails. To put it simply, walkability means it is suitable and safe for walking, or close enough to be reached by walking. The average person will walk up to 5 minutes (1/4 mile) before choosing to drive. For a community to be "walkable" it needs to be safe and more compact. Given that only a portion of residents desired walkability, a range of housing types as mentioned in the "Public Sentiment: Large lots & development costs" section can help support residents in all stages of life and Grantsville community life styles.

Community Character Standards

Quality community character can be costly if the development standards do not focus on the fundamental principles of what makes a quality community. To achieve quality community character, development standards must be established to protect the community environment, welcome contextual variation, and promote the health and safety of its residents. This can be accomplished by integrating open space and trails with a mix of housing types, introducing traffic calming measures and multi-modal street networks in various forms, allowing the surrounding atmosphere and function of the place to lead the design, and incorporating innovative solutions to resolve issues rather than only typical solutions. Three key areas to focus on are:

- **Community Design –** this element covers the architecture (orientation and facades), streets (design and details), and theme (sustainability and branding elements)
- **Community Layout –** this element addresses the architecture (variation), block (length and permeability), and multimodal network connectivity
- **Open Space –** this element outlines standards for open space types and categories

Community Design

Community design in its simplest form is broken into three areas, architecture, streets, and theme. These areas define the community and if addressed properly can produce wonderful vibrant communities. The following sections will help clarify key design elements to establish healthy communities. These sections will focus on items allowable by state code.

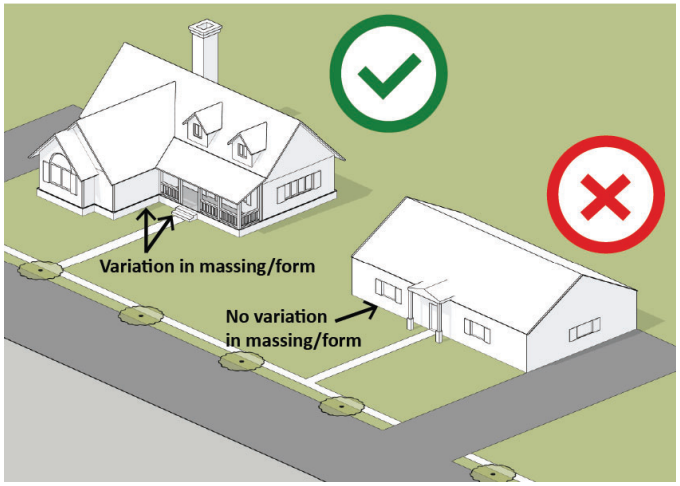


Before addressing the architectural section, it should be noted that Utah House Bill 98 prohibits municipalities from imposing "a requirement for a building design element on a one to two family dwelling or townhome...[unless] agreed to under a development agreement." *le.utah.gov/~2021/bills/static/HB0098.html*. "Building Design element means:

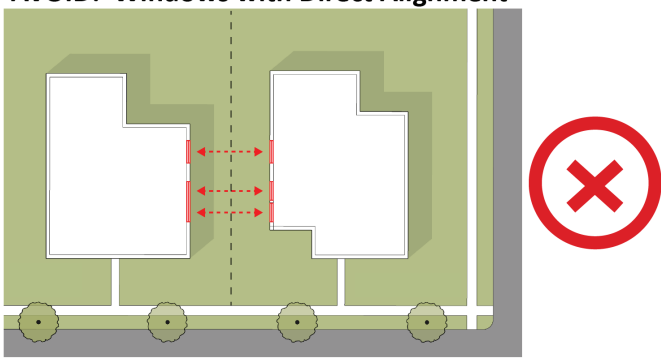
- Exterior color
- Type or style of exterior cladding material
- Style dimensions or materials of a roof structure, roof pitch, or porch
- Exterior non-structural architectural ornamentation
- Location, design, placement, or architectural styling of a window or door
- Location, design, placement, or architectural styling of a garage door, not including a rear-loading garage door
- Number or type of rooms
- Interior layout of a room
- Minimum square footage over 1,000 square feet not including a garage
- Rear yard landscaping requirements
- Minimum building dimensions or
- A requirement to install front yard fencing"

Architecture:

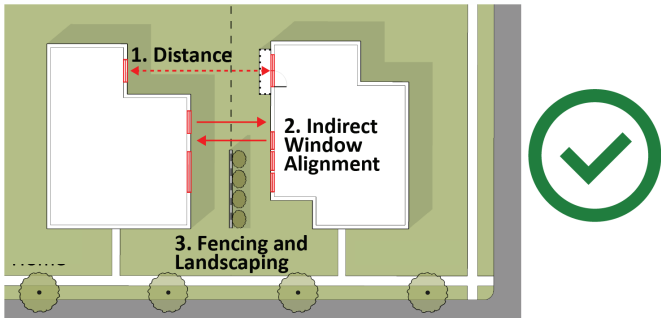
- **Orientation –** Buildings should be oriented towards the street, positively defining and framing adjacent streets, and/or public or common spaces by:
    - Matching or complementing adjacent building setbacks;
    - Matching or complementing adjacent building heights and massing;
    - Completing the streetscape pattern of the street(s) they front.



AVOID: Windows with Direct Alignment



OK: Windows with Privacy Alignment



Houses should be designed to relate to their neighbors rather than as a stand-alone building. State Code prohibits portions of this section unless added within a development agreement. This is one of the more important pieces to help create great communities, and can be accomplished by:

- Orienting the side yards in order to preserve the privacy of the outdoor spaces of both.
- Adjusting side yard and rear yard volumes to provide as much distance as possible between the facades in order to preserve privacy of the outdoor spaces of both.
- Placing windows (with different sizes) in side and rear yards designed with care and sensitivity for the preservation of privacy between buildings. (This item is called out in the HB 98 as prohibited unless it is part of a development agreement.)
- Adding jogs in the principal and secondary frontage for residential units with little to no architectural ornamentation. In addition, when projects enter a development agreement, the principal and secondary frontage should contain architectural ornamentation congruent with the architectural styles utilized by the development group.

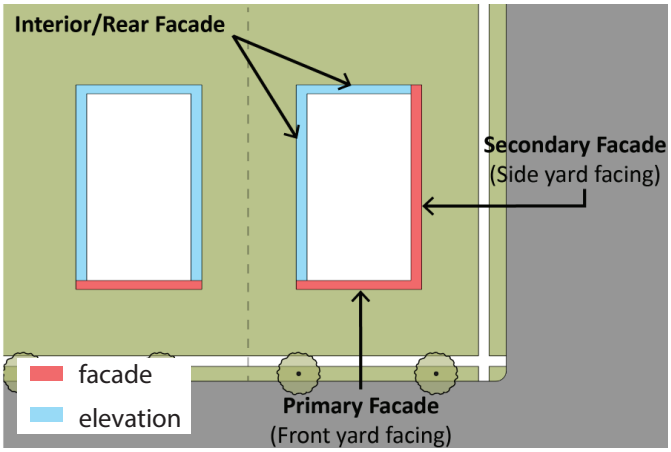
- Garage setbacks should be 20' or greater with principle building (or living space) 15' or greater minimizing the attention being paid to the car. The main entry should be the most prominent feature on the front facade.



- **Facades –** Buildings should be designed with frontages that engage the street by providing direct access to the public realm (street or Community Space).

  The community character standards differentiate between the facade and elevation of buildings. Facades are the vertical portions of the buildings that face public streets. Elevations are the vertical portions of building not facing onto public thoroughfares. Facades are more highly regulated than elevations.

  Lots with secondary frontage will continue the same material treatment from principle frontage facade on the secondary frontage facade.



Streets:

The design of the street can do as much for community character as the architecture of the buildings. Place great buildings on a wide street with an unpleasant environment and the buildings will more rapidly become run down *[tinyurl.com/23v94wpa, sciencedirect.com/science/article/pii/S1687404813000102, nacto.org/publication/urban-street-stormwater-guide/streets-are-ecosystems/the-role-of-streets/, journals.sagepub.com/doi/10.1177/00420980209571981]*. This section outlines principles of good street design. For cross sections please refer to the 2023 Transportation Master Plan.

- **Design & Details –** Streets should be context appropriate, and help establish the community's identity. (Ex. to establish a quite residential neighborhood, the streets should be narrower with plantings, trees, furniture, and lighting on a pedestrian scale to help make the setting feel more intimate and inviting.) In order to allow the streets to fit their context, thought must be placed on the specific characteristics of the community, and the needs of that street. A few key areas to focus on are:
    - Modes of transportation using the street
        - Pedestrians, Bikes, Cars, Bus, etc.
    - Safety and function of the street
        - Type of curb and gutter or bioswale, separation/interaction of modal paths, multimodal/single mode intersection treatments, number/width of lanes or paths, parking, medians, use of park strips, curves and turn radii, visibility, slopes, and access
    - Materials and permeability of the street
        - Are lane and path materials concrete, asphalt, composite, pavers, gravel, dirt; are medians and park strips raised, planted, hard surface, gravel, irrigated, etc;
    - Features included with in the street right-of-way
        - Furniture, trees, plantings, signage, lighting, and utilities

  Below are a few principles that help facilitate great streets:

    - A street's designed speed should take into consideration lane width, straights/curves, land use type/density, modal paths and conflicts, road surface, parking presence, pedestrian proximity, traffic calming measures, approaching context, and lastly road classification.



The street shown above has a posted speed of 25 mph but fits the size of an arterial road. Long wide straight roads encourage higher speeds.

- Promote traffic calming measure for residential communities including trees in parkstrips, on-street parking, bulb-outs and chokers, lateral shifts, chicanes and curves, narrower lanes, fewer lanes, medians, raised intersections, speed cushions or humps, speed tables, and roundabouts and traffic circles
- Create physical barriers between higher and slower modes of traffic. Trees, light poles, park strips, planters, street furniture, fences, are all examples of physical barriers that can be used to create separation between modes.
- Design elements and details should be pedestrian scaled. Lighting and other elements should be appropriately sized to create the highest utility and aesthetic for individuals who use the space.
- Street, sign, and other lighting should be dark sky compliant so as to protect the rural feel and night sky of Grantsville. This can be accomplished by only allowing full cut-off fixtures which reduce glare and avoid unnecessary light pollution.



Theme:

The last item within the community character element covers the sustainability and brand/overall feeling of the development. This is an important item to include given the large amount of residents who wanted to keep the current "feel" of Grantsville intact. Some of the most common words used from the public engagement were: open, rural, natural.

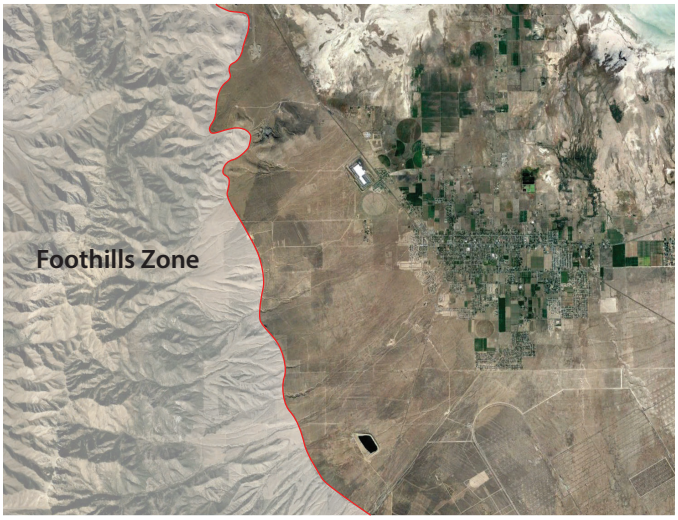
To keep the rural, open, and natural feeling the following principles may be utilized:

- **Sustainability –** An emphasis on sustainability and sustainable design practices should be implemented and maintained for Grantsville. In the City's context, five main sub-elements rise in importance: agriculture, hillside and slope protection, alluvial fans and wetlands, water conservation, and low impact development (LID)

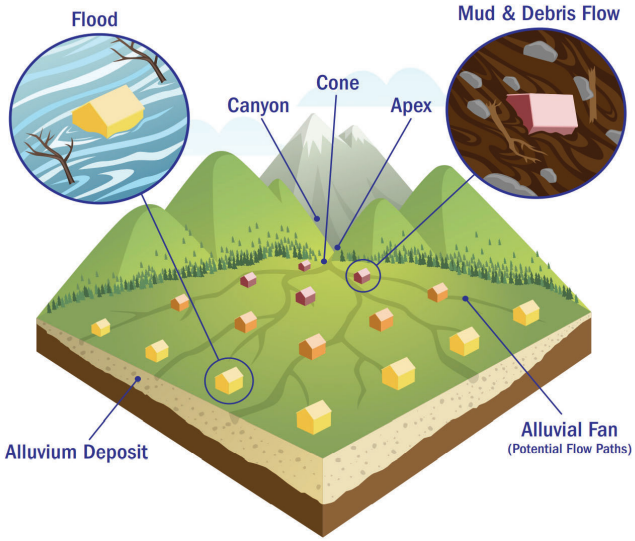
    - **Agricultural Land –** Agricultural land in growing areas tends to be the least expensive land to develop due to its "development ready" potential. This is because developers look at a potential property to purchase based on how much work it will take to develop the site versus how much the land costs. In the case of Grantsville, much of the agricultural ground falls outside of the City's current boundary (approximately 4,775 acres of the total 7,850 acres) making most of the agricultural ground more expensive to develop due to the cost of infrastructure, water, and other services. Despite the cost to develop in these areas, significant development pressure has occurred over the last several years. Measures should be made now to help preserve agricultural ground or offset the desire to develop agricultural ground. Promote the measures outlined on page 7 and 8.

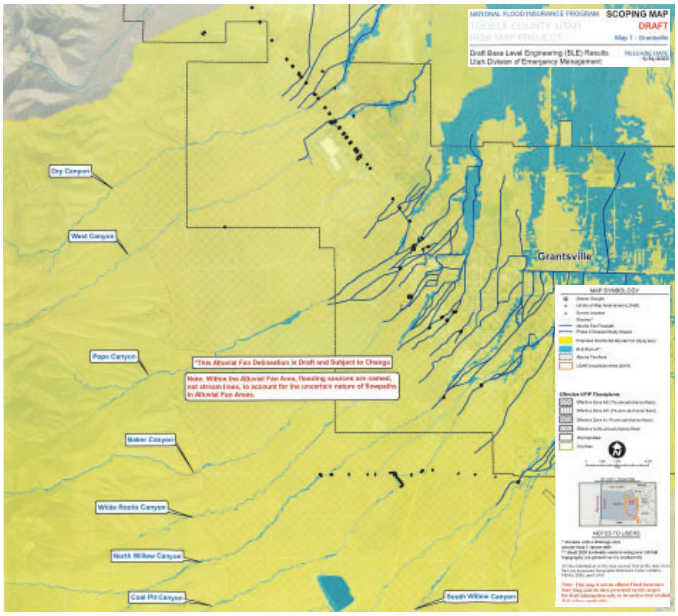


    - **Hillside & Slope Protection –** With heavy amounts of rain, developing the foothills could cause future property damage if not planned for. To help prevent potential incidents, development should be discouraged in the area shown below.



    - **Alluvial Fans & Wetlands –** Alluvial fans and wetlands have a significant level of volatility and developmental constraints should be analyzed and mitigated if development is permitted to occur with in these areas. There are two strategies that can be implemented to protect property within an alluvial fan area (*tinyurl.com/y8w5y5ac*):
        - Large structural flood control measures, such as check dams (See the Water section of th Capital Facilities Plan for more information)
        - Or avoidance of the affected area



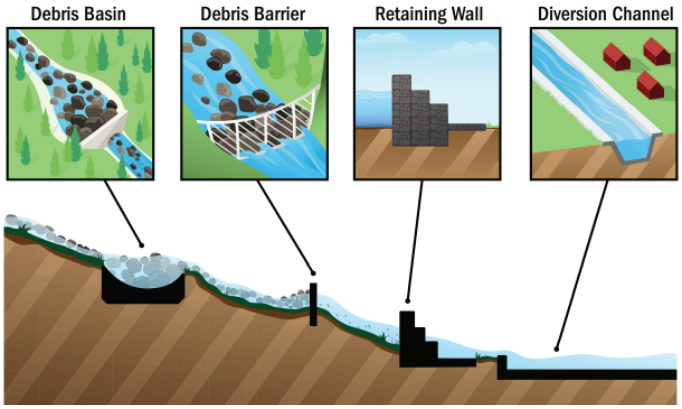


According to the Federal Emergency Management Agency's (FEMA) Best Practices for Building and Developing on Alluvial Fans (*floodhazards.utah.gov/wp-content/uploads/2021/11/AlluvialFanFINAL.pdf*), there are five steps for avoiding loss of property in an alluvial fan:

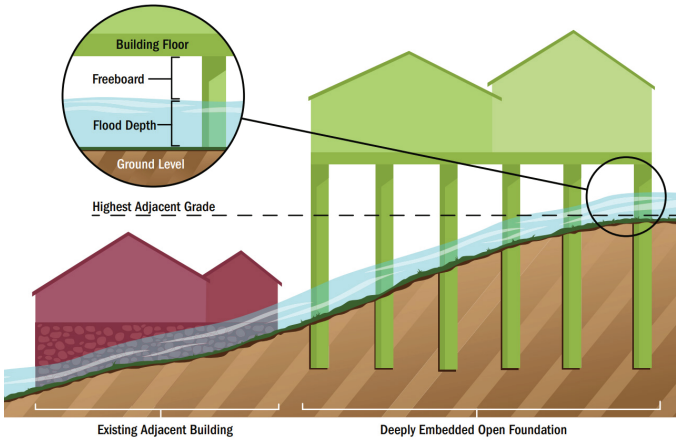
- **Step One:** Map the Alluvial Fan
- **Step Two:** Avoid Any Development in an Alluvial Fan
- **Step Three:** Mitigate Your Risk
- **Step Four:** Consider Building Codes When Permitting Development or Redevelopment
- **Step Five:** Protect Your Home or Business

In step three there are a few measures outlined to help mitigate risk within these areas. A few of those mitigation step are:

- "Fully understand [your risk] by conducting detailed local or regional studies" A study is taking place to better understand risks associated with the Alluvial Fan in this area.
- "Add alluvial fan areas to a community's regulatory flood map, specifically identifying fan apexes and meandering flow paths zones." When the study mentioned above is complete, these areas should be added to the City's map layers.
- "In the most dangerous areas of the alluvial fan, communities should...convert them to open space and prohibit new construction and reconstruction." As part of the land use map, these areas are currently shown as open space corridors with an 75' buffer (150' total from edge to edge) from the deepest portion of the drainage corridor.
- "Use strict floodplain management, zoning, and subdivision regulations similar to the no-rise requirement in floodways to prohibit or limit growth in high-risk areas."
- "Communities should adopt and enforce strict floodplain management and building code requirements for substantial improvements in Special Flood Hazard Areas (SFHAs) and in alluvial fan areas to ensure that they exceed the minimum requirements."
- **Utilize Large- scale Mitigation Measures:**
  - "Ensure there are proper warning systems and evacuation plans are in place that anticipate flash flooding or debris events."
  - "Strongly encourage whole-fan and/or local protection to be structurally designed to mitigate the risk of hazards to [proposed or] existing development." These mitigation activities include debris fences, dikes, levees, channels, detention basins, and debris basins



- **Utilize Individual Mitigation Measures:**
  - Elevate buildings on open foundations or armored fill
  - Reinforce the uphill side of structures against debris impact
  - Build floodwalls or berms around the property



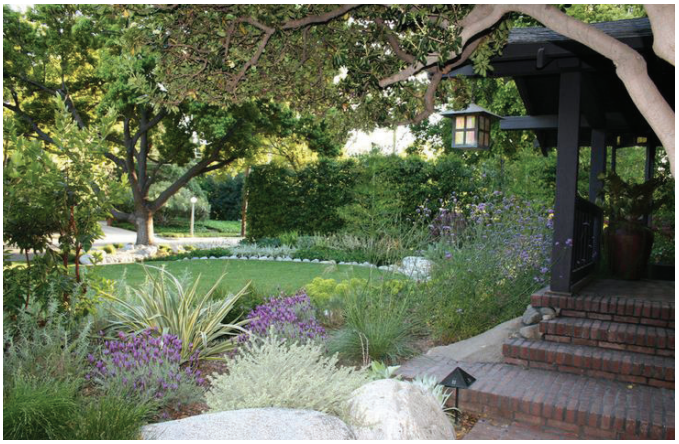
For more information and recommendations for mitigation see: *nap.nationalacademies.org/read/5364/chapter/7*, *cedb.asce.org/CEDBsearch/record.jsp?dockey=0100001*, and *hazards.utah.gov/floods/*

- **Water Conservation, Preservation, & Low Impact Development (LID) (Water Conservancy Plan as required by Utah State Code Section 73-10-32) –** Utah is a semi-arid to desert climate. Whether rainfall is plentiful or not, measures should be taken to help minimize wasteful or unnecessary water use practices. These wasteful practices include leaky waterlines and systems, irrigating landscape when raining or over watering landscape, non-functional lawn areas, non-waterwise appliances, and running faucets when not in use. Some best practices or ways to combat the misuse of water are:
  - **Water System Management –** This management process evaluates and assesses the existing water system and replaces or improves under performing sections and facilities. It also adds meters in critical areas to watch for water leakage. Leakage represents the largest real losses for most water systems [*epa.gov/sites/default/files/2016-12/documents/wc_best_practices_to_avoid_supply_expansion_2016_508.pdf*].
  - **Metering –** Ensure meters are located at each user location to track water consumption and distribute the cost of the system on those consuming the most water using a conservation rate structure. A conservation rate structure incentives users to reduce water use to be under certain thresholds of cost/gallon of water use. [*HB 251 le.utah.gov/~2023/bills/static/SB0251.html*]
  - **Rain Water Harvesting –** Allows users to capture and store water on site for future outdoor irrigation needs. This is regulated by Utah State Code, but each residential unit can store up to 2,500 gallons per year [*waterrights.utah.gov/forms/rainwater.asp*].



  - **Sustainable Water Use Practices –** Changing user habits to utilize smart water sensing irrigation systems, waterwise appliances and toilets, turning off water when not in use, watering landscape the right amount and at the right times. [*HB 349 le.utah.gov/~2023/bills/static/HB0349.html]*

- **Waterwise Landscape Design –** When individuals hear the term waterwise landscape design they typically think no lawn and only use rock or bark mulch. A waterwise landscape design is a design that is thoughtful in its placement or use of lawn and utilizes more drought tolerant native plants. It may also mean replacing typical lawns with other more waterwise plant substitutions. The use of rock or bark mulch, drip irrigation systems, and less water intensive plants is encouraged in waterwise landscape design. The state also offers incentives for implementing water efficient landscaping [*HB 277* and *SB 118*]. Grantsville recently passed a waterwise landscape code, which should be promoted for existing development and required for future development.



- **Greywater Systems & Water Reuse –** Greywater systems or water reuse takes water that has already been used (from places like your laundry, shower, and sink) and uses it for a secondary purpose (like watering gardens or landscaping) before allowing it to enter the sewer system. [*epa.gov/waterreuse*].
- **Low Impact Development (LID) –** "LID refers to engineered systems, either structural or natural, that use or mimic natural processes to promote infiltration, evapotranspirtation, and or reuse of storm water as close to its source as possible to protect water quality and aquatic habitat" [*documents.deq.utah.gov/water-quality/stormwater/updes/DWQ-2019-000161.pdf*].

Green infrastructure includes LID practices but is a broader practice that also includes ecological services. Examples of green infrastructure are:



- Bioswales
- Bioremediation
- Downspout Disconnection
- Green Parking
- Green & Blue Roofs
- Green Streets & Alleys
- Infiltration Basins
- Permeable Pavements
- Rain Gardens
- Rainwater Harvesting
- Subsurface Detention
- Urban Tree Canopy



For more information visit: *epa.gov/green-infrastructure/what-green-infrastructure, & sustainableinfrastructure.org/*

- **Branding –** Creating a brand or cohesive feel which incorporates the context of the development is critical. Many communities can feel stale or cookie cutter due to lazy development practices. Often these lazy development practices are defended as a way to make developments more affordable, when in reality the cost difference between thoughtful and lazy development practices are negligible. Thoughtful development practices include incorporating views and viewsheds, integrating the terrain features into the design, consistent treatments and design elements, blend open spaces with development, capture the areas unique identity with the community details, fuse surrounding development with the community's edges, understand and implement future residents desires, and facilitate placemaking opportunities. The levels at which branding may occur are varied but adding these considerations to community design helps ensure quality development.



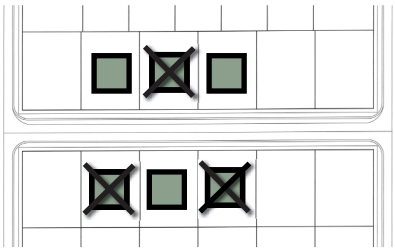
Community Layout

Community layout address the variation of the development and helps accentuate the brand and design of the community. This section further address the architecture, block sizes, and transportation network connectivity.

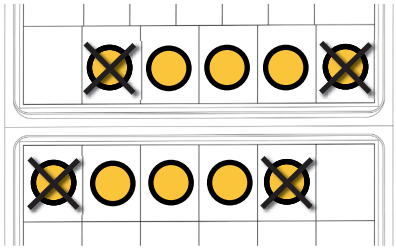
Architectural Variation:

Communities should provide a variety of home styles on each street to create a diverse and interesting street scene. Variation can be achieved through a combination of styles, colors, and floor plans. The variation principles below help illustrate how this could be done:

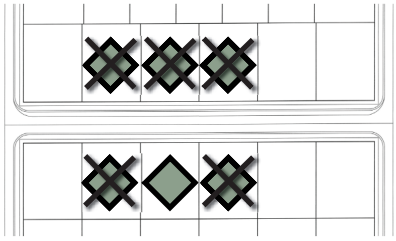
- **Residential Development Guidelines**
  - Single family homes with more simplistic architectural styles (Ex. Traditional) should not be built on adjacent lots or on lots directly across from one another on the same street.



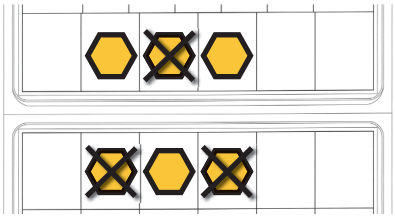
  - Single family homes with more ornate architectural styles (Ex. Craftsman, Farmhouse, Modern) styles should not exceed three consecutive lots of the same style on either side of the street.



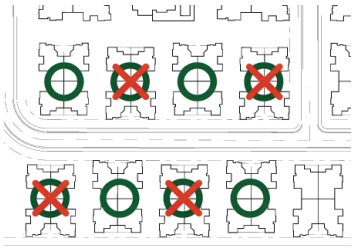
  - Single family homes with the same color scheme shall not be built on adjacent lots or on lots directly across or diagonally from one another on the same street.



  - Single family homes with the same floor plan and style shall not be built on adjacent lots or on lots directly across from one another on the same street.

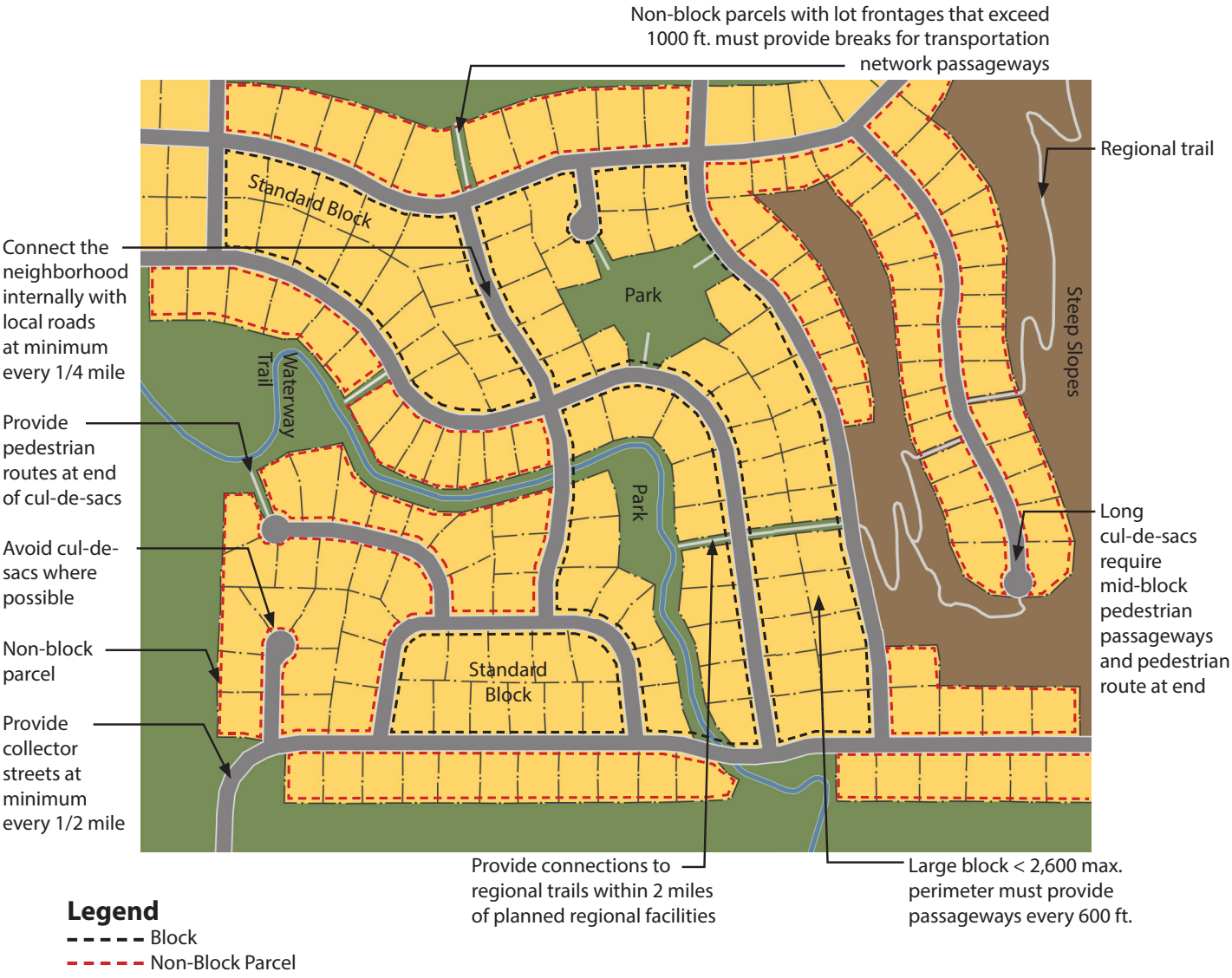


- Attached residential buildings that have the same style or color scheme shall not be built on adjacent lots or on lots directly across from one another on the same street.



Block and Multimodal Network Connectivity:

Neighborhood blocks should be designed, even in rural communities, to be permeable for various modes of transportation or recreation. To this end block lengths should not exceed 1,000 feet without a break for modes of transportation to move through the neighborhood. This allows increased multimodal activity, and greater connectivity for residents and city services. See the diagram below for guidelines on network connectivity.



Open Space Types

Providing quality and accessible open space is the most commonly stated concern among residents, and is consistently one of the most underdeveloped areas within developments. This section is meant to help establish guidelines for how a variety of open space amenities can be established throughout the study area.

The following are best practices for open space and recreation placement, programming, and design:

- Encourage open space to be developed as part of a neighborhood or community during the planning and development phases.
- Catalogue existing public open spaces by type (aesthetic, recreational, environmental, connective link, or buffer), programmed amenities, and size.
- Provide open space close to residents. Open spaces within 1/4 mile of a resident receive significantly more use than those outside of that range.*
- Place open space adjacent to roadways and maintain pedestrian-scale lighting. Doing so increases the user safety and access as well as ease of maintenance.
- Preserve and enhance cultural and natural amenities.
- Design the open space in tandem with local residents and the surrounding context including land features, views, nearby open space types and programming.
- Diversify active and passive recreation opportunities for all user abilities.
- Preserve open space areas based on current and projected land uses and demographics.
- Plan, design, and preserve tail networks and incorporate required connections to these networks to be made or stubbed within a mile of regional trails or connective network trails.
- Connect all open spaces, where feasible by multi-use pathways preferably detached of public street right-of-ways.

* The National Recreation and Park Association (NRPA) states that "the typical park and recreation agency has 10.4 acres of parkland for every 1,000 residents." [*nrpa.org/*].



Delineating open space types helps distinguish the general use of each open space and increases usable open space as the types differentiate end goals of each amenity. Amenities may fit into multiple open space types. Descriptions of each open space type are as follows:

- **Aesthetic –** this open space type is meant to preserve views, maintain historic or rural character, increase community interest, or signify entrance of a location.
- **Recreational –** this open space type is for active and passive recreation uses.
- **Environmental –** the environmental open space type is established to conserve wetlands, agricultural land, critical habitats, wildlife preserves, and other sensitive lands.
- **Historical –** historical open space types are meant to protect or promote historic locations, buildings, and features.
- **Connective Link –** this type is specific to connectivity of various modes and is intended to join source locations to destination locations.
- **Buffer –** this open space type's primary use is to separate non-compatible land uses or establish boundaries for development.



Open Space Categories

The open space categories below illustrate the various Open Space/ Recreation amenities that may be suitable for Grantsville and give an overview of their general character, type, classification, location, size, and spacing.

PLAZA



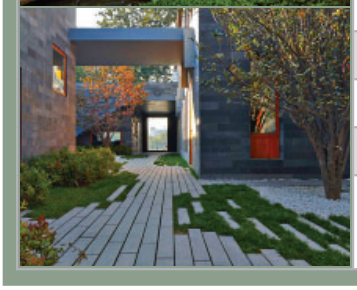


GENERAL CHARACTER
TYPE
Aesthetic, Historic, Connective Link
CLASSIFICATION
Public, Private
LOCATION
Important Intersections, Vista Termini, or Entrances to Community / Civic Buildings
SIZE
4,000 – 1 Acre
SPACING
N/A

- **Plaza –** A plaza is a more urbanized public community space that offers opportunities for civic gathering. Plazas add to the vibrancy of streets within the more urban, higher intensity areas. They create formal community spaces available for civic purposes and commercial activity. These spaces are typically defined by building frontages and contain a mix of hardscape and planting areas with various types of seating and trees provided for shade.

COURTYARD





GENERAL CHARACTER
TYPE
Aesthetic, Recreation
CLASSIFICATION
Public, Semi-Public, Private
LOCATION
Locations Supported by Adjacent Use Pattern
SIZE
600 - 6,000 SF
SPACING
75+ Attached Unit Communities, or Medium+ Retail / Office Properties

- **Square –** A square is a public community space available for civic purposes, commercial activity, unstructured recreation and other passive uses. The square should have an urban, formal character and be defined by the surrounding building frontages or adjacent tree-lined streets. All buildings adjacent to the square should front onto the square, with adjacent streets lined with appropriately scaled trees. Shaded areas for seating should be provided, with the potential addition of a civic element or small structure such as an open shelter, pergola, monument or fountain.

SQUARE





GENERAL CHARACTER
TYPE
Aesthetic, Recreation, Historic, Connective Link
CLASSIFICATION
Public, Private
LOCATION
Important Intersections or Nodes
SIZE
5,000 SF – 4 Acres
SPACING
N/A

- **Courtyard –** A courtyard is a developed space that offers a variety of opportunities for public, semi-public and private gatherings. Courtyards provide a more intimate spatial experience apart from the streets within the more urban, higher intensity areas. They can be formal, paved spaces framed by buildings or restful, garden spaces that can be experienced visually from within building spaces such as offices, retail shops or residences. Building frontages, walls or fences typically define these spaces with a mix of hardscape and planting surfaces dependent upon location and expected use patterns. Shade and heating units should be provided to extend the seasonal use for gatherings or dining, with various forms of seating

GREEN





GENERAL CHARACTER
TYPE
Aesthetic, Recreation, Connective Link
CLASSIFICATION
Public, Private
LOCATION
Vista Protection, Central Community Gathering Space
SIZE
11,000 SF – 2 Acre
SPACING
75+ Unit Communities, or Large Retail / Office Properties

- **Green –** A Green is a public community space available for civic purposes, commercial activity, unstructured recreation and other passive uses. Greens are primarily naturally landscaped with many shaded places to sit. The space may include thoughtful open lawn areas, paths, civic elements, fountains or open shelters. Greens are typically adjacent to a public right of way and are spatially defined by buildings which front onto this space.

NEIGHBORHOOD PARK





GENERAL CHARACTER
TYPE
Aesthetic, Recreation, Environment, Buffer
CLASSIFICATION
Public, Private
LOCATION
Typically within Residential Communities
SIZE
2 – 10 Acre
SPACING
Within 1/2 Mile - 1 Mile of Each Residential Unit*

- **Pocket Park –** Small and frequently dispersed throughout the community, these infill spaces support passive recreation that ensures walkable green space access for everyone within the immediate neighborhood. They may contain specialized facilities that serve a specific demographic or limited population or group such as tots, pets or senior citizens. Thematic elements and uses may be determined by the needs of the target demographic or the nature of the location within the community. Pocket Parks must be adjacent to a public right of way and be fully developed and maintained as finished recreational open spaces. Native landscapes and natural areas do not constitute a Pocket Park.

POCKET PARK





GENERAL CHARACTER
TYPE
Aesthetic, Recreation
CLASSIFICATION
Public, Private
LOCATION
In Neighborhoods Along Minor Collectors or Local Roads
SIZE
20,000 SF – 1 Acre
SPACING
Within 1/2 Mile of Each Residential Unit*

* Each residential unit should be within 1/4 mile of a pocket park, neighborhood park, or regional park.

- **Neighborhood Park –** The neighborhood park remains the basic unit of the local open space system and serves as the recreational and social focus of the neighborhood. The focus is on informal active and passive recreation. The park should be centrally located within the neighborhood and may function as the recreational hub of adjacent neighborhoods. These parks are frequently developed adjacent to civic uses such as an elementary school.

  Parks should be connected to the greater community through multi-use pathways or trails. Parks should also be adjacent to a public right of way on at least one side, with a minimum of 25 percent of the total park perimeter on a street.

REGIONAL PARK





GENERAL CHARACTER
TYPE
Aesthetic, Recreation, Environment, Buffer
CLASSIFICATION
Public
LOCATION
Near Important Intersections, or Community / Civic Buildings
SIZE
11 – 100+ Acre
SPACING
Within 3 Miles of Each Residential Unit*

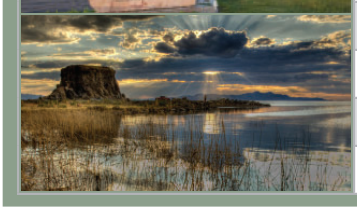
* Each residential unit should be within 1/4 mile of a pocket park, neighborhood park, or regional park.

- **Regional Park –** Regional parks are diverse in nature, serving a broader purpose than the neighborhood or pocket park. While there may be overlap in amenities within these park categories, the focus of a regional park is meeting regionally-based recreation, athletic, and open space needs. These parks should be centrally located within the greater region and should function as the recreational hub for the region. Regional parks should be connected to the region through multi-use pathways, trails, and streets with a minimum of 50 percent of the total park perimeter on a street.

SPECIAL USE







GENERAL CHARACTER
TYPE
Aesthetic, Recreation, Environment, Historic
CLASSIFICATION
Public, Private
LOCATION
Varies
SIZE
Varies
SPACING
N/A

- **Special Use –** This category covers a broad range of parks and recreation facilities oriented toward single purpose uses. Special uses generally fall into three categories: Historic/Cultural/Social Sites (ex. Historic areas, performing arts parks, arboretums, ornamental gardens, indoor theaters, churches, public buildings and amphitheaters). Recreation facilities (i.e., either specialized or single-purpose facilities) fall into this category, for example, community centers, senior centers, hockey arenas, golf courses, campgrounds, skate and water parks. Frequently, community buildings and recreational facilities are located within parks.

- **Community Garden –** Space programmed specifically for edible or ornamental gardening. Located in the center of a neighborhood to provide convenient and safe access. Oftentimes, community gardens may be included in pocket parks and parks. They are a valued asset in urban or higher intensity areas where residential yards are rare.

  Community orchards and vineyards may also be included in this category of open space as long as they are operated as a non-profit organization that provides produce to the local community and they are not a commercial or agricultural use. Appropriate irrigation sources must be provided, and the garden must be locally managed and maintained. Seasonal farmer's markets may occur in these spaces.

COMMUNITY GARDEN



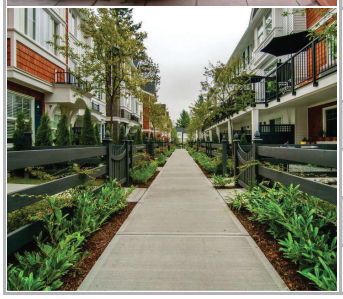


GENERAL CHARACTER
TYPE
Aesthetic, Historic, Environment
CLASSIFICATION
Semi-Public, Private
LOCATION
Typically within Residential Communities
SIZE
Neighborhood Context Appropriate
SPACING
300+ Unit Communities, or Rural Communities

PASEO

GENERAL CHARACTER
TYPE
Aesthetic, Connective Link
CLASSIFICATION
Public
LOCATION
Key Through-Blocks Connecting Adjacent Non-Homogeneous uses
SIZE
Minimum Width 15 FT
SPACING
N/A



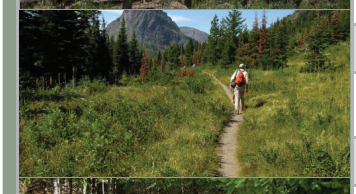


- **Paseo –** Pedestrian passages or paseos are linear public community spaces that connect one street to another at through-block locations. Pedestrian passages create linkages through buildings or lots at designated locations. These pathways may provide direct pedestrian access to residential, commercial, office, or educational addresses. Pedestrian passages allow for social and commercial activity to spill into the public realm and should consist of a hardscape pathway with landscaped edges and must be connected to public paths or thoroughfares at both ends of the corridor.

TRAIL

GENERAL CHARACTER
TYPE
Aesthetic, Recreation, Historic, Connective Link
CLASSIFICATION
Public
LOCATION
Drainage and Canal Corridors**; and Natural Open Space Areas
SIZE
Minimum Clear Surface Width 6 FT
SPACING
N/A





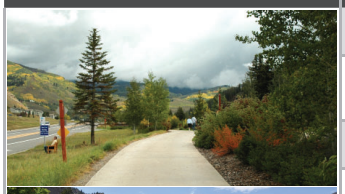


- **Multi-Use Path –** A multi-use path is an improved linear public transportation and recreation corridor that accommodates two or more users on the same, undivided pathway. Path users could include pedestrians, bicyclists, skaters, etc. A multi-use path frequently provides an important place for active recreation and creates a connection to regional paths and biking trails. Multi-use paths should be clearly defined with refined paving materials that provide for safe use and low maintenance.

  Pedestrian amenities add to recreational opportunities, and may include drinking fountains, scenic viewpoints, fitness stations, bike repair stations, and directional signs. These elements may be spread along the pathway or grouped in high use areas.

MULTI-USE PATH

GENERAL CHARACTER
TYPE
Aesthetic, Recreation, Connective Link
CLASSIFICATION
Public, Private
LOCATION
Drainage, Canal, and Road Corridors**; and Between Open Spaces and Communities
SIZE
Minimum Paved Width 10 FT
SPACING
N/A







**All Drainage, Canal, and Major Road Corridors should contain a multi-use path or trail.

- **Trail –** A trail is an unimproved, or semi-improved, linear public transportation and recreation corridor that traverses more natural areas or connecting corridors. Trails could include pedestrians, bicyclists, and equestrian users. A trail provides an important place for active recreation and serves as the backbone for regional non-vehicular connectivity.

  Pedestrian amenities add to recreational opportunities, and may include drinking fountains, scenic viewpoints, fitness stations, bike repair stations, parks, and directional signs. These elements may be spread along the pathway or grouped in high use areas.

STREAM/RIVER CHANNEL OR CANAL

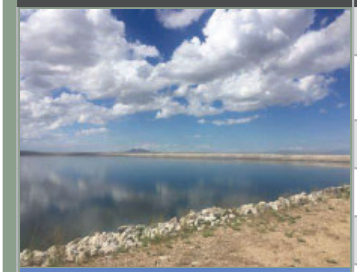


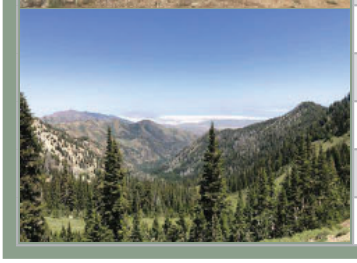


GENERAL CHARACTER
TYPE
Aesthetic, Recreation, Environment
CLASSIFICATION
Public, Private
LOCATION
Stream/River Channel or Canal
SIZE
N/A
SPACING
N/A

- **Stream/River Channel or Canal -** Linear space defined by a waterway. The space should serve as a pedestrian connection or recreational opportunity, enhancing adjacent property values. It can serve as a secondary connection to a natural open space or a greenway. Paths and trails that parallel a water course may also serve as maintenance easements, and serve to enhance, support, and connect other regional trail networks.

SENSITIVE LANDS





GENERAL CHARACTER
TYPE
Aesthetic, Recreation, Environment, Buffer
CLASSIFICATION
Public, Private
LOCATION
N/A
SIZE
N/A
SPACING
N/A

- **Sensitive Lands –** Sensitive Lands contain elements that can influence or limit development through physical or regulatory restrictions. The types of lands represented in this typology may include steep slopes, wetlands, critical habitats, stream corridors, ridgelines, and unique vegetation patterns. Non-physical, locational characteristics, such as critical viewsheds and highway corridor buffers, may also be factors that determine the extent of sensitive land designations. Additional elements may relate to historic or culturally significant landforms or existing development patterns or structures. Preservation of these areas in a natural state may be based on regulatory controls, cost controls or amenity-based strategies.

- **Natural Open Space & Greenway –** Natural open space or greenway areas may occur at the edges of the rural neighborhoods or serve as boundaries to development. These may be areas of hillsides, forests, rangelands, or agricultural land that lies outside of the development limits.

  Selection of an area for preservation may not be required by legislation or ordinance but may be preserved through formal open space or preservation easements or by definition within a development agreement. Trails or raised trails may occur in these areas with low impact paving materials so there is minimal disturbance to the existing landform and vegetated patterns. Developed trail heads at key locations may contain parking and other facilities to support recreational opportunities.

NATURAL OPEN SPACE & GREENWAYS





GENERAL CHARACTER
TYPE
Aesthetic, Recreation, Environment, Historic, Buffer
CLASSIFICATION
Public, Private
LOCATION
N/A
SIZE
N/A
SPACING
N/A

Preferred Concept

Following the public outreach the feedback was analyzed and a preferred concept created. This concept was a direct result of the key themes, ideas, and concerns residents had for the study area. As additional information was provided from City staff, residents, and property owners, further refinement was made to the concept plan. This plan incorporates portions of each of the preliminary concepts as selected by residents (see concept on the following page). The table below delineates the plan by total acreage, total residential units, acreage and percentages of land uses, and overall job creation.

PREFERRED CONCEPT		
GENERAL PROJECT INFO		
Total Acres	10,635	
Total Residential Units	25,240	
Residential Units / Acre	2.37	
Network Roads Acres	492	
Outside Growth Boundary Acres	347	
OPEN SPACE		
Community Open Space / %	1,732 acres / 16.3%	
Local Open Space / %*	1,458 acres / 13.7%	
Total Open Space / %*	3,190 acres / 30%	
LAND USES		
Population / Facility	**AC**	**Jobs**
Commercial	313	6,850
Office	196	8,250
Civic	355	2,850
Religious	145	--
Flex-Use / Manufacturing	916	21,200
NON-RESIDENTIAL TOTAL	**1,925**	**39,150**
High Intensity	465	--
Medium Intensity	1,999	--
Low Intensity	3,131	--
Very Low Intensity	987	--
RESIDENTIAL TOTAL	**6,139**	**--**

*Local Open Space is not included in the preferred scenario, but is required as part of the 30% open space



This information and plan represents the vision of Grantsville City and its residents, a sustainable balance of land uses, best practices in large long-ranged master planned communities, smart growth principles, and a development time horizon of over 60 years. The mix of development and services facilitates the future needs and demands as the City grows. The mix supports maintaining Grantsville City's existing growth patterns, and character, as the overall density is less than the existing City's average. This plan also provides for growth in commercial development and employment centers, open space networks and recreation, 1/2 mile transportation corridor network, general connectivity, environmental constraint planning and mitigation, and preservation of historic Grantsville.

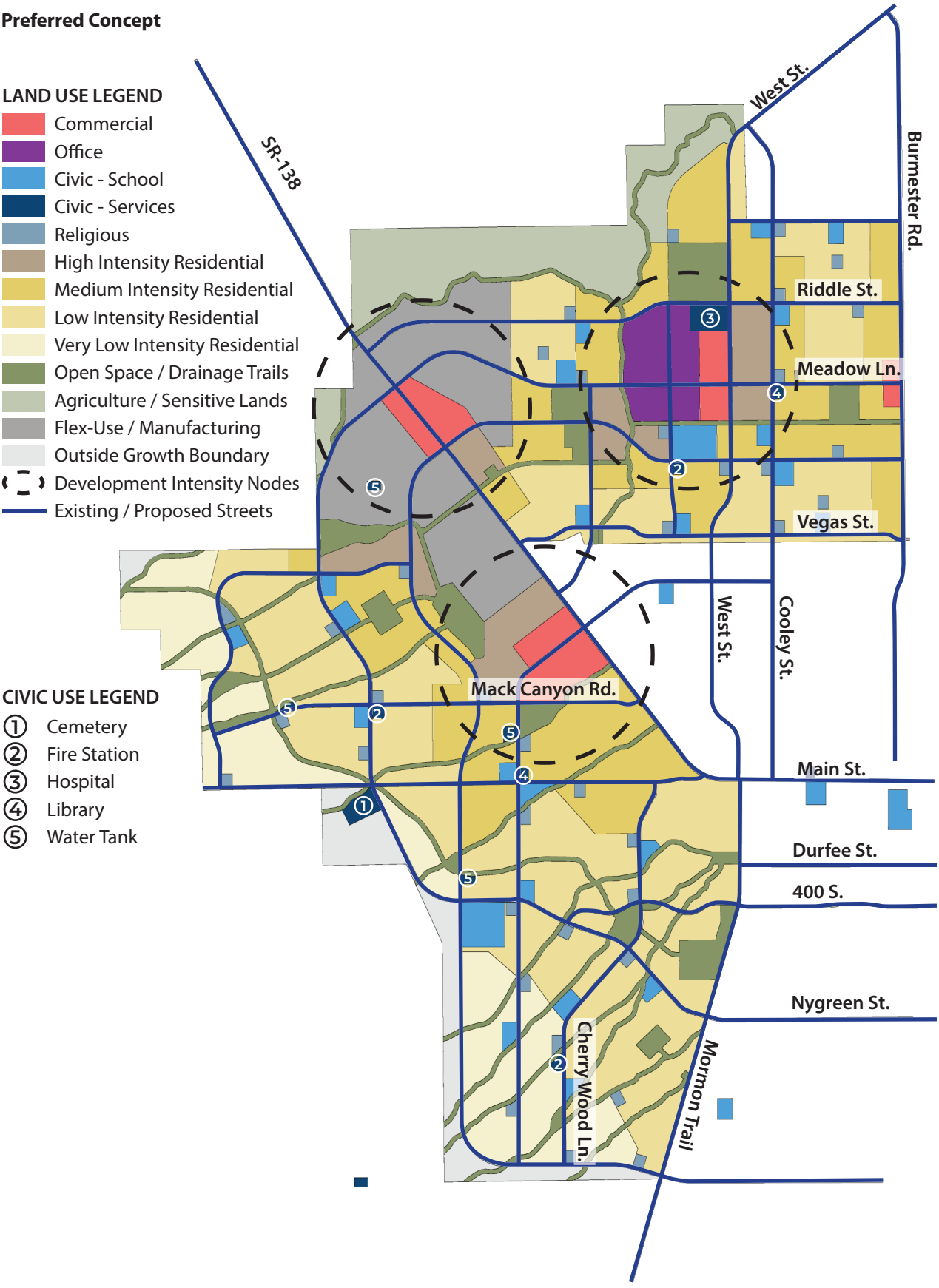
The Land Use and Civic Use Legends provide clarity for the plans distribution of uses and services, keeping with best practices in the location and response times of emergency services. This plan also distributes open space, civic, and religious uses based on trends in communities across Utah and the Western United States.

Residential Property Types Minimum Lot Sizes

- **Detached****
  - Large Lot SF – 21,780 SF / lot
  - Medium Lot SF – 7,000 SF / lot
  - Small Lot SF – 3,000 SF / lot
- **Attached****
  - Twinhome – 1,500 / unit
  - Triplex – 1,500 / unit
  - Fourplex – 1,500 / unit
  - Townhomes – 1,800 SF / lot
  - Condos – 600 SF / unit
  - Apartments – 600 SF / unit

**Minimum square footage over 1,000 square feet not including a garage can not be regulated by a City according to Utah House Bill 98 unless agreed to in a development agreement.

Preferred Concept



Road Network Adjustments:

- Burmester Rd. "T"s into West St.
- West St./Mormon Trail becomes the new interchange road
- Moderate to High intensity grid road network
- Main St. SR-138 Unchanged
- Nygreen St./Meadow Ln. Bypass Loop
- Secondary Bypass Loop South of Nygreen/Meadow Ln. Bypass Loop
- Main St. / Mack Canyon Rd. continuation to the West

Land Use Adjustments:

- Use of high intensity residential supporting flex-use / manufacturing land use west of SR-138 and around the office / commercial centers
- Regional Park north of Riddle St.
- Regional Park West of the Walmart Distribution Center
- Moderate to High intensity of trails
- Significant office land use centered on West St. and Meadow Ln. intersection
- More low and very-low intensity residential
- Significant open space, agriculture, and sensitive lands preserved in concept
- Land use buffers around historic Grantsville

Implementation

The following steps should be taken upon approval of the West Bank and Northwest Area Master Development Plan and Capital Facilities Plan:

1. **Attach the Community Character Standards to Development Agreements for Projects within the Study Area**
   As part of Utah House Bill 98 municipalities are allowed to impose requirements "for a building design element on a one to two family dwelling or townhome...agreed to under a development agreement." *https://le.utah.gov/~2021/bills/static/HB0098.html*. These community character standards help create high quality amenity rich communities that preserve the character and culture of Grantsville without incurring significant cost on the part of the developer.

2. **Adjust the General Plan Future Land Use Map to Reflect the Study Area Preferred Concept**

   Several locations on the map have been identified that would modify the existing general plan land use map. These areas of adjusted land uses should be updated as part of this plan's adoption. Zoning updates may be done in the near-term or as development or redevelopment occurs. Those locations that increase intensity may help to meet specific State requirements for moderate-income housing.

3. **Integrate the Road Network Into the Recently Updated Transportation Master Plan (TMP)**

   In this process we corresponded with the project team for the TMP and City Staff to incorporate proposed development, and transportation networks. Street networks in a few key locations were modified to incorporate a more regional approach to connectivity west of SR-138, and West St. becoming the new interchange road which connects to Rush Valley.

4. **Require FEMA's Steps in the "Best Practices for Building and Developing on Alluvial Fans" Document** (*floodhazards.utah.gov/wp-content/uploads/2021/11/AlluvialFanFINAL.pdf*)
   - **Step One:** Map the Alluvial Fan
   - **Step Two:** Avoid Any Development in an Alluvial Fan
   - **Step Three:** Mitigate Your Risk
   - **Step Four:** Consider Building Codes When Permitting Development or Redevelopment
   - **Step Five:** Protect Your Home or Business

5. **Adjust the Grantsville City Growth Boundary Map**

   Adjust the City's growth boundary map to reflect the study area boundary

6. **Adopt a Growth Boundary for the West Bank**

   Add a growth boundary to the zoning map restricting development beyond the line delineated on the Foothills Zone Map on page 25

05
CAPITAL FACILITIES PLAN

"Any developed areas need to have the road structure to accommodate it...Housing developments need to take into account the impact on services, schools roads, utilities, and infrastructure."

- SURVEY PARTICIPANT

Introduction & Background

This Capital Facilities Plan (CFP) covers the transportation, culinary water, sewer water, storm water, and preliminary geotechnical investigation of the West Bank and Northwest Area Master Development Plan (MDP). This chapter will cover the five subsection previously mentioned and provide detailed summaries of the facilities and infrastructure required for this development area. These capital facilities sections look at provided data of areas outside of the study's boundary for a universal view on how these facilities will complement existing and proposed City infrastructure.



Transportation

During the process of this MDP the City was completing the Transportation Master Plan for the existing City boundary. This MDP and CFP incorporated the information gathered for that process, and made modification and adjustments to create a unified network for the City and the study area.

Culinary Water

To accurately evaluate the hydraulics that result from a major trunkline network needed for the study, a hydraulic model was set up. The base model was created using the existing Grantsville system water model, provided by the city; a Digital Elevation Model (DEM) created by the JDE GIS department for the purpose of extracting spot elevations; and the Land Use Map created by the Psomas planning department. After creating the base model in ArcGIS Pro, the proposed water system's major trunkline network was modeled using the Innovyze InfoWater Pro Version 2023 program. This model allows for the evaluation of pressure zones, size pipes, locate pressure reducing valve (PRV) locations, optimize system layouts and configurations, test tank elevations and locations, and analyze different iterations of the system based on specific common scenarios. Due to the iterative nature of modeling, this software is extremely useful for providing a comprehensive, optimized view of the existing and future systems.

The existing system information was reviewed and used as the template for the future system to keep system components as uniform as possible. Because the existing system is already constructed and developed, it functions independently. Any changes made to the existing system are going to be more cost prohibitive than changes on undeveloped land and will upset existing users that are already a part of the system. To avoid user-upset and save on costs, the model planned for the existing and future systems to function separately. These considerations in the model will provide a high-functioning overall system while reducing the city's cost absorption to improve the existing water system.

The major road network proposed in this study was used as the skeletal structure to layout the trunkline network to future service areas. Because this is a feasibility study, this level of study did not require minor roads and developments to be modeled. To achieve system representation, junctions were strategically placed at the beginning, middle, and end of pipes; along major roads and intersections; and at other locations as necessary. Junctions were used to represent the nearby demand values based on the future land-use categories. The demand allocator tool within InfoWater was used to assign storage-demand data to the placed junctions, based on the nearest connection locations, and to associated land-use type assumed in the study's MDP.

Sewer Water

The Sewer Water Capital Facilities Plan (CFP) modeled the feasibility of expanding the West Bank area of Grantsville City. The expansion would involve the addition and development of 10,600 acres of land, characterized by a significant difference of 925 feet (ft) in elevation. The model assessed how the future sewer system could connect to the existing system and how the projected future land-use will influence the design of the new system.

The modeling efforts considered issues of land elevation, system connectivity, and projected land-use. This comprehensive approach aimed to facilitate the city's expansion while optimizing economic feasibility and efficiency of infrastructure development.

The model accounted for feasibility by allowing phased build-outs of the sewer system, rather than requiring the entire expansion be completed at once. A phased build-out refers to building smaller developments over time and developing the city utility systems just before the building of said developments. This allows impact fees to be commensurate with city expenses due to expansion and avoids furnishing facilities that are only at minimal capacity.

Due to the amount of land being developed, a phased build-out approach was taken in developing this model. Building in phases balances achieving the entire build-out and avoiding overextension of development. This gradual approach will enable a more cost-effective and economically viable expansion of the city, aligning with the city's needs for growth and development.

Storm Water

Grantsville City is located at the eastern base of the Stansbury Mountain Range and borders the south end of the Great Salt Lake. The terrain surrounding Grantsville slopes toward the Great Salt Lake in a northeastern-bound direction on the west side of the city and in a northern-bound direction on the south side of and through the city. This study looked at the watersheds that would affect the proposed West Bank area as seen in Figure 3.5. Project Area Basins.

The West Bank area of Grantsville was recently studied by FEMA and classified as an alluvial fan. These conditions result in water moving down the Stansbury Mountains and spreading out on the relatively flat landscape at the base of the mountains. The soil at the base of the mountain is mostly sand, gravel, silt, and clay, which naturally allows the water to spread out in braded stream networks and sheet flow conditions rather than staying in defined channels. As a result, FEMA draft mapping shows much of Grantsville in a Zone A flood zone as shown in Figure 3.6. FEMA Map Draft Base Level Engineering Results. These same conditions were also observed in this study and confirm FEMA's classification of the area as an alluvial fan. This report looked at design storms with standard 100-year return periods and 24-hour durations, often referred to as 100-year 24-hour storms.

The Capital Facilities Plan, prepared by Ensign Engineering in 2022, along with the Storm Water Management Study for Baker and Pope Watersheds Grantsville City and Tooele County, prepared by AQUA Engineering in 2015, were used as reference materials for this study. This study differentiates from the former studies with a more refined/updated analysis and the accommodation of the proposed developments. These differences are discussed in more detail within the body of this report.

As Grantsville continues to develop to the west, additional infrastructure should be constructed to handle flows from the upstream watersheds and to stabilize the alluvial nature of the drainage. This will provide additional protection to the proposed developments and existing City.

This study will look at two approaches for handling stormwater. The first aspect is controlling external flows, defined as flows originating outside the study boundary, primarily from the Stanbury Mountains. The external flows will be captured by cutoff channels and directed to debris/detention basins to reduce peak flows through or around Grantsville. The second aspect is controlling internal flows, defined as drainage within the study boundary. Criteria defined in the Capital Facilities Plan (CFP) prepared by Ensign Engineering and recommendations provided in this study will require developments to manage and attenuate storm water that falls within the development and discharge as needed to defined channels.

Geotechnical

This report is intended to be preparatory, or preliminary study and should not be used for final design. It is intended to provide a high-level assessment of the geotechnical conditions that could impact future development of areas included in the proposed Grantsville West Bank study area. A more in-depth site investigation, with additional borings and engineering analysis, should be completed for the design of any new development in the area.

A seismic site evaluation is not included within this report, but one should be performed for any future projects. The conclusions and recommendations presented in this report are based on the data acquired and analyzed during this study, our engineering analysis, and on prudent engineering judgment and experience. This study does not include an assessment of potentially toxic or hazardous materials that may be present on or beneath the site. As mentioned previously, this report should not be used for final design and a thorough geotechnical investigation and geotechnical engineering analysis will be needed for each development project and street construction.

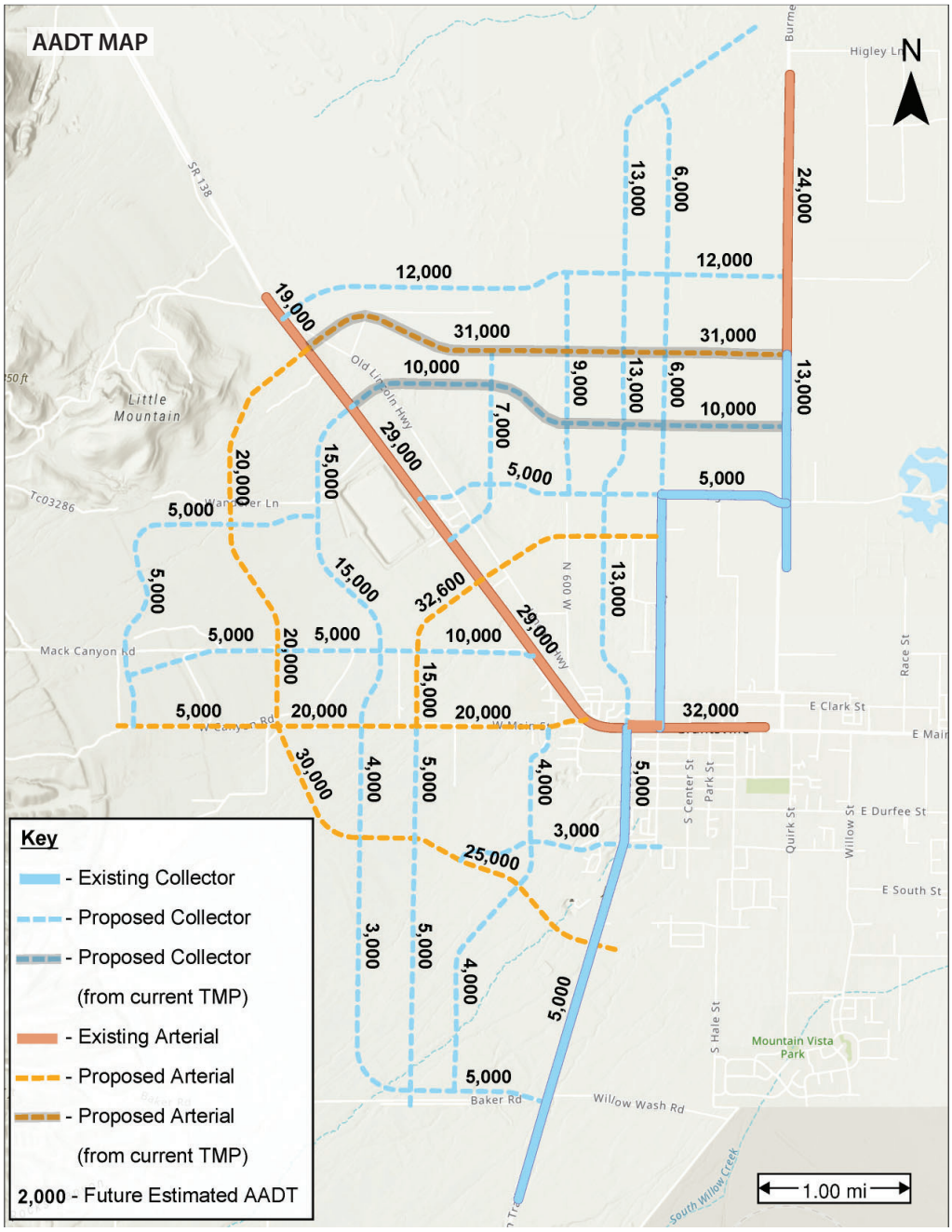
Pertinent geologic and geotechnical literature pertaining to the area and other project information was reviewed. The literature included various publications and maps issued by the United States Geological Survey (USGS) and Utah Geologic Survey (UGS). Details of the findings from the geologic and geotechnical literature will be discussed in the subsequent sections.

Transportation

Annual Average Daily Traffic (AADT)

The projected future AADTs completed for this study were based on the land uses and roadway network shown in the Grantsville West Bank Master Development Plan Preferred Concept Plan.

Trip generation rates published in the Institute of Transportation Engineers (ITE) Trip Generation,11th Edition were used to calculate the number of daily trips generated by each area in the Preferred Concept. These trips were assigned to the roadway network based on local and regional trip attractions. Trip attractions include commercial and employment areas both inside and outside the study area. Trips were assigned to roadways designated as collectors or arterials in this plan and in the Grantsville Transportation Master Plan (TMP) (August 2022).

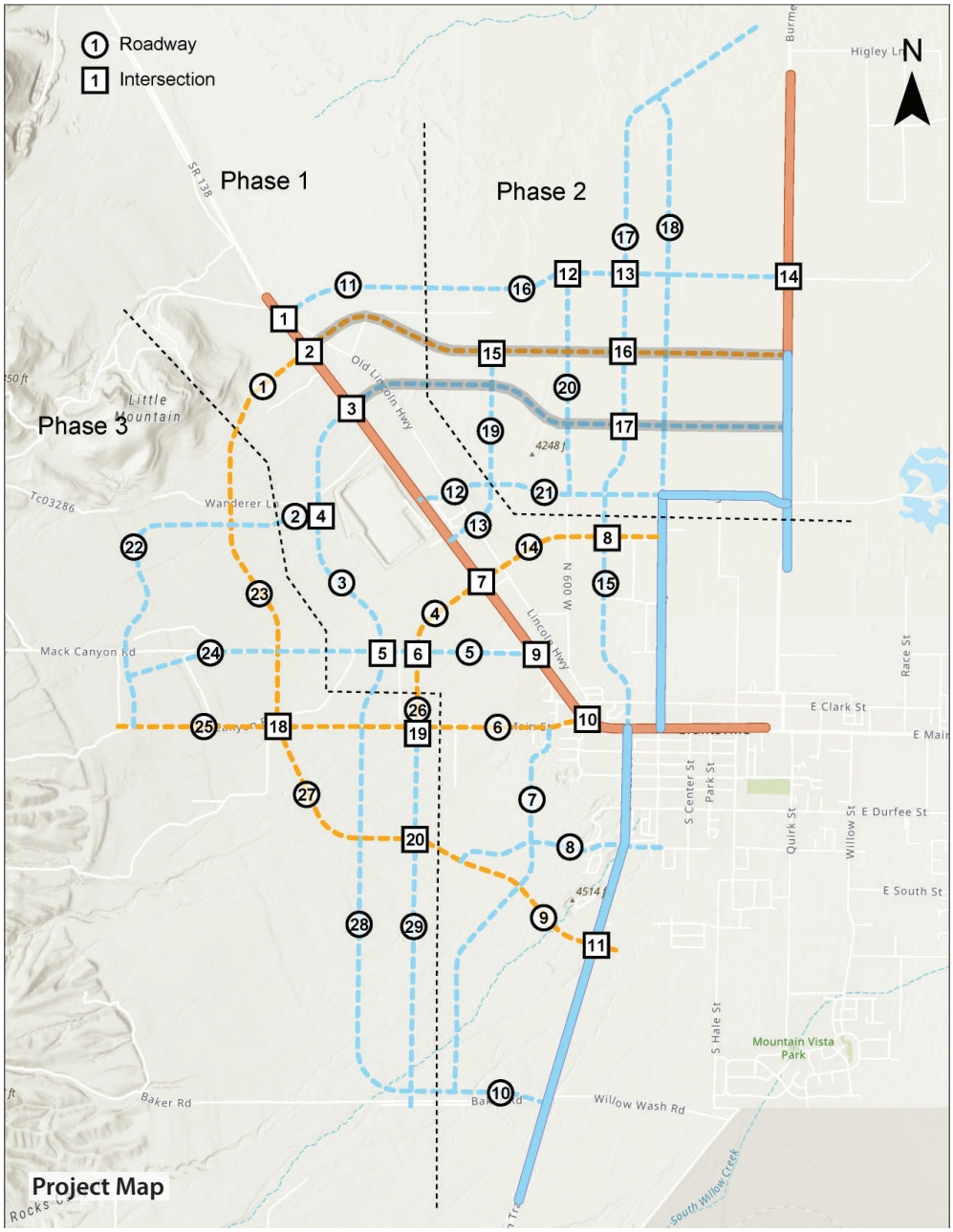


Functional Classification

The functional classification of each roadway shown in the Preferred Concept was designated based on functional classifications established in the Grantsville TMP and following the ITE guideline that arterial roads should be spaced approximately one mile apart.

Roadways in the Preferred Concept that coincide with arterial roadways in the Grantsville TMP were designated as arterials. Roadways in the Preferred Concept that were extensions of arterial roadways in the Grantsville TMP were also designated as arterials.

Additional roadways in the Preferred Concept were designated as arterials such that the ITE recommended arterial spacing of one mile would be met where possible. All other roadways in the figure were designated as collectors.



Future Projects

New roadways that will need to be constructed in the Grantsville West Bank area were identified in the attached figure, and a brief description and cost estimate has been provided in the attached tables. The roadway sizes (number of lanes) were determined using the LOS thresholds for ADT outlined in Table 3 and Table 4 in the Grantsville TMP for arterial and collector streets. Streets were sized such that with future 2050 AADTs the roadways would operate at LOS D or better.

Intersection projects were identified considering the functional classification and AADT of each roadway and the combined 2050 AADT of each intersection.

Any intersection of two arterial roadways, any intersection of an arterial roadway and a collector roadway with a future 2050 AADT of more than 5,000, or any intersection where the combined 2050 AADT would be greater than 55,000 was identified as a location for a future traffic signal. Intersections with a combined 2050 AADT between 25,000 and 55,000 was identified as a location for a future dual-lane roundabout. Intersections with a combined 2050 AADT of 25,000 or less were identified as locations for future single-lane roundabouts. Intersections with a combined 2050 AADT of less than 15,000 or with one or more legs with a future 2050 AADT of less than 5,000 were not identified as locations for future traffic signals or roundabouts and were assumed to be stop-controlled.

Future Roadway Projects

Project Number	Description	Improvement Scope	Proposed	Length (ft)	Right of Way	Design and Construction	Total
Phase #1 (2023-2033)							
1	New Arterial	New Roadway	5	4230	$6,479,514	$13,156,990	$19,636,504
2	New Collector	New Roadway	3	1700	$2,181,780	$3,807,230	$5,989,010
3	New Collector	New Roadway	3	12100	$15,529,140	$27,098,519	$42,627,659
4	New Arterial	New Roadway	5	5310	$8,133,858	$16,516,222	$24,650,080
5	New Collector	New Roadway	3	8040	$10,318,536	$18,005,958	$28,324,494
6	New Arterial	New Roadway	5	5450	$8,348,310	$16,951,678	$25,299,988
7	New Collector	New Roadway	3	14950	$19,186,830	$33,481,228	$52,668,058
8	New Collector	New Roadway	3	7650	$9,818,010	$17,132,535	$26,950,545
9	New Arterial	New Roadway	5	7980	$12,223,764	$24,820,989	$37,044,753
10	New Collector	New Roadway	3	4240	$5,441,616	$9,495,679	$14,937,295
11	New Collector	New Roadway	3	5850	$7,507,890	$13,101,350	$20,609,240
12	New Collector	New Roadway	3	2870	$3,683,358	$6,427,500	$10,110,858
13	New Collector	New Roadway	3	2770	$3,555,018	$6,203,545	$9,758,563
14	New Arterial	New Roadway	5	7300	$11,182,140	$22,705,917	$33,888,057
15	New Collector	New Roadway	3	8270	$10,613,718	$18,521,054	$29,134,772
Phase #2 (2033-2040)							
16	New Collector	New Roadway	3	13020	$26,517,834	$46,273,910	$33,238,239
17	New Collector	New Roadway	3	19070	$38,839,869	$67,775,995	$48,683,043
18	New Collector	New Roadway	3	15050	$30,652,335	$53,488,659	$38,420,545
19	New Collector	New Roadway	3	5010	$10,203,867	$17,805,859	$12,789,829
20	New Collector	New Roadway	3	8320	$16,945,344	$29,569,810	$21,239,796
21	New Collector	New Roadway	3	6630	$13,503,321	$23,563,442	$16,925,463
Phase #3 (2040-2050)							
22	New Collector	New Roadway	3	12760	$44,025,828	$76,825,550	$32,574,495
23	New Arterial	New Roadway	5	11440	$47,111,064	$95,661,465	$38,483,162
24	New Collector	New Roadway	3	7550	$26,049,765	$45,457,124	$19,274,094
25	New Arterial	New Roadway	5	12310	$50,693,811	$102,936,420	$41,409,766
26	New Arterial	New Roadway	5	1160	$4,776,996	$9,699,939	$3,902,139
27	New Arterial	New Roadway	5	8590	$35,374,479	$71,829,719	$28,896,010
28	New Collector	New Roadway	3	17230	$59,448,669	$103,738,576	$43,985,780
29	New Collector	New Roadway	3	14280	$49,270,284	$85,977,183	$36,454,843

Future Intersection Projects				
Project Number	**Description**	**Responsibility**	**Improvement Scope**	**Estimated Cost**
Phase #1 (2023-2033)				
1	New Collector / Main St	UDOT	New Signal	$483,000
2	New Arterial / Main St	UDOT	New Signal	$517,500
3	New Collector / Main St	UDOT	New Signal	$483,000
4	New Collector / New Collector	City	New Roundabout (1-Lane)	$1,559,578
5	New Collector / New Collector	City	New Roundabout (1-Lane)	$1,559,578
6	New Arterial / New Arterial / New Collector	City	New Signal	$483,000
7	New Arterial / Main St	UDOT	New Signal	$517,500
8	New Arterial / New Collector	City	New Signal	$483,000
9	New Collector / Main St	UDOT	New Signal	$483,000
10	New Arterial / Main St	UDOT	New Signal	$517,500
11	Nygreen St / Mormon Trail Rd	City	New Signal	$517,500
Phase #2 (2033-2040)				
12	New Collector / New Collector	City	New Roundabout (1-Lane)	$2,474,982
13	New Collector / New Collector	City	New Roundabout (1-Lane)	$2,474,982
14	New Collector / Burmester Rd	City	New Signal	$766,500
15	New Collector / New Arterial	City	New Signal	$766,500
16	New Collector / New Arterial	City	New Signal	$766,500
17	New Collector / New Collector	City	New Roundabout (2-Lane)	$3,268,418
Phase #3 (2040-2050)				
18	New Arterial / New Arterial	City	New Signal	$1,391,250
19	New Arterial / New Arterial	City	New Signal	$1,391,250
20	New Arterial / New Collector	City	New Signal	$1,391,250

Culinary Water

System Performance Scenarios

The hydraulic model was used to check multiple scenarios for system performance in accordance with Utah drinking water laws. The scenarios evaluated include Average Day Demand (ADD), Peak Day Demand (PDD), Peak Instantaneous Demand (PID), and PDD + Fire Flow. The scenarios include minimum system pressures that must be checked for system function.

Average Day Demand (ADD) represents the average volume of water consumed or demanded by users within a specific area over a 24-hour period. ADD is an important parameter used in water distribution system modeling to estimate the water requirements and plan for adequate supply.

Peak Day Demand (PDD) represents the maximum water demand that occurs within a water distribution system during a typical day. This parameter is useful for sizing pipes, pumps, and storage facilities to ensure that the system can handle the peak demand and maintain sufficient water pressure.

Peak Instantaneous Demand (PID) refers to the maximum rate of water consumption that occurs within a water distribution system at any given instant. It represents the highest demand experienced by the system and is crucial for sizing infrastructure components such as pipes, pumps, and storage facilities to ensure adequate capacity to meet peak demands and maintain system performance.

PDD + Fire Flow combines the concepts of Peak Daily Demand (PDD) and Fire Flow. Fire Flow refers to the amount of water required to combat a fire in a specific area. By considering both the peak daily demand and the additional demand for fire suppression, water modeling helps determine the necessary infrastructure capacity to effectively meet these requirements.

Modeling Design Factors

The hydraulic model was created to evaluate future scenarios. The Equivalent Residential Connection (ERC) section below describes the assigned rate values per ERC by scenario. These calculations were used as a global demand factor and adjusted for the required scenario.

Fire-flow tests were not performed to calibrate the model, because the model represents a future system, making fire-flow tests impossible. Hazen-Williams roughness values were assigned based on pipe material. A roughness value of 150 was used for PVC, which is the assumed material for the future system. The system model was continually updated as adjustments were made during the modeling process. The model represents the estimated conditions that will occur once Grantsville City has achieved full build-out.

Conversion factors to determine the various demand scenarios were determined by using the Grantsville City Capital Facilities Plan (CFP) and were applied to the future model. The conversion factors are shown in Table 1.1. Conversion Factors for Water Model.

Table 1.1. Conversion Factors for Water Model

	Demand (gdp/ERC)	Conversion Factor
Average Day Demand	807	1.00
Peak Day Demand	1,416	1.7546
Peak Instantaneous Demand		2.1*
Fire Flow	2,050	n/a

*Based on 5,000 ERCs per pressure zone and using the equation PID= (10.8 (ERCs in zone)^.64)/(ERCs in zone)+1.58

Water Demand Analysis

Several proposed land-use maps were developed by Psomas and reviewed by City officials and residents. With public input, Grantsville City selected one of the proposed future land-use map options, which was then used to determine projected water usage.

- **Equivalent Residential Connection (ERC) projections –** ERC calculations are commonly used in water modeling to estimate water demand, assess system capacity, and plan for future water supply requirements. This study utilized ERC calculations for the following purposes:
  - **Quantifying Water Demand:** By assigning an ERC value to different land-uses or developments, water demand can be quantified and compared across various sectors. This allows water planners and modelers to estimate the total water consumption based on the number of equivalent residential connections associated with each land-use type.

- **Evaluating System Capacity:** Water modeling involves assessing the capacity of water supply systems, including sources, treatment plants, storage facilities, and distribution networks. By converting the water demand of different land uses into ERC units, modelers can analyze the impact of various developments on the overall system capacity and identify potential constraints or areas of concern.
- **Planning and Scenario Analysis:** Water modeling often involves evaluating different scenarios and planning for future water supply needs. ERC calculations enable modelers to estimate the additional water demand generated by new developments or changes in land use patterns. This information helps in evaluating the adequacy of existing infrastructure, identifying necessary upgrades or expansions, and making informed decisions regarding water resource management and allocation.
- **Conservation and Efficiency Analysis:** Equivalent Residential Connection values can be used to assess the effectiveness of water conservation measures or efficiency improvements. By comparing the water demand before and after implementing water-saving initiatives, the impact in terms of the number of ERCs can be determined. This analysis aids in understanding the potential water savings and benefits of conservation strategies.

Overall, ERC calculations provide a standardized approach for quantifying and comparing water demand across different land-uses in water modeling. They assist in assessing system capacity, planning for future needs, and evaluating the impact of various factors on water resources and infrastructure.

- **ERC Calculations –** ERCs were calculated for the West Bank study by considering the storage-demand per acre associated with specific land-use categories. Utah Code R309-510 for land-use was utilized as a foundation and supplemented by general land-use trends observed in the state. See Exhibit 1. Minimum Sizing Requirements. By assigning appropriate demands to each land-use type, the system was effectively modeled to assess feasibility and provide accurate projections.

ERCs are the standard method for allocating water demands in civil engineering. ERCs are used to create a baseline to compare water usage from different land use categories. The basic unit of an ERC is a residential unit, which is one ERU. Other land-use categories, industrial or commercial for example, may have much larger demands than a residential unit, and so more demand is allocated to those land uses. For example, an industrial building may require 15 times more water, so the industrial land-use would have 15 ERCs compared to the 1 ERC for a residential unit.

ERCs are calculated by dividing the average residential sewer demand by the number of residential units.

$$ERC = \frac{total\ residential\ water\ demand}{total\ \#\ of\ residential\ units}$$

After the demand per ERC has been calculated, the number of ERCs can be found for the non-residential land use categories. Table 1.2. ERCs by Connection Type shows the quantity of ERCs per connection-type in the West Bank Study. The amount of ERCs per acre was used to determine the demand allocations for the water model.

Table 1.2. ERCs by Connection Type

Connection Type	Acres	ERCs
Attached Residential	458.00	2,640.71
Mixed Residential	1,696.00	7,140.92
Detached Residential	2,886.00	9,396.99
Detached Rural Residential	954.00	1,947.39
Churches	144.19	225.14
Civic Uses	73.36	63.67
Commercial	296.20	266
Flex Use/Distribution	917.19	1,236
Office	213.24	279
Open Space	1,063.70	3,929
Outside Growth Boundary	328.12	1,269
Agriculture/ Sensitive Lands	683.39	2,186.86
Schools	283.58	380.06
Total	9,996.97	30,960.54

- **Level of Service Requirements –** According to the Grantsville CFP, Grantsville City currently has a total of 5,975 ERCs, and this model anticipates that the number of additional ERCs after full build-out is 30,961 ERCs, equaling a total of 36,936 ERCs or a 518.18% increase of ERCs. This represents a significant increase and will require all levels of the water system be increased to accommodate such a level of expansion.

  Table 1.3. Level of Service Requirements lists the necessary increases in source requirements, storage requirements and water rights to accommodate the future system at full build-out. Note: the water model was designed to accommodate construction in phases. This means that the system will be able to function without an entire build-out. Smaller phases can be constructed, allowing the cost of water system development to remain consistent with the growing expansion of the city.

Table 1.3. Level of Service Requirements

Source Requirements	33,548.30	Pump Rate (gpm)
	50,322.45	Well Capacity (gpm, safe yield)
Storage Requirements	492,000	Fire Flow Storage (gallons)
	863,618.9	Indoor Storage (gallons)
	12,292,535.6	Outdoor Irrigation Storage
	13,648,154	Total Storage (gallons)
Water Rights	74.75	Diversion Amount (cfs)
	42,048.06	Annual Diversion (ac-ft)

Water Rights

Grantsville City holds a considerable volume of water rights acquired from several sources, namely Well 3 Park, Well 4 South, South Willow Well, Hunsaker Well, and the North Well. These sources collectively contribute to the city's overall water supply infrastructure, ensuring a reliable water source for its residents and various purposes.

To meet the growing population's increasing demand and maintain the desired level of service at full build-out, Grantsville City must augment its existing water rights portfolio. To accommodate this requirement, an additional diversion amount of 74.75 cubic feet per second or an annual diversion of 42,048.06 acre-feet (ac-ft) per year is necessary. Water rights can be acquired in tandem with development to not pose a large, instantaneous risk and financial obligation to the city.

Source Needs

The city will need an additional 33,548.30 gpm or 50,322 gpm of safe-yield well water to accommodate future growth. This is based on the projected land use and the ERC calculations.

Grantsville's existing water supply source comes from five existing wells. As the city continues to grow and expand, additional wells will need to be located and drilled to keep up with demand. This study has not located new sources, since new wells would be best located by a hydrogeological engineer based on underground geological features at the time each is required .

Storage Needs

To ensure compliance with storage and pressure requirements for the anticipated influx of new residents, five additional storage tanks must be strategically positioned within the new build-out area. The size of each tank needs to be determined at the time of design to accommodate the development area that will be supplied. The location of these tanks should allow for a phased build out, starting with the construction of the tank closest to the next development and expanding outward until the entire West Bank area is developed. See Table 1.4. Tank Elevations and Tie-In Locations.

The extra tanks are designed to create internal redundancies in the system, in case of tank failure. The total storage requirement — including internal use, external use, and Fire Flow storage — is 13,648,154. The average storage per tank is approximately 275,000 gallons. However, each tank must be sized according to its service area.

- **Fire Flow –** To ensure public safety and to combat any fires that may happen within the city, every water tank must have a designed and designated fire flow reserved that can be drawn from in the event of an emergency. The required fire flow capacity for the West Bank area is 492,000 gallons at full build-out.

  The required fire flow reserve must be distributed throughout the different tanks in the system, and each tank must be designed and modeled to provide sufficient flow commensurate with the demands of its specific service area.

For phased build-out, each development within the West Bank study area must have adequate fire flow reserves before construction. The phased approach is still achievable, but the tank that will supply the fire flow reserve for that area must be built first.

- **Proposed Locations –** Implementing these additional storage tanks is crucial to meet the growing demands for water storage and to maintain optimal pressure levels within Grantsville's expanding community. Strategically locating the tanks will enhance the water distribution system's efficiency and effectiveness, ensuring an uninterrupted and reliable water supply for new residents.

Table 1.4. Tank Elevations and Tie-In Locations

ID	Elevation (ft)	Tie-In Location
Tank 1	5,052.85	Southwest corner of future system. Ties into pressure zone 9.
Tank 2	5,214.00	Westernmost fixture in future system. Ties into pressure zone 15.
Tank 3	4,640.00	Ties into pressure zone 1.
Tank 4	4,536.00	Ties into pressure zone 1.
Tank 5	4,530.00	Ties into pressure zone 16.

Transmission/Distribution System

- **Major Trunkline Layout and Sizing –** The system layout for the anticipated expansion into the Grantsville West Bank encompasses the integration of various essential components, including storage tanks, pressure reducing valves (PRVs), and major trunklines, see Figure 1.1. Proposed System Layout.

  To ensure the system's integrity and longevity, the trunklines were sized and calibrated to ensure optimum performance. The sizing of these trunklines was designed to prevent pipe velocities from exceeding 5 feet per second during normal PDD conditions and under 10 feet per second during PDD + Fire Flow conditions, thus mitigating the risk of high internal forces and unnecessary wear and tear on the system. By maintaining pipe velocities under 5 feet per second during PDD, the infrastructure is safeguarded, and its long-term sustainability is promoted.

  Moreover, the pipe sizing process also considers the objective of effectively meeting service demands. The pipes are sized to accommodate the projected water requirements and ensure an optimal flow rate throughout the system. The largest modeled pipe measures 42 inches in diameter located at the far west end of the West Bank development.

  This pipe supplies water to the system by connecting the westernmost tank to the pipe network. This specific pipe is located on the westernmost edge of the study area, where the steepest elevation changes are occurring, so the internal velocity of the water is a concern. The cross-sectional area was increased to lower the velocity and protect the pipe and system. While there is a range of pipe sizes, the majority of pipes in the system range from 8 inches to 30 inches in diameter. This range of pipe sizes strikes a balance between meeting the necessary service demands and ensuring efficient water distribution.

- **Pressure Zones –** The West Bank water distribution system model incorporates a total of 22 PRVs. The considerable quantity of PRVs is primarily attributed to the substantial difference in elevation, amounting to approximately 983 feet, observed across the system. See Figure 1.3. Proposed System Pressure Zone Overview.

  The significant variation in elevation leads to a rapid accumulation of pressure within the system. To maintain the desired pressure range and prevent any excessive pressure buildup, the installation of PRVs is essential. These valves play a crucial role in containing and regulating the pressure levels to ensure that the system operates within the targeted range.

  At the request of City personnel, the target pressure range throughout the system was set between 50-110 pounds-per-square-inch (psi). This range falls within the state's regulated range of 40-120 psi, and is carefully designed to protect homeowners from experiencing excessively high pressure while also guaranteeing sufficient pressure for the optimal utilization of home fixtures.

Table 1.5. Pressure Zones

Zone ID	Minimum Elevation (ft)	Maximum Elevation (ft)	Peak Day Demand	Equalization Storage	Pipe Length (ft)	Minimum Pressure	Maximum Pressure
PZM9	4828.8	4914.5	338.6	152,537	8357	66.7	102.8
PZM8	4712.8	4814.5	520.1	234,315	6176	53.6	97.4
PZM7	4845.1	4957.6	233.9	105,377	1945	52.1	100.1
PZM6	4826.9	4918.5	910.8	410,329	3683	65.9	104.2
PZM5	4851.5	4940.9	322.1	145,099	1829	59.2	97.7
PZM4	4679.4	4813.1	1425.1	642,036	14939	53.4	110.1
PZM3	4506.7	4659.6	3840.7	1,730,325	25450	56.9	115.6
PZM2	4222.7	4350.7	12213.5	5,502,441	124368	51.9	96.0
PZM17	4618.0	4655.7	272.1	122,577	2981	63.0	79.7
PZM16	4449.9	4449.9	217.1	97,817	2473	77.1	77.1
PZM15	4974.8	5090.0	287.1	129,331	8871	61.7	109.4
PZM14	4521.4	4684.7	1085.0	488,805	13385	52.5	122.8
PZM13	4517.6	4647.0	668.3	301,060	7105	50.4	106.4
PZM12	4690.6	4759.7	307.9	138,711	3814	74.7	104.3
PZM11	4630.0	4759.9	1865.0	840,219	16938	75.3	130.8
PZM10	4524.5	4596.1	399.4	179,938	3545	89.8	121.1
PZM1	4344.1	4523.3	4295.6	1,935,239	31353	57.4	130.4

Included below is the pipe summary by pressure zone that specifies how much piping is included in each pressure zone and the size of the piping. This is included to help with quantity estimates for each zone for a phased build-out. See Figure 1.2. Pipe Summary by Pressure Zone.

Future Improvement Impacts on Existing System

The implementation of looping and the addition of more water tanks in the existing system of Grantsville City will significantly enhance its robustness and enable the provision of consistent water pressure, even during scenarios involving high fire flow or substantial demand such as high drought years when Grantsville Irrigation Company is not able to provide irrigation water during peak demand. The design of the new system accounts for the avoidance of disruptive measures such as tearing up and replacing existing infrastructure.

By incorporating looping, water can flow through multiple interconnected pathways, creating redundancies, improving the system's resilience and making maintenance easier. This looping configuration ensures that water can be efficiently distributed from various directions, reducing the risk of pressure drops and enhancing the overall performance of the system.

Furthermore, the addition of more water tanks strategically placed within the system provides additional storage capacity, allowing for better regulation of water pressure and accommodating fluctuating demands. This ensures that the system can meet the needs of both regular water consumption and emergency situations, such as firefighting.

Importantly, the design of the new system aims to minimize the need for upsizing or changing existing lines within the town, thus avoiding the associated costs. By leveraging existing infrastructure and optimizing its functionality, Grantsville City can achieve system improvements and increased robustness while minimizing disruptions and expenditure.

The following Tables are sourced from Utah Code R309-510 and outline minimum sizing requirements for source demand, storage demand, and distribution systems.

Table 1.6. Utah Code R309-510-1 Source Demand for Indoor Use

Table 510-1 Source Demand for Indoor Use		
Type of Connection	Peak Day Demand	Average Yearly Demand
Year-Round Use		
Residential	800 gpd/conn	146,000 gal./conn
ERC	800 gpd/ERC	146,000 gal./ERC
Seasonal/Non-Residential Use		
Modern Recreation Camp	60 gpd/person	(see note 1)
Semi-Developed Camp a. With pit privies b. With flush toilets	 5 gpd/person 20 gpd/person	 (See note1) (See note 1)
Hotels, Motel & Resort	150 gpd/unit	(See note1)
Labor Camp	50 gpd/person	(See note1)
Recreational Vehicle Park	100 gpd/pad	(See note1)
Roadway Rest Stop	7 gpd/vehicle	(See note1)
Recreational Home Development	400 gpd/conn	(See note1)

Table 1.8. Utah Code R309-510-3 Source Demand for Irrigation

Table 510-3 Source Demand for Irrigation (Outdoor Use)		
Map Zone	Peak Day Demand (gpm/irrigated acre)	Average Yearly Demand (AF/ irrigated acre)
1	2.26	1.17
2	2.80	1.23
3	3.39	1.66
4	3.96	1.87
5	4.52	2.69
6	4.90	3.26

Table 1.9. Utah Code R309-510-4 Storage Volume for Indoor Use

Table 510-4 Storage Volume for Indoor Use	
Type	Volume Required(gallons)
Community Systems	
Residential; per single resident service connection	400
Non-Residential; per Equivalent Residential Connection (ERC)	400
Non-Community Systems	
Modern Recreation Camp; per person	30
Semi-Developed Camp; per person a. with Pit Privies b. with Flush Toilets	 2.5 10
Hotel, Motel, & Resorts; per unit	75
Labor Camp; per unit	25
Recreational Vehicle Park; per pad	50
Roadway Rest Stop; per vehicle	3.5
Recreational Home Development; per connection	400

R309-510-8(2)(b) Required equalization storage for indoor use is provided in Table 510-4. Storage requirements for non-community systems not listed in this table shall be determined by calculating the average day demands from the information given in Table 510-2.

Table 1.7. Utah Code R309-510-2 Source Demand for Indoor Use - Individual Establishments

Table 510-2 Source Demand for Indoor Use – Individual Establishments	
Type of Establishment	Peak Day Demand (gpd)
Airports a. per passenger b. per employee	 3 15
Boarding Houses a. for each resident boarder and employee b. for each nonresident boarders	 50 10
Bowling Alleys, per alley a. with snack bar b. with no snack bar	 100 85
Churches, per person	5
Country Clubs a. per resident member b. per nonresident member c. per employee	 100 25 15
Dentist's Office a. per chair b. per staff member	 200 35
Doctor's Office a. per patient b. per staff member	 10 35
Fairgrounds, per person	1
Fire Stations, per person a. with full time employees and food prep b. with no full time employees and no food prep	 70 5
Gyms a. per participant b. per spectator	 25 4
Hairdresser a. per chair b. per operator	 50 35
Hospitals, per bed space	250
Industrial Buildings, per 8 hour shift, per employee (exclusive of industrial waste) a. with showers b. with no showers	 35 15
Launderette, per washer	580
Movie Theaters a. auditorium, per seat b. drive-in, per car space	 5 10
Nursing Homes, per bed space	280
Office Buildings & Business Establishments, per shift, per employee (sanitary wastes only) a. with cafeteria b. with no cafeteria	 25 15
Picnic Parks, per person (toilet wastes only)	5
Restaurants a. ordinary restaurants (not 24 hour service) b. 24 hour service c. single service customer utensils only d. or, per customer served (includes toilet & kitchen wastes)	 35 per seat 50 per seat 2 per customer 10
Rooming House, per person	40
Schools, per person a. boarding b. day, without cafeteria, gym or showers c. day, with cafeteria, but no gym or showers d. day, with cafeteria, gym and showers	 75 15 20 25
Service Stations (b), per vehicle served	10
Skating Rink, Dance Halls, etc., per person a. no kitchen wastes b. additional for kitchen wastes	 10 3
Ski Areas, per person (no kitchen waste)	10
Stores a. per public toilet room b. per employee	 500 11
Swimming Pools and Bathhouses(c), per person	10
Taverns, Bars, Cocktail Lounges, per seat	20
Visitors Centers, per visitor	5

Table 1.10. Utah Code R309-510-5 Storage Volume for Irrigation Use

Table 510-5 Storage Volume for Irrigation Use	
Map Zone	Volume Required (gallons/irrigated acre)
1	1,782
2	1,873
3	2,528
4	2,848
5	4,081
6	4,964

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SYSTEM LAYOUT FIGURES

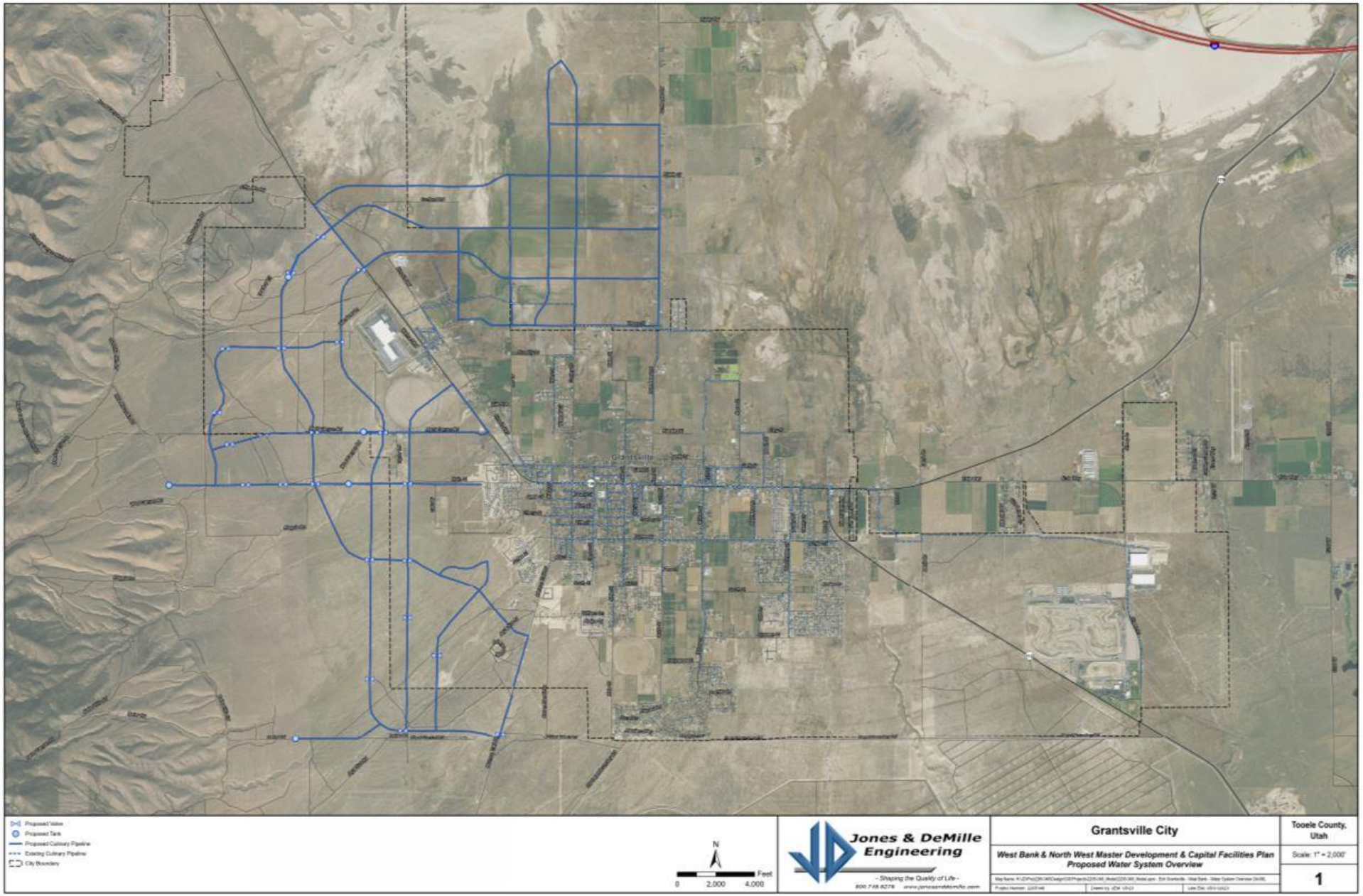


Figure 1.1. Proposed System Layout

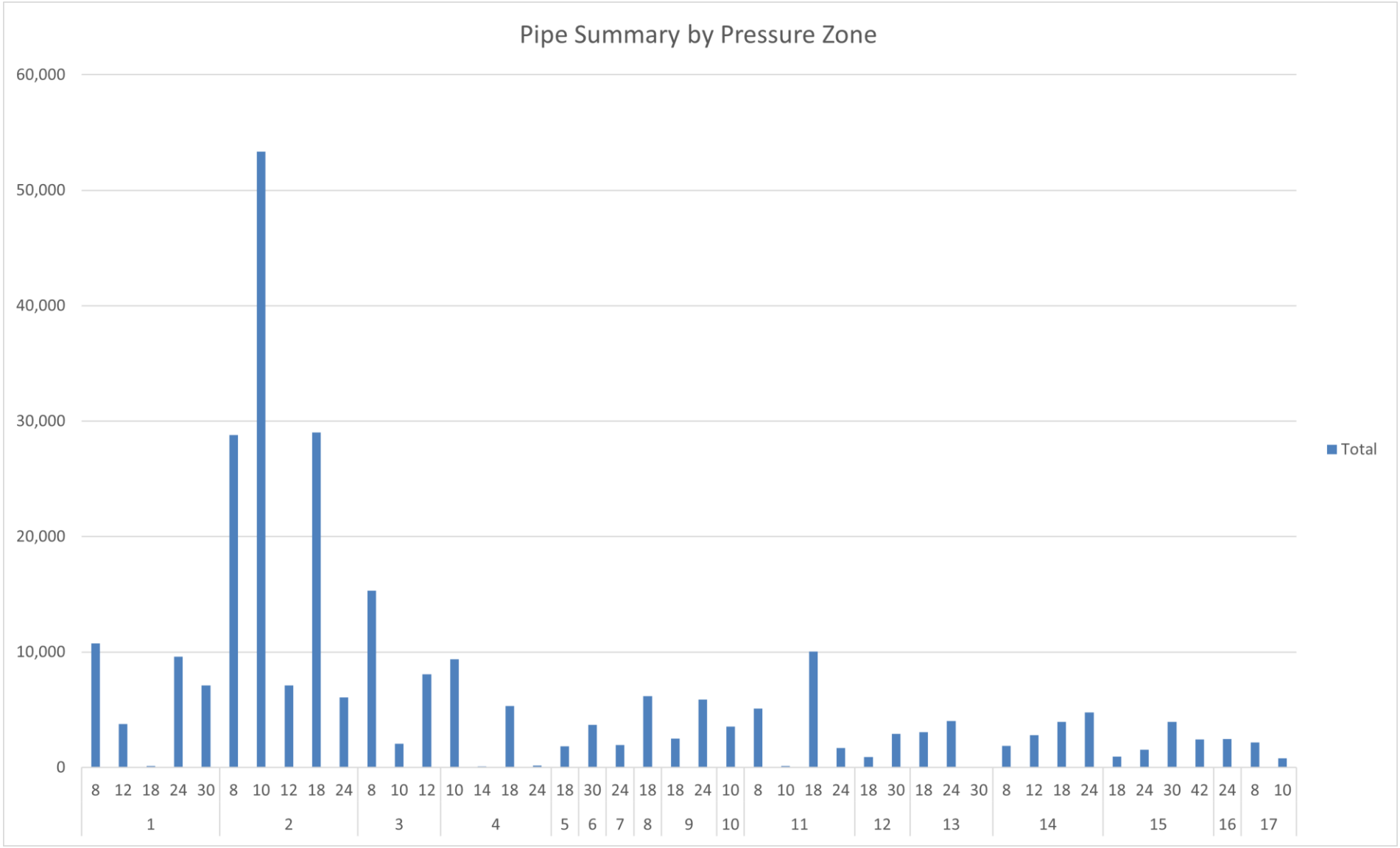


Figure 1.2. Pipe Summary by Pressure Zone

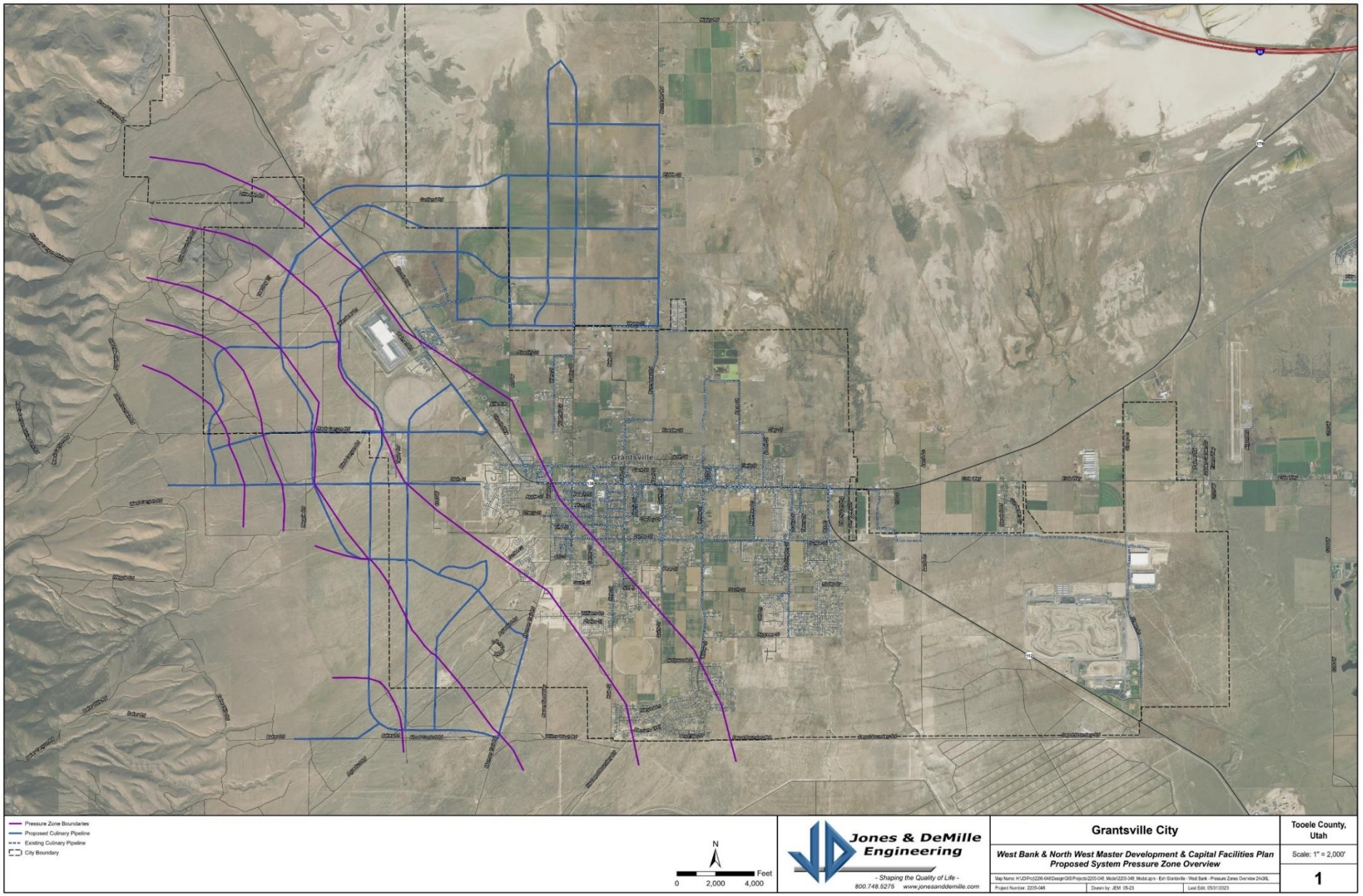


Figure 1.3. Proposed System Pressure Zone Overview

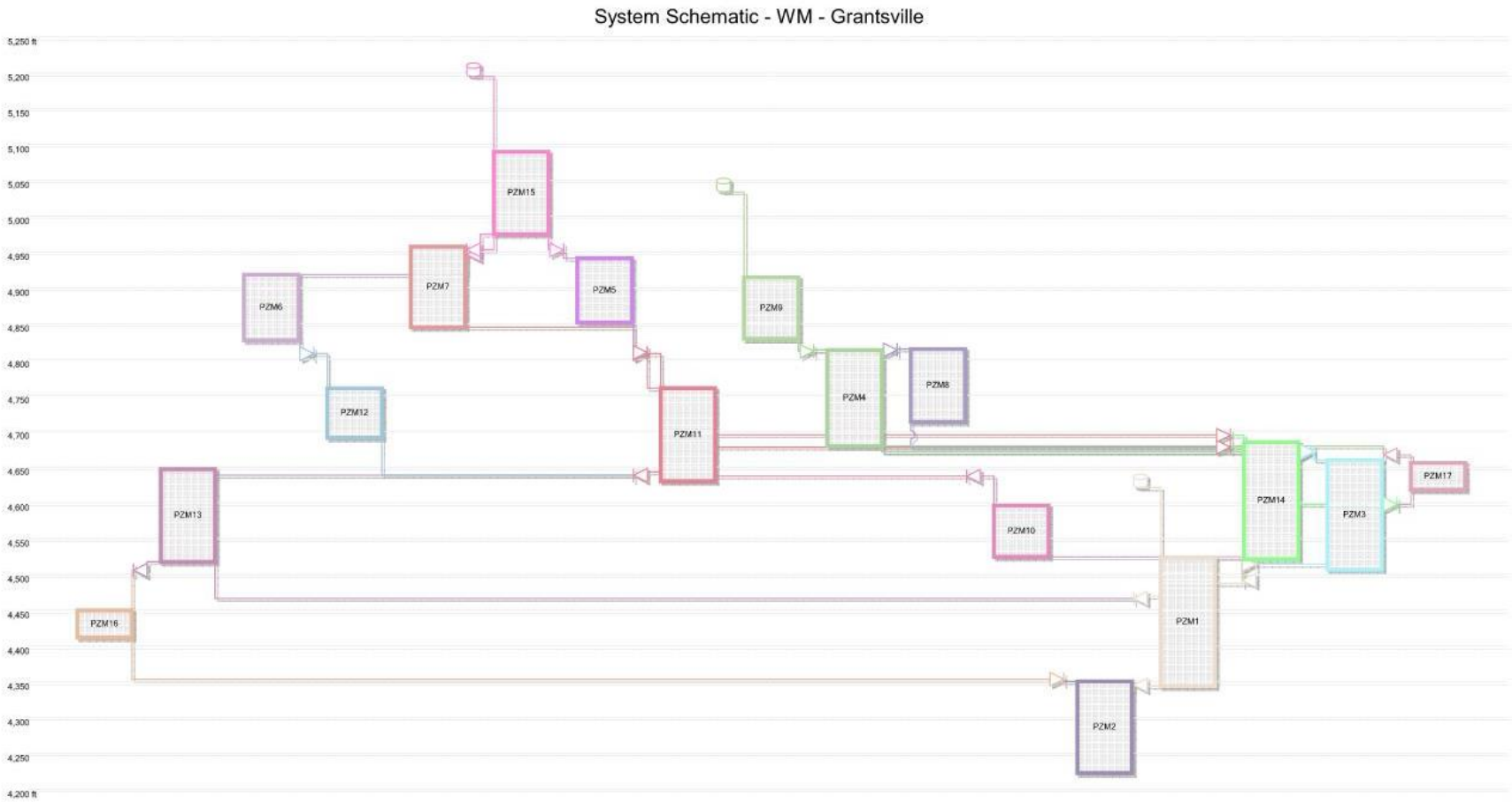


Figure 1.4. System Schematic

Sewer Water

Demand Assumptions

Demand assumptions refer to the underlying factors and considerations used to estimate the future wastewater generation and flow rates within the sewer system. These assumptions play a crucial role in determining capacity requirements and design parameters of the sewer infrastructure.

- **Data and Future Build-outs –** One of the primary demand assumptions made in the sewer water CFP was the reliability of average/historical data to forecast future sewer system demands. The demands were allocated based on the indoor water usage of the city. This water usage was calculated using the Land Use map and the State of Utah's code R309-510-8 Storage Volume for Indoor Use. See Table 2.1. Indoor Storage Volume Per Acre.

Potential factors that might affect future water usage patterns should be considered. Changes in population demographics, economic conditions, technological advancements, and water conservation practices could influence water consumption trends in the future. As such, periodic reviews and updates should be undertaken to ensure continual accuracy of demand assumptions.

- **Daily Peaking Factor –** The sewer model incorporates a daily peaking factor of 2.25. This factor assumes that the peak wastewater flow rate experienced during a typical day will be approximately 2.25 times higher than the average daily flow rate. This peaking factor is applied to account for fluctuations in water usage throughout the day.

  Various factors contribute to the daily peaking factor, including residential and commercial activities, industry operations, and peak periods of water usage (e.g., morning and evening routines).

Table 2.1. Indoor Storage Volume Per Acre

Connection Type	Acres	ERUs	Indoor Storage Volume (gpd)	Indoor Water Use Per Acre (gpm/ac)	Total Water Use Per Acre (gpm/ac)
Attached Residential	458.00	2640.71	1,860,362	2.821	2.582
Mixed Residential	1696.00	7140.92	4,726,664	1.935	1.514
Detached Residential	2886.00	9396.99	3,758,796	0.904	0.938
Detached Rural Residential	954.00	1947.39	394,606	0.287	0.269
Churches	144.19	225.14	123,000.00	0.592	0.511
Civic Uses	73.36	63.67	9,000.00	0.085	0.072
Commercial	296.20	266	80,801.70	0.189	0.178
Flex Use/Distribution	917.19	1,236	570,581.55	0.432	0.409
Office	213.24	279	4,178.11	0.014	0.013
Open Space	1063.70	3,929	0.0	0.000	0.000
Outside Growth Boundary	328.12	1,269	0.0	0.000	0.000
Agriculture/ Sensitive Lands	683.39	2186.86	0.0	0.000	0.000
Schools	283.58	380.06	208,058	0.510	0.476
Total	9996.97	30,960.54	863,618.86		

By considering this factor in the sewer model, engineers and planners can design the system to accommodate peak demands and ensure its reliable performance — even during periods of high-water usage.

Worth noting, the peaking factor of 2.25 may vary depending on the specific characteristics of the area under consideration. Local data and historical trends should be analyzed to determine an appropriate peaking factor that aligns with the local water-usage patterns.

- **Assumptions for Planned Land Use –** The sewer capital facilities plan (CFP) incorporates assumptions regarding planned land use as outlined in the land use map. The land use map identifies the future allocation of land for various purposes, such as residential, commercial, industrial, institutional, or recreational use.

  These assumptions consider the projected growth and development of the area, accounting for factors such as population growth, economic trends, and urban planning objectives. By aligning the sewer system design with planned land use, the CFP aims to accommodate the anticipated wastewater generation from different land-use categories.

  However, land-use plans are subject to change due to evolving city needs, regulatory requirements, or shifts in priorities for development. As such, the demand assumptions should be periodically reviewed and updated to reflect any modifications or new information regarding planned land-use.

Model and Design Approach

Sewer modeling for Grantsville and the West Bank was accomplished using Storm and Sanitary Analysis (SSA).

SSA is a software tool developed by Autodesk, which is used for the analysis and design of stormwater and sanitary sewer systems. It is part of Autodesk's Civil 3D software suite and is primarily used by civil engineers and urban planners for infrastructure projects.

The process of modeling a sewer system using SSA involves several steps. The first step was to collect all the necessary data for modeling the sewer system. This included gathering information about the area's topography, land-use, existing infrastructure, and any relevant regulatory requirements.

Light Detection and Ranging (LiDAR) is surveying and imaging technology that is used in drones, airplanes and satellites to collect topographical data. LiDAR was used to collect elevations for the entire study area. The LiDAR data used was collected by the Utah Department of Emergency Management in 2018 and has a resolution of 1 meter per pixel, which is considered high-resolution for aerial and satellite imagery.

Using the collected data, a digital representation of the sewer system was created. This involved defining the pipe network, locating junction manholes, identifying required locations for lift stations, and other relevant components. The network was created using ArcGIS Pro and imported into SSA.

After the network was created, hydraulic properties such as pipe diameter, slope, roughness coefficients, and junction manhole depths need to be assigned to each component. These properties are essential for simulating the flow of water through the system accurately. PVC pipe was assumed for the piping with a roughness coefficient of 150.

After all hydraulic properties have been defined, flow simulations were performed by SSA to simulate the flow of water through the sewer system. The hydraulic calculation run by the program considers factors such as pipe capacity, flow rates, velocities, and water levels at different points in the network.

Gravity flow through pipelines was planned for all pipes where possible. The goal was to limit the number of lift stations needed, because these add to capital and maintenance costs. However, there were multiple locations where the elevations would not allow gravity flow to the sewer treatment plan, so lift stations were located in key locations to pump to the sewer plant.

ERU Projections

To accurately model the future sewer system, an Equivalent Residential User (ERU) calculation was made. ERUs are the standard method for allocating sewer demands in civil engineering. ERUs are used to create a baseline to compare sewer usage from different land-use categories. The basic unit of an ERU is a residential unit, which is one ERU. Other land-use categories — industrial or commercial, for example — may have much larger demands than a residential unit, and so more demand is allocated to those land-uses. For example, an industrial building may generate 15 times more waste, so the industrial land-use would have 15 ERUs compared to the 1 ERU for a residential unit.

ERUs are calculated by dividing the average residential sewer demand by the number of residential units.

$$ERU = \frac{total\ residential\ sewer\ demand}{total\ \#\ of\ residential\ units}$$

After the demand per ERU has been calculated, the number of ERUs can be found for the non-residential land-use categories. For modeling purposes, the value of indoor water use per acre was also calculated by dividing the total indoor water use for each connection type by the total acreage of each connection type, see Table 2.2. Indoor Water Use per Acre.

Table 2.2. Indoor Water Use Per Acre

Connection Type	Indoor Water Use Per Acre (gpm/ac)
Attached Residential	2.582
Mixed Residential	1.514
Detached Residential	0.938
Detached Rural Residential	0.269
Churches	0.511
Civic Uses	0.072
Commercial	0.178
Flex Use/Distribution	0.409
Office	0.013
Open Space	0.000
Outside Growth Boundary	0.000
Agriculture/ Sensitive Lands	0.000
Schools	0.476

Collection System

- **Major Trunkline Layout and Sizing –** After multiple iterations and fine tuning, the optimized sewer model incorporated a range of pipe sizes, with most pipes being 8-12 inches in diameter. However, the trunkline connecting to the treatment facility is larger, so modeling indicated that the pipe needs to be 48 inches in diameter. The trunklines primarily rely on gravity flow to transport wastewater to the treatment facility. However, a significant number of pipes on the north end of the development require pumping through a lift station to reach the treatment facility. See Figure 2.1 Trunkline Overview for a layout of the sewer trunkline network along with sizes.

  To comply with the State of Utah's code, R 317-3, which specifies pipe sizing and minimum slopes, some pipes in the system were upsized. This ensures adherence to the code requirements and promotes efficient wastewater flow. The connector branch leading to the treatment facility has a maximum flow of 20,000 gallons per minute (gpm) when accounting for a peaking factor. Other pipes in the system have lower flows based on their position within the overall system.

  The northeast end of the system presents unique topographical challenges, as it is considerably flatter compared to the rest of the system. As a result, this area requires pumping via a lift station, as it cannot rely on gravity flow alone.

- **Lift Stations –** Much of the land to the north and northwest of the sewer plant lies lower in elevation and therefore cannot be gravity flowed to the sewer plant. Optimizations to the SSA model were made so that only two or three l lift stations will be needed for final build-out. A second sewer model was created to analyze the challenge of collecting and conveying sewage from the lowest point in the system to the treatment facility. The second model anticipates the need for the construction of an intermediate lift station that could be phased out once the northernmost lift station is built.

  The four lift stations are listed in Table 2.3. Lift Station Sizing Requirements below along with the required pumping flow and head. The lift station locations can also be found in Figure 2.2 Lift Station Overview. Initial conversations with City Public Works requested lift stations to handle flows of 1,500-2,000 gpm. However, this required significantly more lift stations that would cause significant long-term maintenance, therefore the number of identified lift stations were minimized.

  Each lift station should be designed with multiple pumps. This provides redundancy, but also allows for pump additions to the lift stations as demand requires.

  Lift Station #3 is termed as an intermediate lift station. Flow could gravity flow past this lift station to Lift Station #2. However, the decision to implement an intermediate lift station and phase it out later enables the sewer system to be built in manageable phases, avoiding the need to construct a large lift station located three miles from the treatment plant before any development occurs. This phased approach aligns the construction of lift stations with the pace of development, ensuring more efficient resource-allocation and cost-effectiveness. The flows in Table 2.3. Lift Station Sizing Requirements below for Lift Station #2 shows flows if Lift Station #2 were to phase out or remain.

The phased approach allows for gradual construction based on development progress, avoiding the need for a premature and distant lift station. By planning for the intermediate lift station's abandonment at the end of the final build-out, overall system maintenance could be reduced, resulting in improved efficiency and cost savings.

In summary, the design of the new sewer system prioritizes minimal impact on the existing system. By achieving gravity flow outside of the existing system, the need for costly upsizing of existing pipes and disruptive tie-ins is avoided. The impact on the existing system is primarily focused on the upsizing of the Northwest Lift Station to handle the increased flow from the new development.

Table 2.3. Lift Station Sizing Requirements

Lift Station	Lift Station Location	Flow Requirements (gpm)	Elevation Head (ft)
Lift Station #1	Burmester Road & Meadow Lane	7,287	43.00
Lift Station #2	40 38' 36.71 N 112 29' 09.66" E	2,625	24.96
Lift Station #3	Higley Road & Burmester Road	5,575 (with Lift Station #3 phased out) 3,475 (if Lift Station #3 remains)	28.00
Northeast Lift Station #4	Vegas Street	27,100 (Additional Flow)	Existing Head

Future Improvement Impacts on Existing System

- **Existing Collector Sizes and Impacts –** The design of the new sewer system aims to minimize its impact on the existing system. This is primarily achieved by ensuring that gravity flow can be achieved outside of the existing system. By avoiding the need to tie the new system into the existing system, extensive and costly upsizing of multiple existing pipes is avoided. Instead, the new sewer lines are placed in largely undeveloped areas, reducing the need for disruptive and expensive construction work.

  Connecting the new system to the existing system at multiple points outside of the collector to the treatment plant is deemed unnecessary and costly. It would require significant road repairs and replacements and could potentially disrupt the city residents. Therefore, it is not considered a beneficial option for the overall system.

  The most notable impact of the new system on the existing system is the need to substantially upsize the Northwest Lift Station. This is necessary to accommodate the additional flow from the northern part of the development. This specific upgrade represents the primary interaction between the new and existing systems.

SEWER SYSTEM LAYOUT FIGURES

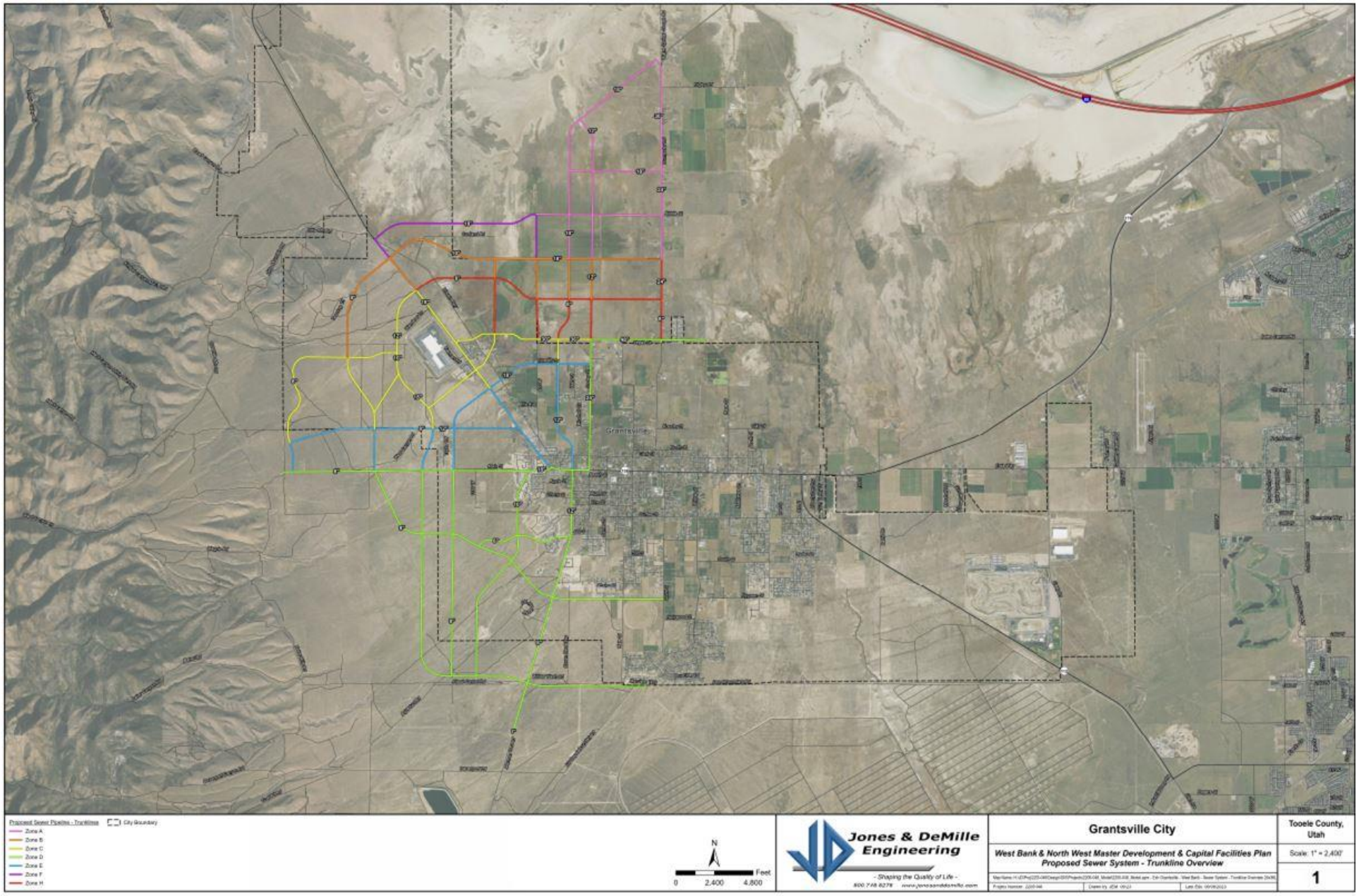


Figure 2.1. Trunkline Overview

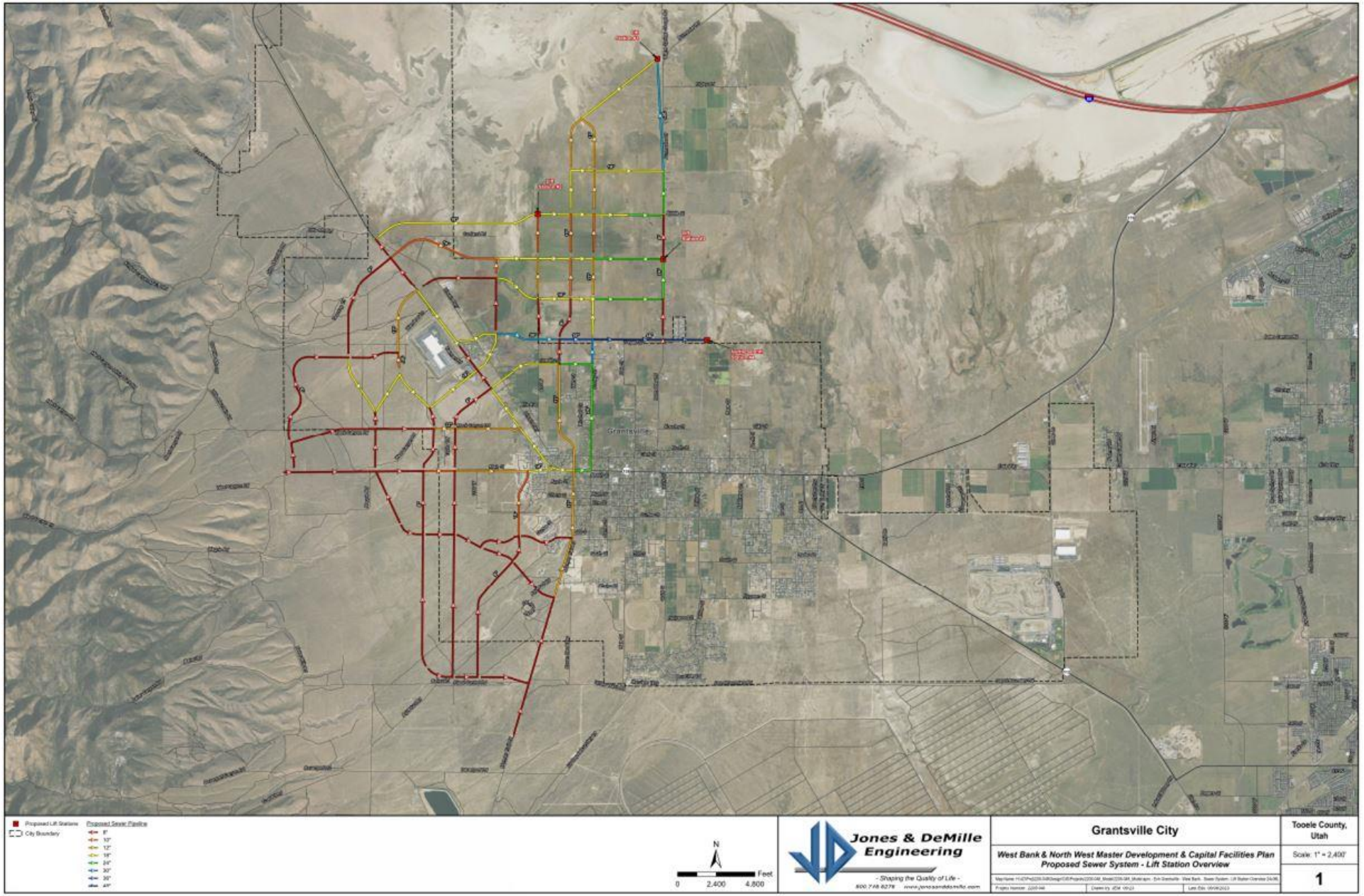


Figure 2.2. Lift Station Overview

Storm Water

Major Flood Protection Infrastructure (External Flows)

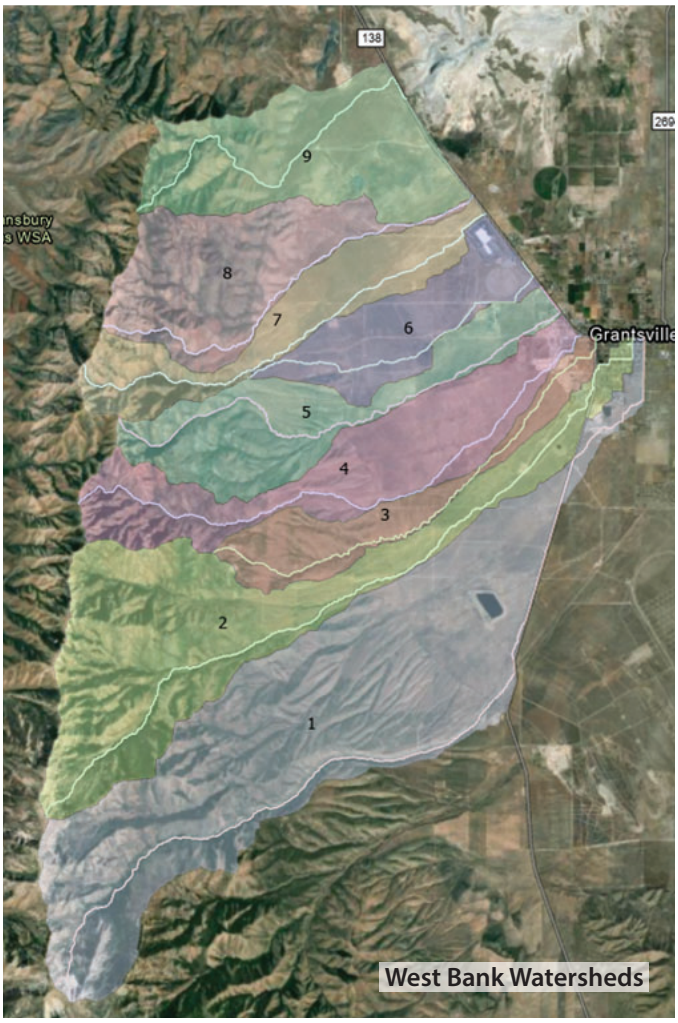
Nine watersheds, shown in Figure 3.5. Project Area Basins, were identified as flowing either through or near the defined West Bank area. These watersheds along the West Bank of Grantsville are classified by steep mountain drainages in the upper portions of the watershed and a low-sloping valley before entering the Great Salt Lake. The alluvial nature of the watersheds presents a challenge to contain and convey external flows. Hydraulic calculations were performed for each watershed using a HEC-RAS 2D model. The 2D model was developed based on existing conditions to provide insight on flow behavior and the alluvial nature of the external flooding sources. Hydrologic and Hydraulic model inputs are further defined below.

- **Defined Goals and Criteria –** The following goals and criteria were used to direct the analysis of the West Bank stormwater external flows:
  - Safely manage the 100-year 24-hour storm flows through or around the study area.
  - Prevent external inflows from entering man-made pipe and channel infrastructure as much as possible to reduce sediment removal and ongoing maintenance cost. This includes directing flows to open channel drainages as much as possible.

- **Hydrologic Calculations –** To achieve the most accurate hydrologic calculations possible, the best data available was utilized. There are four major characteristics of a watershed that, if accounted for accurately, will increase the accuracy of the Hydrologic model. These four characteristics include the delineation of the watershed, curve number, time of concentration and the precipitation intensity that falls within the watershed. These inputs were modeled in the Army Corps HEC-HMS software to estimate peak flows from the nine watersheds.

  LiDAR available from the Association of Governance, Risk and Compliance (AGRC) was used in ArcGIS to delineate nine sub-basins within the West Bank Study area. LiDAR data consisted of a 1-meter digital elevation model from 2018. These nine sub-basins drain through the proposed study area. Watersheds to the south also drain through the existing city and newly developed areas.

Figure 3.1. West Bank Watersheds shows the location of these watersheds overlayed on satellite imagery.



The nine identified sub-basins correlate with watersheds identified and named in previous studies including the City's Capital Facilities Plan (Ensign Engineering 2022). The correlated watershed names are summarized in Table 3.1. Sub-Basin Number and Name.

Table 3.1. Subbasin Number and Name

Subbasin	Subbasin Name
1	South Willow and Coal Pit Canyon
2	North Willow Canyon
3	White Rocks
4	Baker Canyon
5	Pope Canyon
6	West Canyon 1
7	West Canyon 2
8	Dry Canyon
9	Unnamed

Table 3.2. Area Weighted Curve Numbers

Subbasin	Subbasin Name	Area (Square Miles)	CN
1	South Willow and Coal Pit Canyon	20.1	68.26
2	North Willow Canyon	12.2	70.45
3	White Rocks	3.5	63.41
4	Baker Canyon	7.4	65.38
5	Pope Canyon	5.8	67.97
6	West Canyon 1	3.9	62.73
7	West Canyon 2	4.8	63.86
8	Dry Canyon	6	70.42
9	Unnamed	7.1	66.08

Curve Numbers (CNs) were assigned based on the best available data to estimate the runoff generated during storm events. Soil data was taken from the United States Department of Agriculture (USDA) 2Soil Survey Geographic Database (SSURGO) from 2022. Landcover Data from the National Land Cover Data (NLCD) from 2019 was used in combination with Soil data to estimate CN's. Area-weighted curve numbers were calculated from each of the 9 basins and can be seen in Table 3.2. Area Weighted Curve Numbers.

Table 3.3. Lag Times for Each Identified Watershed

Subbasin	Subbasin Name	Longest Flow Path (ft)	Time of Concentration (min)	Lag Time (0.6*TOC) (min)
1	South Willow and Coal Pit Canyon	91,350	387	232
2	North Willow Canyon	76,760	299	180
3	White Rocks	47,800	352	211
4	Baker Canyon	57,600	346	208
5	Pope Canyon	51,580	271	163
6	West Canyon 1	31,490	343	206
7	West Canyon 2	45,200	275	165
8	Dry Canyon	41,500	168	101
9	Unnamed	36,000	200	120

The Time of Concentration (TOC), the time for water to flow from the most remote point in the watershed to the watershed outlet, for the basins were estimated using the Soil Conservation Services (SCS) Velocity Method as described in the National Engineering Handbook (NEH) Part 630 Chapter 15. Lag times — the time it takes a drainage to respond to a storm event — were also estimated using NEH Part 630 Chapter 15 (NRCS 2019). The times of concentration and lag times used for each basin are shown in Table 3.3. Lag Times for Each Identified Watershed.

Rainfall data was taken from NOAA Atlas 14 for each sub-basin. Due to the elongated nature of the watersheds, an average rainfall over each watershed area was used for model inputs. In previous studies, a single point has been used as the rainfall in several basins. In upper portions of the South Willow watershed, the rainfall depth associated with a 100-year 24-hour storm event are as high as 4.55 inches, while locations within Grantsville are as low as 2.31 inches. Due to the high variability in rainfall depth between the mountain regions of the basins and location within the city, the area averaged rainfall depth provides the best estimate for rainfall depth over the entirety of the watershed. Summary of rainfall depths for each basin can be seen in Table 3.4. NOAA Atlas Rainfall Depths.

Table 3.4. NOAA Atlas Rainfall Depths

Subbasin	Subbasin Name	NOAA Atlas Average Rainfall Depth (Inches)			
		10 Year 24 Hour	25 Year 24 Hour	50 Year 24 Hour	100 Year 24 Hour
1	South Willow and Coal Pit Canyon	2.28	2.67	2.97	3.27
2	North Willow Canyon	2.46	2.88	3.21	3.54
3	White Rocks	1.89	2.2	2.44	2.68
4	Baker Canyon	1.98	2.31	2.56	2.81
5	Pope Canyon	2.07	2.42	2.68	2.95
6	West Canyon 1	1.78	2.07	2.29	2.52
7	West Canyon 2	2.06	2.4	2.66	2.93
8	Dry Canyon	2.2	2.57	2.85	3.15
9	Unnamed	1.94	2.26	2.50	2.75

The nine watersheds were modeled using these hydrologic inputs, soil, landcover data and watershed areas in HEC-HMS. A frequency storm model was used to model the rainfall event using NOAA Atlas data. Modeled flows can be seen in Table 3.5. Existing Conditions Flow Summary.

Table 3.5. Existing Conditions Flow Summary

Subbasin	Subbasin Name	10 Year 24 Hour Peak Discharge (CFS)	25 Year 24 Hour Peak Discharge (CFS)	50 Year 24 Hour Peak Discharge (CFS)	100 Year 24 Hour Peak Discharge (CFS)
1	South Willow and Coal Pit Canyon	611	1207	1813	2582
2	North Willow Canyon	655	1171	1676.3	2300
3	White Rocks	19	72.4	142.4	242
4	Baker Canyon	105.5	298.2	525.4	832
5	Pope Canyon	161.1	360.1	573.1	849
6	West Canyon 1	13.2	69.8	155.5	286
7	West Canyon 2	57.8	176.3	319.7	516

This study's predicted flows are much higher than predictions from previous studies. A sensitivity analysis showed the discrepancy in rainfall data provided the reduced flows shown in the Storm Water Management Study (Aqua 2015). In this study, rainfall data was either taken at the bottom of both Baker Canyon and Pope Canyon watersheds, rather than taking it at the centroid as an average over the watershed area.

A detailed exhibit with the watersheds and estimated 100-year 24-hour peak flows is included in Figure 3.7. Stormwater 100-Year Flows.

- **Existing Conditions 2D Model –** A HEC-RAS 2D hydraulic model was developed to gain insight into the flow behavior and risk associated with external flows entering the study boundary.

The preliminary flood inundation model was developed by completing a paper study of the area which included using the best available public data, identifying any known culverts. LiDAR available from the Association of Governance, Risk and Compliance (AGRC) was used, which consisted of a 1-meter digital elevation model from 2018. Some development has occurred since 2018. After the preliminary model was created it was run to evaluate the behavior of the model to see if preliminary results made sense. The model results were shared with the city and a site visit was arranged to further calibrate the model. A site visit in April of 2023 was conducted with key City personnel to explain how existing infrastructure conveyed storm water and known problem areas. The site visit confirmed that developments to date have not incorporated infrastructure to convey or divert large external storm flows. Results from the 100-year storms with a 24-hour duration can be seen in Figure 8. Stormwater RAS Results.

The model results show the alluvial nature of the lower watersheds. An on-site visit in May of 2023 confirmed that natural drainage becomes shallow and branching as they proceed down the watershed. Sandy topsoil within the drainages is prone to erosion and redirection of these flows. Without major infrastructure to contain and direct flows to establish drainages external flows pose a significant flooding risk to the existing City and the Project area.



The site visits also showed major issues with current stormwater practices within existing development. Stormwater discharges from developments are directed under fences into downstream neighborhoods.



Instances of culverts across SR-138 into parking lots and backyards were also observed. In one location, a resident built a berm to protect their home from stormwater discharged by the culvert. Figure 3. Existing Drainage Obstructed by a Road shows a road has no inlet culvert directing flows over and down the roadway.

This obstruction to the major existing drainage is not only a hazard to the roadway infrastructure, but it also poses a risk to residents who would become trapped in their neighborhood if this road were to be flooded and washed out. This existing drainage terminates at a residential property near Mormon Trail, directing flows further into the city. See Figure 3.4. Aerial View of Existing Drainage Obstructed by a Road.

- **Proposed alternatives for major flood protection insurance –** Four alternatives for external stormflow were developed in coordination with Grantsville City. All four alternatives along with high-level cost estimates can be found in 4.2 Stormwater Alternatives Maps and Cost Estimates and are outlined below:
  - **Alternative 1 –** Alternative 1 uses the concept of creating a cutoff ditch around the study boundary. Along the southern boundary of the study is an existing cutoff ditch. This alternative would extend the existing cutoff ditch around the development, directing the entirety of flows to the east. This would involve expanding the capacity of the existing cutoff ditch and extending it towards the north to the Great Salt Lake.



The cutoff ditch would be a large (approximately 45-feet wide and 10-feet deep with a 2:1 side slope) ditch to convey all the water from offsite around the city. The ditch would be armored to reduce the erosion potential caused by the high-water velocities and fine soil. The flow through the cutoff ditch would be as much as 9,500 CFS during a peak storm event. Preliminary cost estimates projected this would be the least expensive option. However, the feasibility of constructing the ditch with this alternative is at a disadvantage. For Alternative 1 to work correctly, most of the ditch would need to be built all at once, not allowing for construction in phases. The size of the ditch would also cut off access to the trails and recreation opportunities that the Stansbury Mountains provide.

- **Alternative 2 –** Alternative 2 is similar to Alternative 1; however, it utilizes a large retention basin. Alternative 2 would improve and extend the existing cutoff ditch along the south boundary of the study to the east and north towards the Great Salt Lake. In addition, one large retention basin would be constructed in the center of the watersheds and new cutoff ditches would be used to direct flows towards the central basin. The ditches would be armored to reduce the erosion potential caused by the high-water velocities and fine soils. The large basin would then meter flows at a controlled rate through the city in an armored channel.

  Like Alternative 1, Alternative 2 did not give very much flexibility to phase in improvements as development occurred. The alternative requires the construction of a very large detention basin to contain all the flows, the construction of which would be very costly. This basin would likely need to be maintained as a medium- to high-hazard dam due to its location and the risk it could pose to the developments below it.

- **Alternative 3 –** Also like Alternative 1, Alternative 3 would only use cutoff ditches to direct flow around the city. This alternative would intercept half of the external flows from the west and all the water coming from the south before routing them to the existing cutoff ditch along the south boundary of the study to ultimately continue to the east through the cutoff ditch and north towards the Great Salt Lake.

  The other half of the flows would be captured by constructing a new cutoff ditch to direct flows to the Northwest and then towards the Great Salt Lake. The ditches would be armored to reduce the erosion potential caused by the high-water velocities and fine soils.

  The disadvantages of Alternative 3 were the same as Alternative 1 but with a higher construction cost due to the increased length of channel. This alternative was not selected as the preferred alternative.

- **Alternative 4 –** Alternative 4 would construct five debris/detention basins across the watersheds with smaller cutoff ditches to convey flows to these basins. Two of the Basins would be located along the existing cutoff ditch, and improvements to it would be needed. The existing ditch would need to be extended to the east and north to convey stormwater towards the Great Salt Lake. The cutoff ditches needed to route water to each of the basins will be armored to reduce the erosion potential caused by the high-water velocities and fine soils. Channels through the city would also need to be armored and improved to handle flows from the five basins.

  Alternative 4 is advantageous because it allows for flexibility to phase-in construction of the improvements when they are needed rather having to build it all at once. The basins and cutoff ditches also could be slid upstream or downstream of the watershed to allow room for development if needed. In coordination with Grantsville City, Alternative 4 was identified as the preferred alternative. Alternative 4 best aligns with the city's goals while allowing phased construction. Individual basins will also allow for alternative placement, accounting for additional future development.

- **Funding opportunities for major flood protection infrastructure –** Due to the nature of the large-scale infrastructure needed to handle storm flows and the high-dollar amount associated with the needed infrastructure, several funding opportunities were identified. Federal Funding opportunities require a benefit-cost-analysis of impacts to existing infrastructure to assess the economics of funding.

Strategic planning to maximize the benefit-cost-analysis may be required to take full advantage of these opportunities. Funding opportunities are summarized and identified below.

The Natural Resources Conservation Service (NRCS) provides funding through what is commonly referred to as The Watershed Protection and Flood Prevention Act (PL-566). PL566 requires direct benefits to rural communities and has varying cost-share requirements based on the primary purpose of the project. For flood control projects, the PL-566 program will pay 100 percent of construction costs, excluding culverts and roadway crossings as well as any property rights (e.g., land purchase, easements, or water rights). This process involves an initial Preliminary Investigation Feasibility Study (PIFR), Environmental Assessment or Environmental Impact Statement (EA or EIS), and final design and construction phases. This process typically takes three to five years to reach the construction phase. Grantsville City would need to reapply for funding at each stage and be accepted. Design and planning costs are covered by the NRCS, expecting direct city involvement. To apply to have a PIFR completed, a simple letter outlining the project's needs can be submitted to the Utah NRCS.

FEMA funds flood protection projects through several programs, including the Building Resilient Infrastructure and Communities (BRIC) program. The program will fund up to 75 percent of the total project costs. Typically, a scoping study is completed before final design and construction funding is applied for, requiring a two-stage process. Like the PL-566 process, the BRIC funding process typically takes three to five years to reach construction.

Note that both FEMA and NRCS funding comes through the federal government, and federal funds cannot be used as a match for either source. However, both funding programs can be applied to a project if there are standalone parts of the project.

Another potential source of funding could arise from developing an impact fee assessment. This would involve developing an impact fee for developers when they direct their stormwater into existing infrastructure. Impact fees would require the city to develop the needed infrastructure before development could occur. Impact fees could be implemented to pay back infrastructure not covered by grant funding.

Individual Site Development (Internal)

- **Site Development Goals –** Goals for internal flows of the West Bank stormwater project are defined below:
  - Eliminate increased peak runoff which naturally occurs with development due to an increase in imperviousness (i.e., do not increase downstream flows from pre-development or existing/natural conditions).
  - Define and maintain capacity in major conveyance features, such as regional detention basins, channels, culverts, and other infrastructure that is existing or proposed.
  - Require site-specific solutions to be implemented for conveyance and detention/retention as required to maintain pre-development flows.
  - Recommend criteria to include in Grantsville City storm drainage manual for development adherence.

- **Site development criteria and requirements –** The recommended on-site stormwater criteria will require that an analysis be performed by the developer and approved by the designated City engineer. The analysis should involve enough detail to provide assurance that the developed area does not pose a flood risk to residents downstream of or within the development. The requirements in terms of the analysis, approach, and report submittal are outlined below:
  - **Hydrology Methods**
    - Utilize the SCS or TR-55 method for sizing of conveyance and detention/retention facilities within adherence to the methodology guidelines.
    - The Rational Method may be used for sizing of conveyance features only within adherence to the methodology guidelines.
  - **Considerations for offsite and onsite drainage**
    - Drainage designs must consider offsite drainage in the analysis and how to safely convey any offsite drainage through the development. The drainage study should clearly show and analyze the offsite and onsite drainage and pre-development and post-development conditions.
  - **Conveyance**
    - Size all minor conveyance, including stormdrain inlets and piping to major conveyance features for a minimum of the 10-year 24-hour storm event.

- Size all major conveyance, including storm drainage piping connecting to inlets and minor piping for a minimum of the 50-year 24-hour event.
- The combination of conveyance features such as piping, ditches, swales, curb and gutter, must convey the 100-year 24-hour storm event to any detention and retention facilities.
- Minimum pipe diameter: 15 inches.

- **Detention/Retention Basins**
  - Size all detention, retention, or a combination or detention and retention basins to release a maximum peak flow equal to the 10-year 24-hour and 100-year 24-hour pre-development peak flow.
  - Design detention/retention facilities with a minimum of 1 foot of freeboard.
  - If the entire drainage area cannot be routed to the detention/retention basins, increase size/effectiveness of the detention pond to compensate for areas that are released without being routed through the detention/retention basins.
- **Combination of Conveyance and Detention/Retention**
  - The combination of conveyance and detention/retention must show that pre-development flows downstream of the development are maintained in the post-development condition, and the combination must consider offsite and onsite flows. This will ensure that downstream infrastructure continues to have sufficient capacity.
  - Identify major drainage features upstream and downstream affecting the development, particularly major drainage features which will receive flow from the development.
- **FEMA Floodplains**
  - Drainage studies must identify and consider impacts to existing FEMA floodplains. If the development is within a current effective FEMA floodplain, a floodplain development permit is required. This permit may require additional analysis, studies, and coordination to meet the community, state, and federal FEMA requirements (see standard floodplain development permit).
  - Identify any floodplain map boundaries on maps and figures.
- **Drainage Report**
  - Drainage reports should be well-written with maps, figures, and tables addressing each of the required criteria above.
  - Show all references, criteria, guidelines, models, and other information used.
  - Clearly identify pre-development and post-development flows, drainage areas, etc.
  - The appendix should include model inputs/outputs, and other pertinent information.
  - The drainage models used should be submitted with the report.
  - Reference the existing and proposed major drainage features in the project area.

- **Regional Basin Locations –** Regional basin locations are recommended as shown in Figure 3.8. Stormwater RAS Results. Regional basins would allow for a reduced crossing of Highway 138 and downstream infrastructure and channels. Downstream infrastructure will be required to convey non-attenuated flows if regional basins are not used in strategic locations. Basins should be placed low enough to retain storm flows from the designated drainage pathways and high enough to substantially benefit from reduced infrastructure and channel sizes.

  Additional basins were considered on the east side of SR-138; however, they did not provide much advantage to the overall system. Once flows have reached any area on the other side of SR-138, attenuated flows do not benefit from reduced infrastructure.

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- Aqua Engineering. 2015. "Storm Water Management Study for Baker and Pope Watersheds Grantsville City and Tooele County."
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- USDA. 2022. "Soil Survey Geographic Database."
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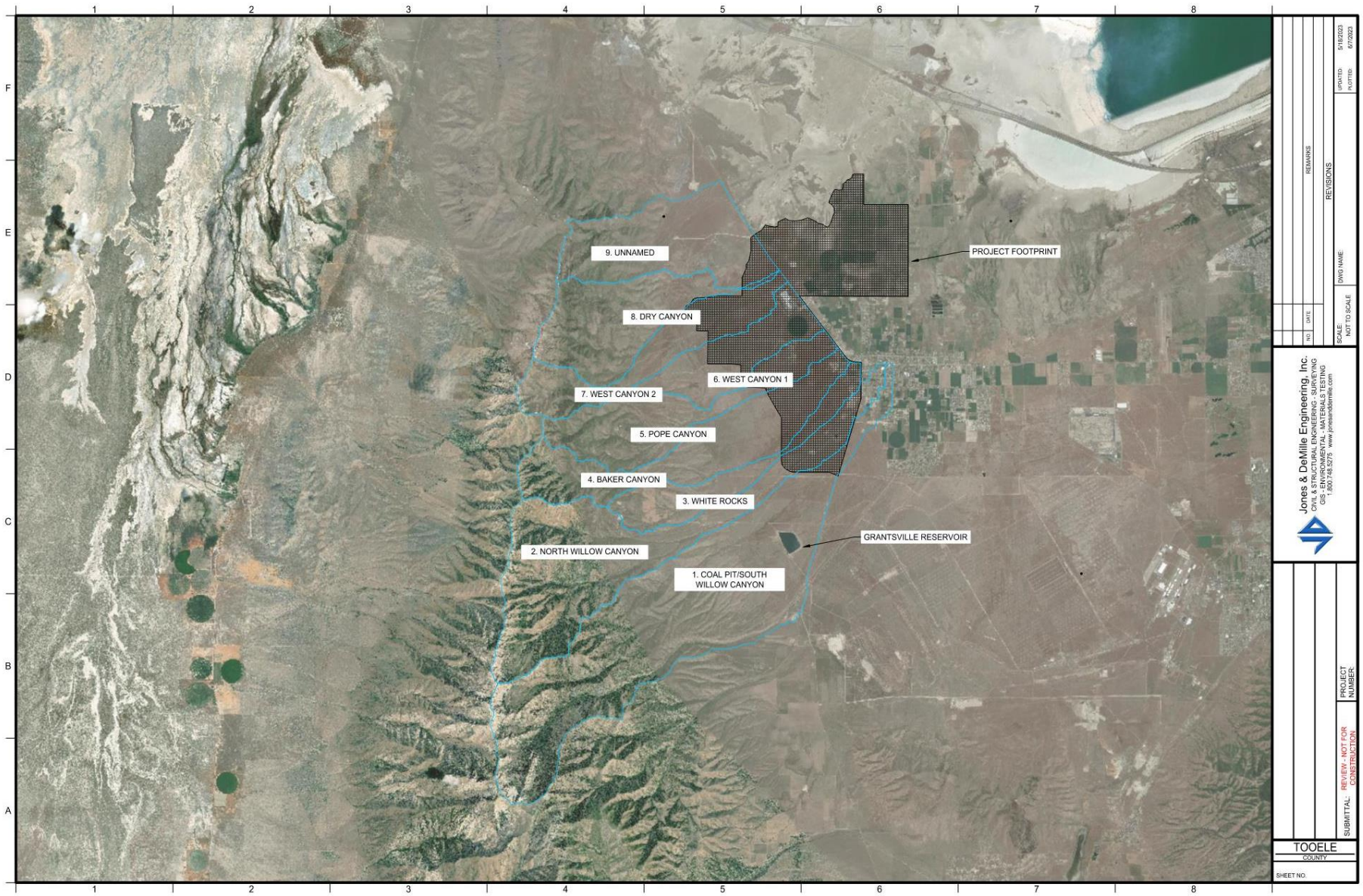


Figure 3.5. Project Area Basins

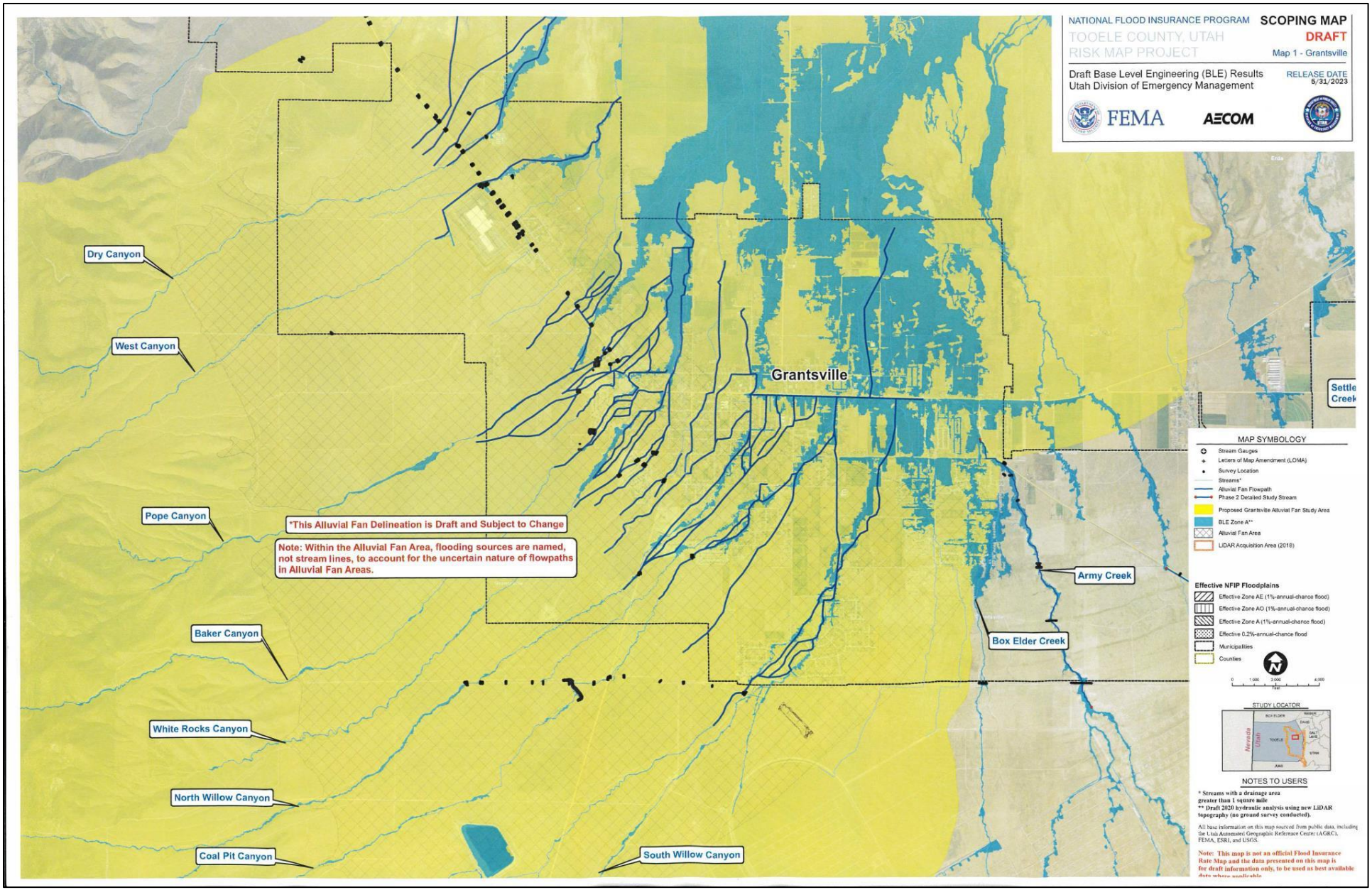


Figure 3.6. FEMA Map Draft Base Level Engineering Results

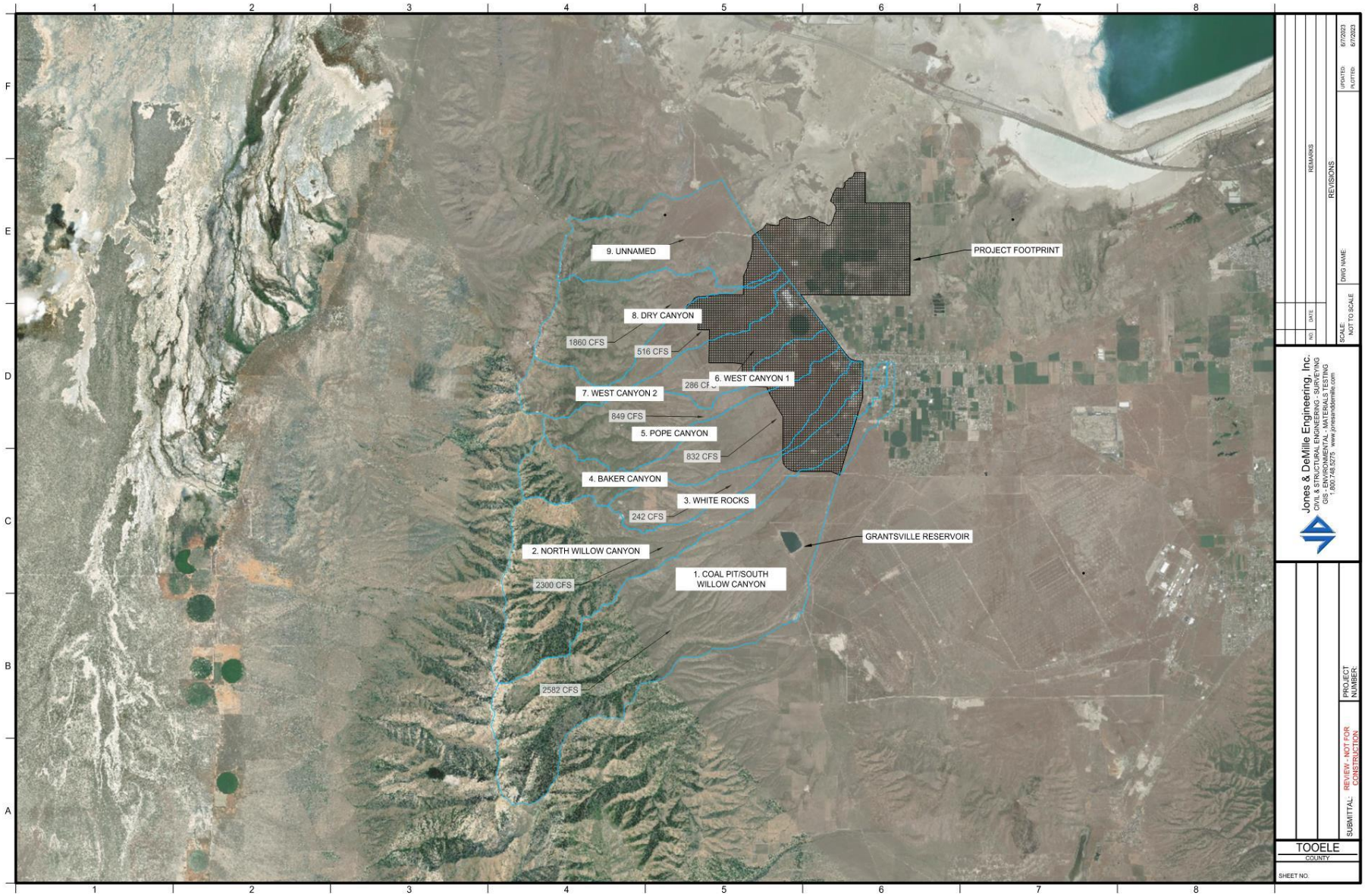


Figure 3.7. Stormwater 100-Year Flows

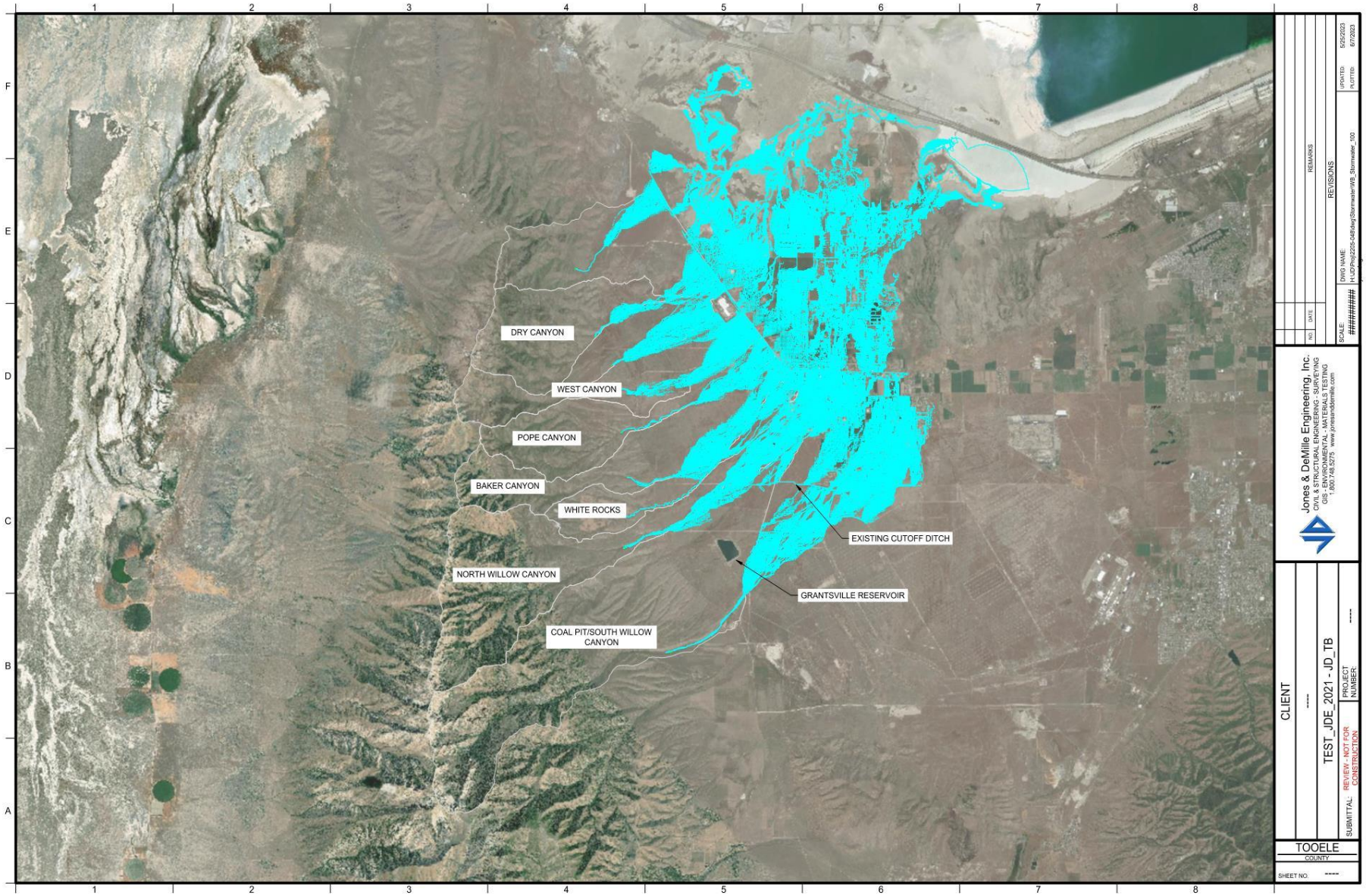


Figure 3.8. Stormwater RAS Results

4.2. STORMWATER ALTERNATIVES MAPS AND COST ESTIMATES

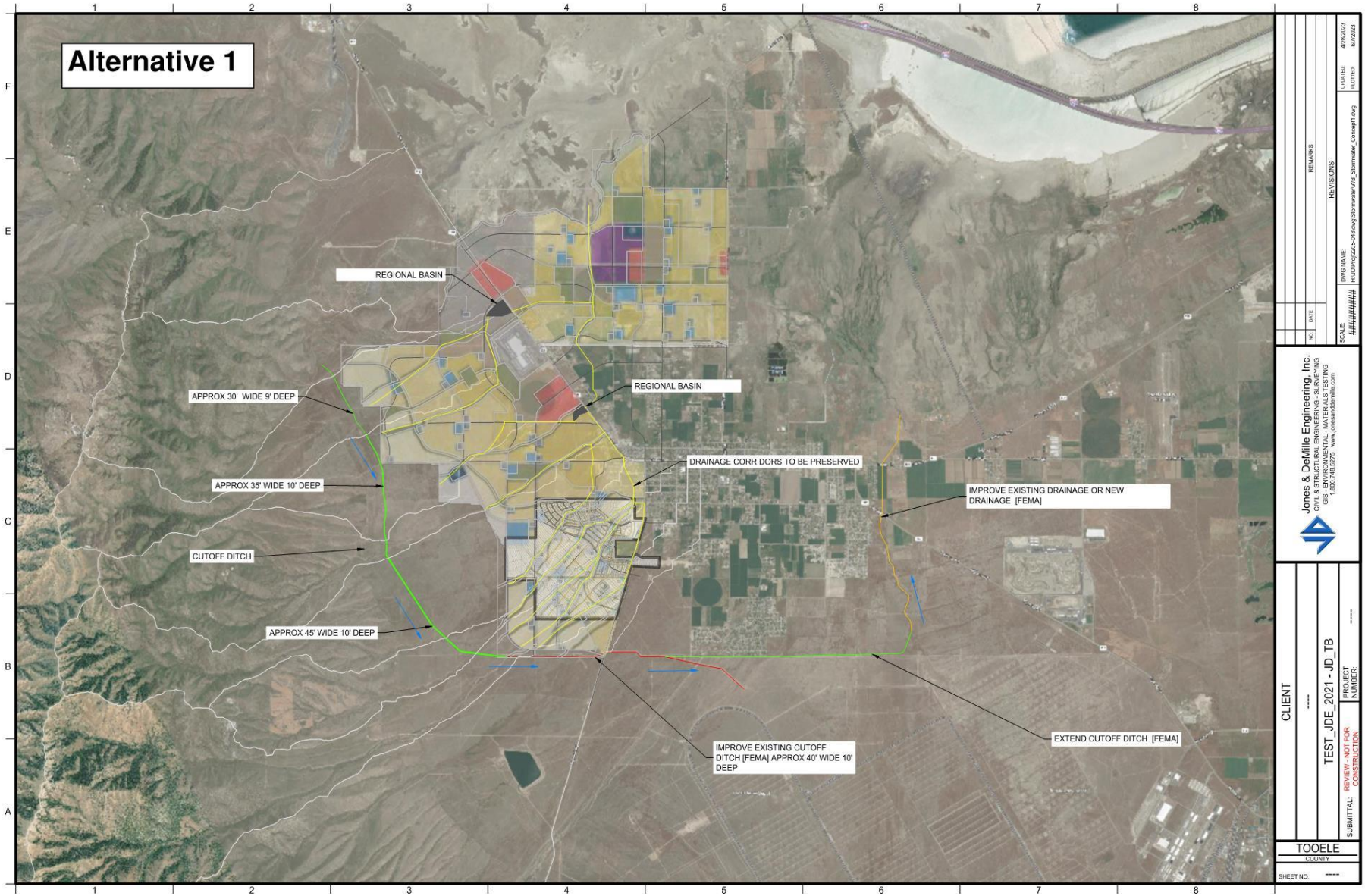


Figure 3.9. Stormwater Alternative 1 Map

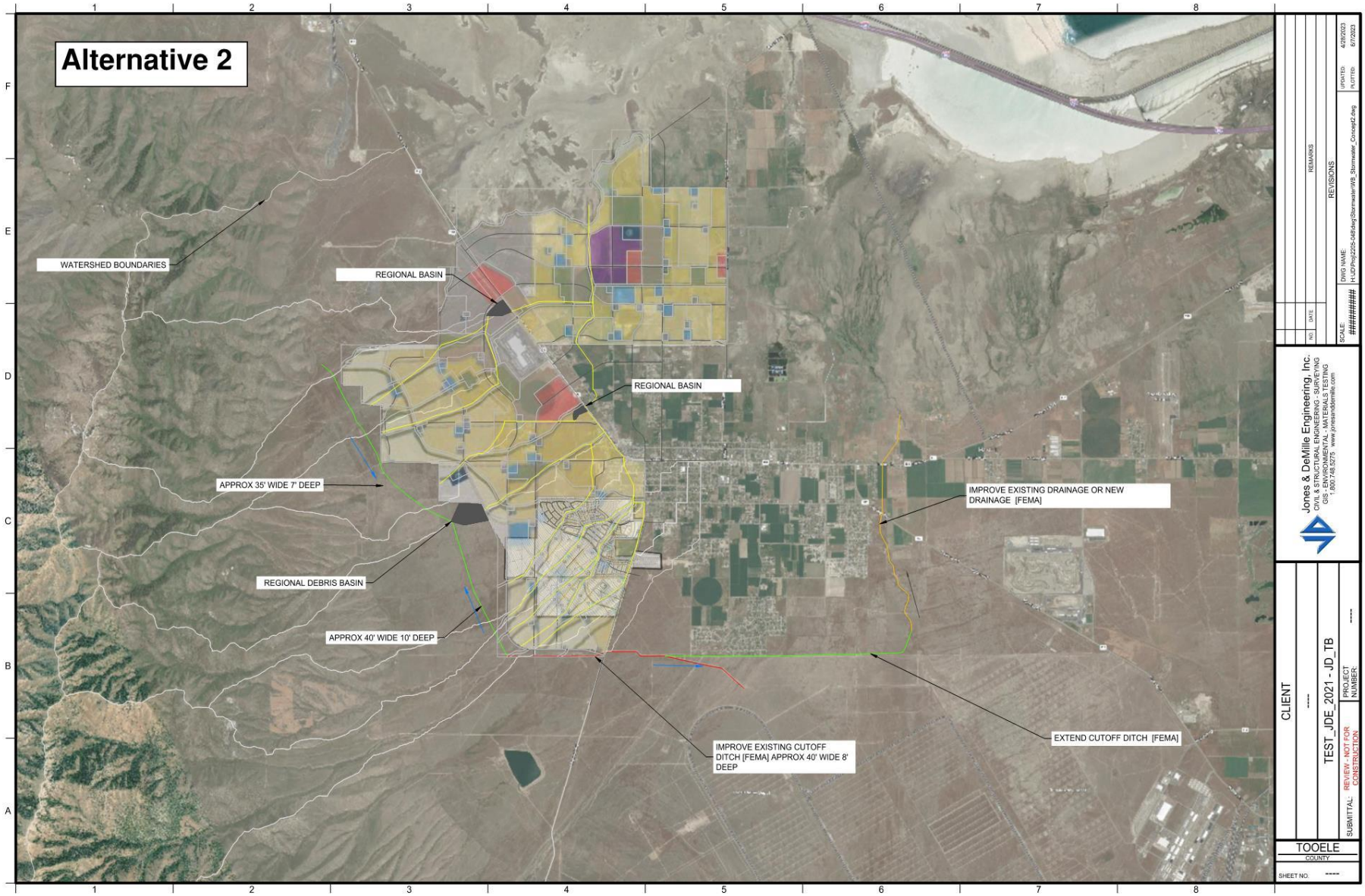


Figure 3.10. Stormwater Alternative 2 Map

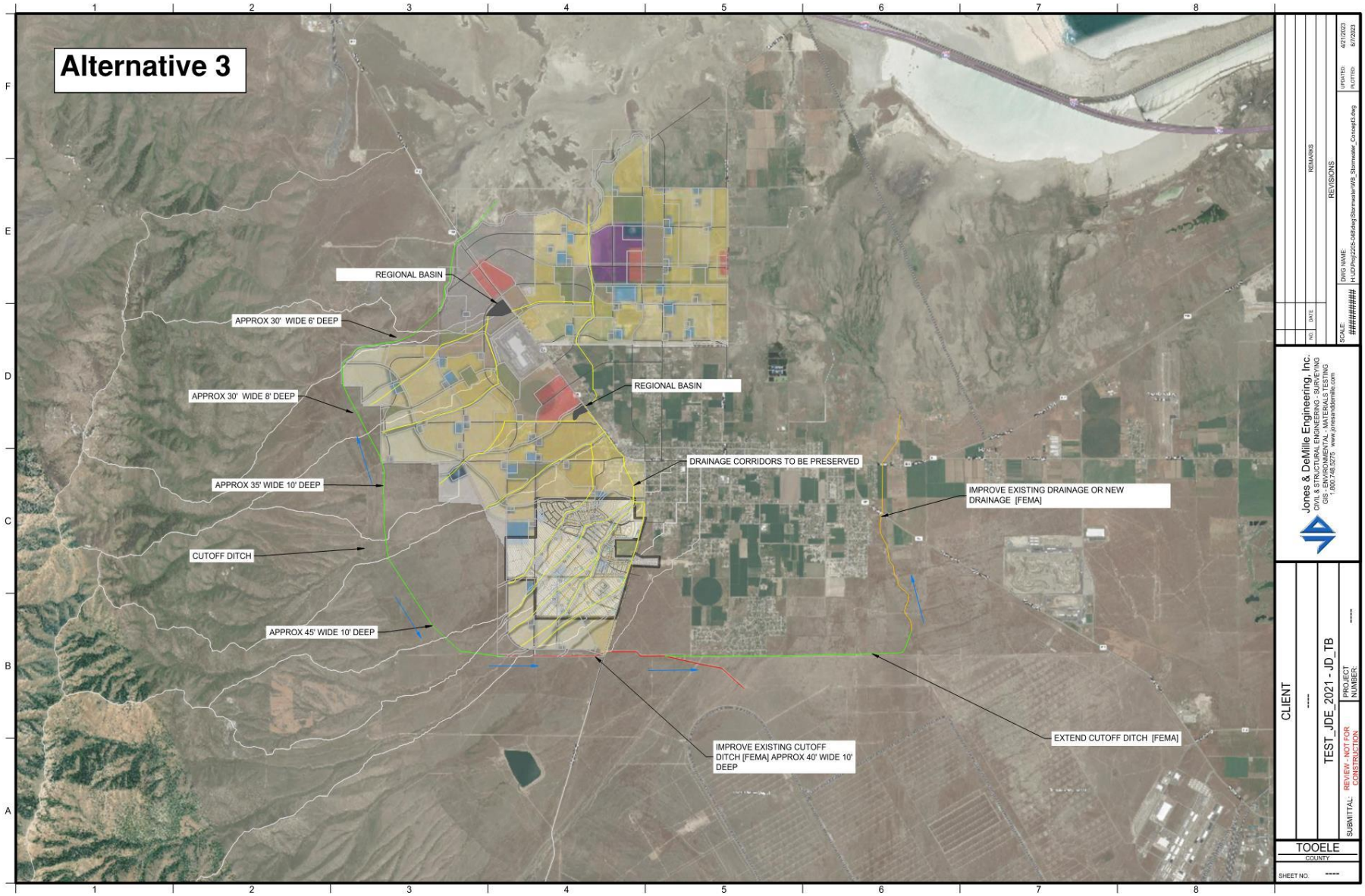


Figure 3.11. Stormwater Alternative 3 Map

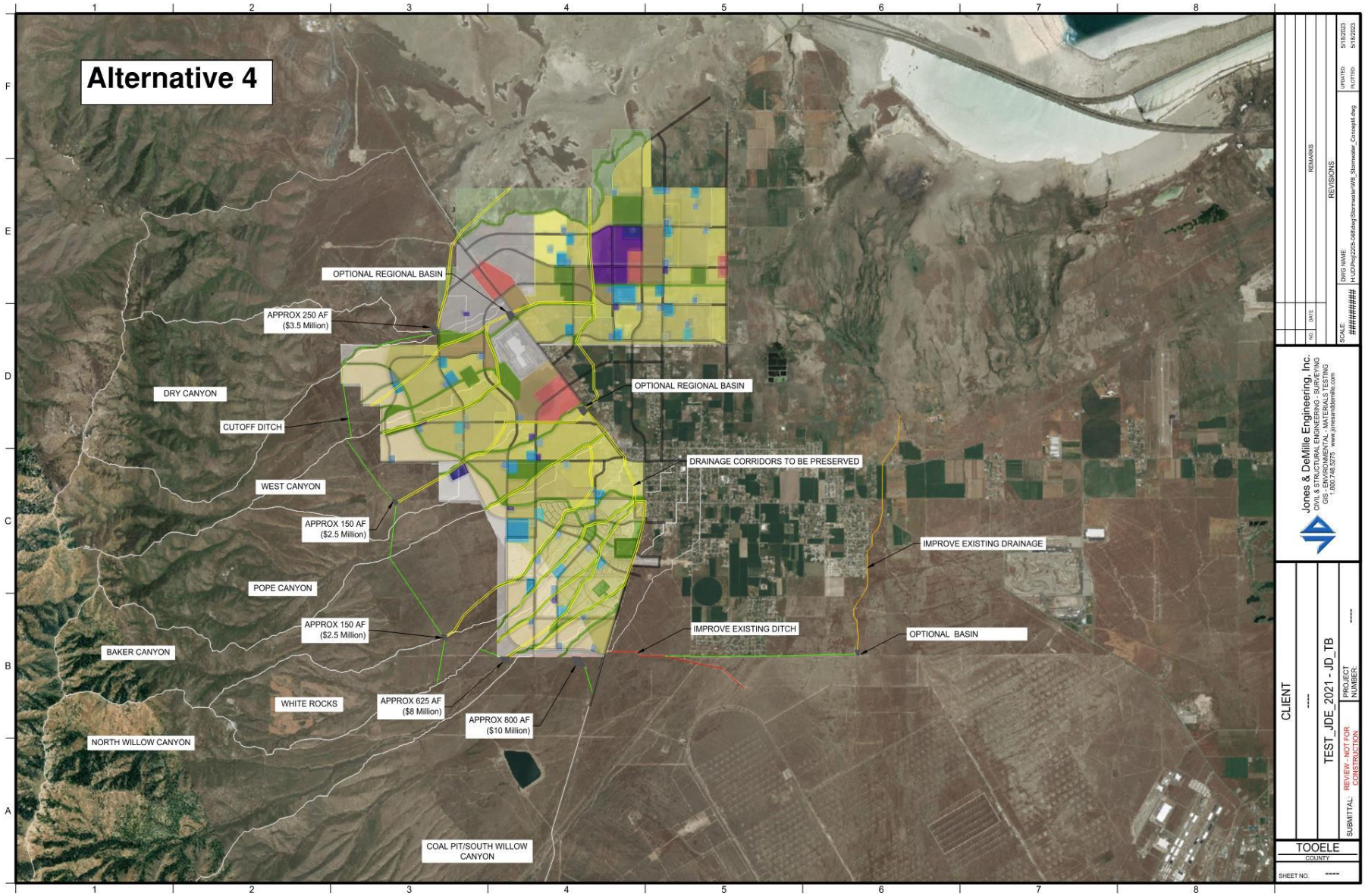


Figure 3.12. Stormwater Alternative 4 Map

Owner: Granstville City
Project: West Bank Stormwater Master Plan
Project #: 2205-048
PM: Matt Laurendeau
Date: 4/21/2023

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Alternative 1

ENGINEER'S OPINION OF PROBABLE COST					
Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Price
Construction					
1	Mobilization and Survey	LS	1	$ 5,000,000.00	$ 5,000,000.00
2	Channel Excavation	CY	770,000	$ 9.00	$ 6,930,000.00
3	Channel Riprap (9" D50 1.5' thick)	CY	250,000	$ 90.00	$ 22,500,000.00
4	Road Crossings	LS	1	$ 5,000,000.00	$ 5,000,000.00
5	Land Acquisition	LS	1		$ -
6	Acquire Additional Channel ROW	Acre	200	$ 100,000.00	$ 20,000,000.00
7	General Site Improvements	LS	1	$ 1,000,000.00	$ 1,000,000.00
				Construction Subtotal =	**$ 59,430,000.00**
Professional Services and Permitting					
1	Engineering Design	LS	1	$ 11,886,000.00	$ 11,886,000.00
2	Construction Management	LS	1	$ 5,943,000.00	$ 5,943,000.00
3	Environmental Permitting	LS	1	$ 500,000.00	$ 500,000.00
				Professional Services and Permitting Subtotal =	**$ 18,329,000.00**
Contingency					
1	Construction Contingency (30%)	LS	1	$ 17,829,000.00	$ 17,829,000.00
2	Uncosted Items (10)%)	LS	1	$ 5,943,000.00	$ 5,943,000.00
				Contingencies Subtotal =	**$ 23,772,000.00**
				Total Probable Construction Cost	**$ 101,531,000.00**

Figure 3.13. Stormwater Alternative 1 Cost Estimate

Owner: Granstville City
Project: West Bank Stormwater Master Plan
Project #: 2205-048
PM: Matt Laurendeau
Date: 4/21/2023

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Alternative 2

ENGINEER'S OPINION OF PROBABLE COST					
Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Price
Construction					
1	Mobilization and Survey	LS	1	$ 7,500,000.00	$ 7,500,000.00
2	Channel Excavation	CY	670,000	$ 9.00	$ 6,030,000.00
3	Channel Riprap (9" D50 1.5' thick)	CY	230,000	$ 90.00	$ 20,700,000.00
4	Road Crossings	LS	1	$ 4,000,000.00	$ 4,000,000.00
5	Debris Basin	LS	1	$ 31,000,000.00	$ 31,000,000.00
6	Land Acquisition	LS	1		$ -
7	Acquire Additional Channel ROW	Acre	200	$ 100,000.00	$ 20,000,000.00
8	General Site Improvements	LS	1	$ 1,000,000.00	$ 1,000,000.00
				Construction Subtotal =	**$ 89,230,000.00**
Professional Services and Permitting					
1	Engineering Design	LS	1	$ 17,846,000.00	$ 17,846,000.00
2	Construction Management	LS	1	$ 8,923,000.00	$ 8,923,000.00
3	Environmental Permitting	LS	1	$ 500,000.00	$ 500,000.00
				Professional Services and Permitting Subtotal =	**$ 27,269,000.00**
Contingency					
1	Construction Contingency (30%)	LS	1	$ 26,769,000.00	$ 26,769,000.00
2	Uncosted Items (10)%)	LS	1	$ 8,923,000.00	$ 8,923,000.00
				Contingencies Subtotal =	**$ 35,692,000.00**
				Total Probable Construction Cost	**$ 152,191,000.00**

Figure 3.14. Stormwater Alternative 2 Cost Estimate

Owner: Granstville City
Project: West Bank Stormwater Master Plan
Project #: 2205-048
PM: Matt Laurendeau
Date: 4/21/2023

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Alternative 3

ENGINEER'S OPINION OF PROBABLE COST					
Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Price
Construction					
1	Mobilization and Survey	LS	1	$ 7,000,000.00	$ 7,000,000.00
2	Channel Excavation	CY	850,000	$ 9.00	$ 7,650,000.00
3	Channel Riprap (9" D50 1.5' thick)	CY	350,000	$ 90.00	$ 31,500,000.00
4	Road Crossings	LS	1	$ 5,000,000.00	$ 5,000,000.00
6	Land Acquisition	LS	1		$ -
7	Acquire Additional Channel ROW	Acre	350	$ 100,000.00	$ 35,000,000.00
8	General Site Improvements	LS	1	$ 1,000,000.00	$ 1,000,000.00
				Construction Subtotal =	**$ 86,150,000.00**
Professional Services and Permitting					
1	Engineering Design	LS	1	$ 17,230,000.00	$ 17,230,000.00
2	Construction Management	LS	1	$ 8,615,000.00	$ 8,615,000.00
3	Environmental Permitting	LS	1	$ 500,000.00	$ 500,000.00
				Professional Services and Permitting Subtotal =	**$ 26,345,000.00**
Contingency					
1	Construction Contingency (30%)	LS	1	$ 25,845,000.00	$ 25,845,000.00
2	Uncosted Items (10)%)	LS	1	$ 8,615,000.00	$ 8,615,000.00
				Contingencies Subtotal =	**$ 34,460,000.00**
				Total Probable Construction Cost	**$ 146,955,000.00**

Figure 3.15. Stormwater Alternative 3 Cost Estimate

Owner: Granstville City
Project: West Bank Stormwater Master Plan
Project #: 2205-048
PM: Matt Laurendeau
Date: 4/21/2023

Jones & DeMille Engineering

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Alternative 4

ENGINEER'S OPINION OF PROBABLE COST					
Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Price
Construction					
1	Mobilization and Survey	LS	1	$ 7,500,000.00	$ 7,500,000.00
2	Channel Excavation	CY	530,000	$ 9.00	$ 4,770,000.00
3	Channel Riprap (9" D50 1.5' thick)	CY	225,000	$ 90.00	$ 20,250,000.00
4	Road Crossings	LS	1	$ 2,000,000.00	$ 2,000,000.00
5	Debris Basins	LS	1	$ 27,500,000.00	$ 27,500,000.00
6	Land Acquisition	LS	1		$ -
7	Acquire Additional Channel ROW	Acre	340	$ 100,000.00	$ 34,000,000.00
8	General Site Improvements	LS	1	$ 1,000,000.00	$ 1,000,000.00
				Construction Subtotal =	**$ 96,020,000.00**
Professional Services and Permitting					
1	Engineering Design	LS	1	$ 19,204,000.00	$ 19,204,000.00
2	Construction Management	LS	1	$ 9,602,000.00	$ 9,602,000.00
3	Environmental Permitting	LS	1	$ 500,000.00	$ 500,000.00
				Professional Services and Permitting Subtotal =	**$ 29,306,000.00**
Contingency					
1	Construction Contingency (30%)	LS	1	$ 28,806,000.00	$ 28,806,000.00
2	Uncosted Items (10)%)	LS	1	$ 9,602,000.00	$ 9,602,000.00
				Contingencies Subtotal =	**$ 38,408,000.00**
				Total Probable Construction Cost	**$ 163,734,000.00**

Figure 3.16. Stormwater Alternative 4 Cost Estimate

Geotechnical Report

Field Exploration

- **Test Pits –** A total of eight (8) possible test pit locations were selected. Out of these original locations, five (5) were completed on April 12, 2023. The other three (3) were not completed due to accessibility issues and limited time. The test pits were excavated by Direct Push Services using a mini hydraulic excavator to depths of approximately 6 to 8 feet below the existing ground surface. The subsurface soil and groundwater conditions were logged in the field by an Atlas field representative. Disturbed bulk soil samples were recovered at approximate depth intervals.

  The location of the test pits is shown on Figure A1 in Appendix A. Test pits 2, 5, and 6 were not completed, so these are not included on Figure A1. The test pit logs with descriptions of the various soils encountered in each exploration are also included in Appendix A.

- **Laboratory Testing –** Laboratory tests were performed on selected samples to determine the physical and engineering properties of the subsurface soils. Results of the laboratory testing are presented on the boring logs and in Appendix B. The following soil tests were performed for this study.
  - **Moisture Content (ASTM D2216) –** Moisture tests were conducted on selected samples to measure the in-place moisture content of the subsurface soils. Moisture content provides information for evaluating the physical characteristics of subsurface soils.
  - **Particle Size Analysis (Wet and Dry Sieve) or Fines Content (ASTM D422 or D1140) –** Sieve analysis or fines content (minus No. 200 sieve) tests were conducted on selected samples to determine the soil particle size distribution. This information is useful for characterizing the soil type according to the USCS.
  - **Compaction Test, i.e. Standard Proctor (ASTM D698) –** Test to evaluate the optimum moisture content at with a soil will achieve its maximum density were performed on representative samples. This information can be used as a correlation to soil strength and suitability for supporting applied loads.

Subsurface Conditions

- **Geologic Description –** The geology map (Clark et al, 2020) is provided on Figure A2 in Appendix A. The approximate test pit locations are shown as blue circles. The description of the identifies soils with the approximate project extents include:
  - **Qa; Alluvium, undivided (Holocene) –** Primarily clay, silt, and sand deposited in a broad, flat area in northern Tooele Valley; sediment reflects local sources; locally merges with alluvial-fan deposits and playa mud, and locally includes lacustrine and eolian deposits; thickness generally less than about 20 feet (6 m)
  - **Qafty; Younger fan alluvium, post-Lake Bonneville (Holocene to uppermost Pleistocene) –** Poorly sorted gravel, sand, silt, and clay; deposited by streams, debris flows, and flash floods on alluvial fans and in mountain valleys; merges with unit Qal; includes alluvium and colluvium in canyon and mountain valleys; may include areas of eolian deposits and lacustrine fine-grained deposits below the Bonneville shoreline; includes active and inactive fans younger than Lake Bonneville, but may also include some older deposits above the Bonneville shoreline; in Puddle Valley and west of Cedar Mountains commonly includes eolian silt and sand cover typically less than 6 feet (2 m) thick; locally, unit Qafy spreads out on lake terraces and, due to limitations of map scale, is shown to abut Lake Bonneville shorelines even though it is not cut by these shorelines; Qafy also locally drapes over, but does not completely conceal shorelines; thickness variable, up to 50 feet (15 m) or more.
  - **Qla; Lacustrine and alluvial deposits, undivided (Holocene to upper Pleistocene) –** Sand, gravel, silt, and clay; consists of alluvial deposits reworked by lakes, lacustrine deposits reworked by streams and slope wash, and alluvial and lacustrine deposits that cannot be readily differentiated at map scale; grade into other lacustrine and alluvial deposits; west of Cedar Mountains includes more sand than typical gravelly exposures elsewhere, probably due to source material; in Puddle Valley and west of Cedar Mountains commonly includes eolian silt and sand cover commonly less than 6 feet (2 m) thick; thickness locally exceeds 30 feet (10 m).

- **Qlf; Lacustrine fine-grained deposits (Holocene to upper Pleistocene) –** Sand, silt, marl, and calcareous clay of Great Salt Lake and Lake Bonneville; thin to very thick bedded; may include ostracode- and gastropodrich layers; locally includes the white marl of Gilbert (1890); locally may include small areas of sand and gravel; can include thin eolian sand deposits at surface; in Puddle Valley and west of Cedar Mountains commonly includes eolian silt and sand cover commonly less than 6 feet (2 m) thick; near the margin of Great Salt Lake locally includes thin Qlk deposits at surface; thickness 10 to 100 feet (3–30 m) or more.

These descriptions are generally similar to the soils that were observed during the site investigation. It should be noted that there can be significant variation in alluvial and lacustrine deposits due to the inherent chaotic nature of water deposition and the shifting shoreline of lakes. There can be a significant variation over a relatively short distance both spatially and with depth.

- **Subsurface Conditions –** The subsurface conditions for TP-1, TP-3, and TP-4 were generally similar with an approximate 0.5-foot-thick topsoil layer, followed by a silt layer, and then silty gravels with cobbles and boulders. Atlas was provided borings logs from another project located roughly in the same general area as these test pits and the boring logs indicated similar subsurface conditions. The subsurface conditions for TP-7 and TP-8 was generally similar. The topsoil transitioned to varying silt-clay mixtures, with groundwater present at about 4 to 5 feet.

  Additional details of the subsurface soil conditions encountered in the test pits are included on the logs in Appendix A. The lines designating the interface between soil types on the exploration logs generally represent approximate boundaries. In situ, the transition between soil types may be gradual or distinct and will likely vary with location. The laboratory test results are included in Appendix B.

- **Groundwater Conditions –** Groundwater was not encountered during the subsurface exploration for TP-1, TP-3, or TP-4. Groundwater in TP-7 and TP-8 was encountered at depths of approximately 5 and 4 feet, respectively. This relatively shallow groundwater could be problematic for construction and will be discussed further in the Geologic Hazards Section.

  Groundwater levels may vary with changes in precipitation, seasonal weather, surface water, local irrigation practices, and other site-specific factors. Localized perched water may occur after periods of heavy rainfall. Consequently, the groundwater table may fluctuate seasonally or over other time periods.

Geologic Hazards and Geotechnical Issues that Could Impact Construction

The relatively shallow groundwater and soil conditions observed in TP-7 and TP-8 could prove challenging for construction. It will make the area more susceptible to liquefaction; and the area generally north of Grantsville is classified as having a high potential for liquefaction (Black et al, 1999). This area is also listed as having potentially expansive clays by Black et al (1999).

Saturated fine-grained soils will likely provide relatively poor support for foundation loads and roadways. Construction of multi-story or large buildings with heavy foundation loads in this area could require an alternative to shallow foundations. The subgrade for roadways may require additional stabilization. Additionally shallow foundations, or roadway embankments, could be susceptible to time-dependent consolidation settlement. Any excavations below the groundwater would require dewatering which typically significantly increases construction costs. Also, any materials below the water table would need to be dried to reach optimum moisture content for compaction. This would add additional costs if these materials are intended to be reused.

The soil conditions observed in TP-1, TP-3, and TP-4 are generally better for construction. The generally non-saturated granular soils should provide relatively sufficient support for building foundations and roadways. Although the larger cobbles/boulders observed could be difficult to compact and may need to be either crushed or removed. The area generally west of town is classified as potentially susceptible to debris flows according to Black et al (1999). This would be consistent with the cobbles and boulders observed in the test pits and care should be taken to mitigate potential flooding issues.

Based on the soils observed in TP-7 and TP-8, similar fine-grained soils are estimated to have a low California Bearing Ratio (CBR) of about 3. The shallow gravels observed in TP-1, TP-3, and TP-4 are estimated to have a significantly higher CBR, with an estimate of around 10. These values can be used for an initial high level pavement design, but as stated before, additional borings and analysis must be completed before final design.

The difference in CBR values could have a significant impact on the pavement design. Depending on the traffic loading, the relative thickness of the asphalt, subbase, base layers could increase by 100% to support the same traffic volume for the lower CBR value.

Limitations

The recommendations contained within this report are based upon the soil and groundwater conditions encountered in the test pits at the time of exploration. It is the responsibility of the client to ensure the information and recommendations contained herein are provided to the design team. This report was prepared at your request for our services, and in accordance with currently accepted geotechnical engineering practice. No warranty based on the contents of this report is intended, and none shall be inferred from the statements or opinions expressed herein.

The scope of our services for this report did not include an environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on, below, or around this site. Any statements within this report or on the attached figures, logs or records regarding odors noted or other items or conditions observed are for the information of the Client only.

References

- Black, B.D., Solomon, B.J., and Harty, K.M., 1999. Geology and geologic hazards of Tooele Valley and the West Desert Hazardous Industry Area, Tooele county, Utah. Utah Geologic Survey Special Survey Study 96.
- Clark, D.L., Oviatt, C.G., Dinter, D.A., 2020. Geologic Map of the Tooele 30'x60' Quadrangle, Tooele, Salt Lake, and Davis Counties, Utah. Utah Geological Survey Map 284 M.

APPENDIX A

DEVELOPMENT PLAN, MAPS, AND SUBSURFACE EXPLORATION

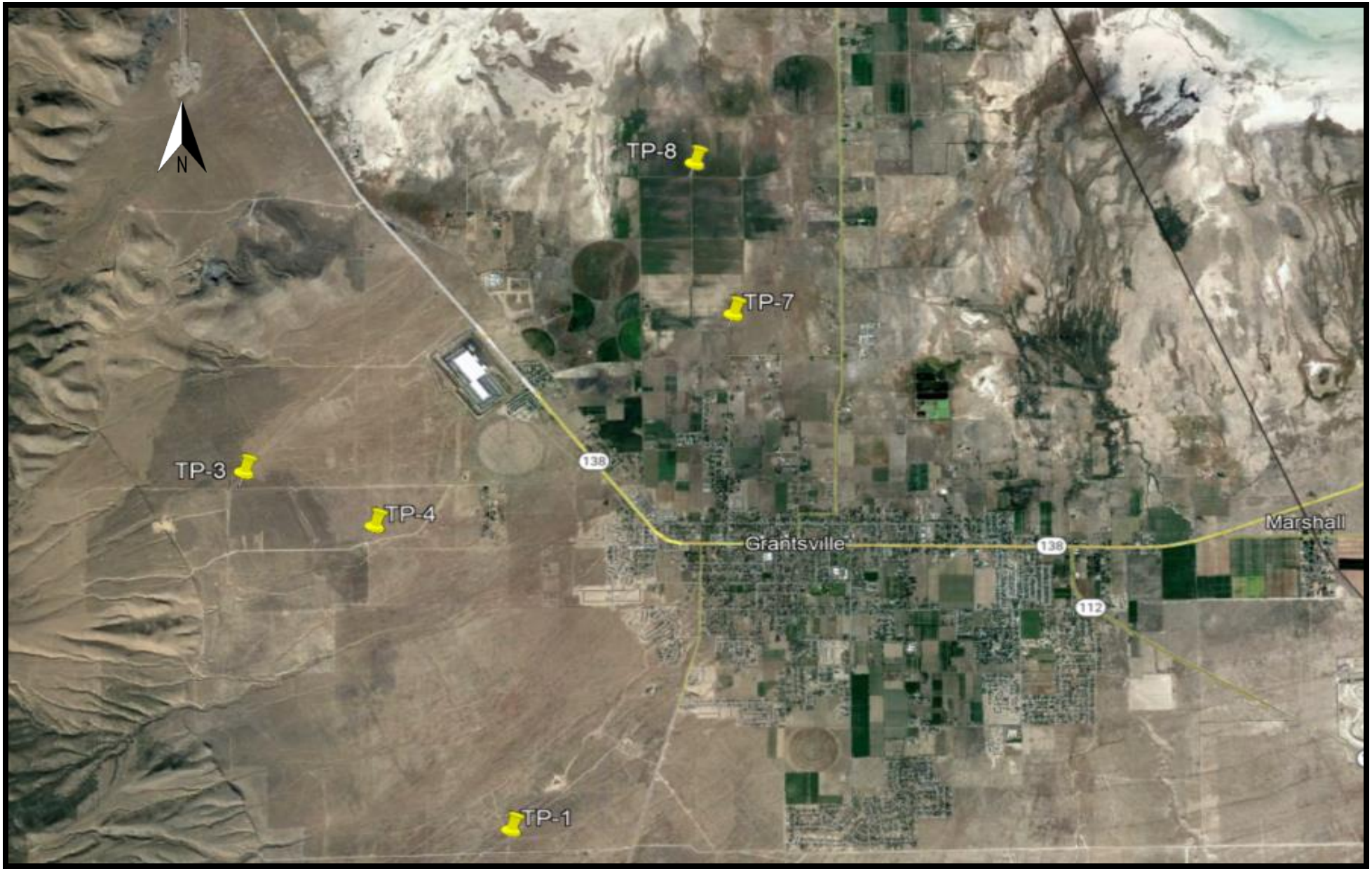


FIGURE A1
Exploration Location Map
SOURCE: Google Earth
SCALE: Not to Scale

ATLAS

Grantsville West Bank
Unincorporated
Tooele County
Atlas Project Number: 22.07445

Qa Alluvium, undivided

Qafy Younger fan alluvium, post-Lake Bonneville

Qla Lacustrine and alluvial deposits, undivided

Qh Human disturbance

Qlf Lacustrine fine-grained deposits, Great Salt Lake and Lake Bonneville

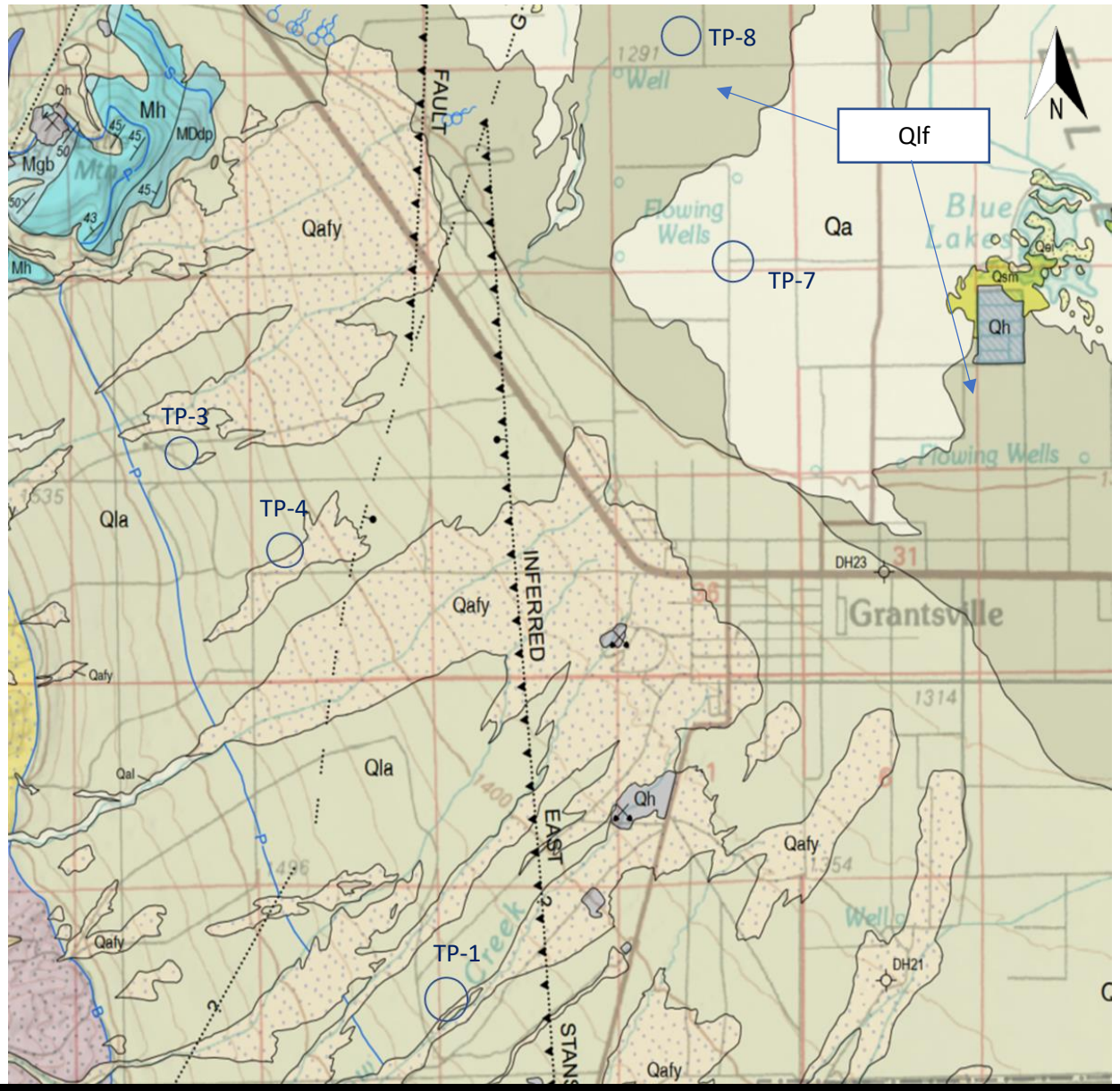


FIGURE A2

Geology Map

SOURCE: Geologic Map of the Tooele 30'x60' Quadrangle, Tooele, Salt Lake, and Davis Counties

AUTHORS: Clark, Oviatt, Dinter (2020)

ATLAS

Grantsville West Bank

Unincorporated

Tooele County

Atlas Project Number: 22.07445

ATLAS
358 South 700 East, B518
Salt Lake City
Telephone: (801)935-4917

TEST PIT NUMBER TP-1

CLIENT Jones and DeMille Engineering
PROJECT NAME Grantsville West Bank Geotechnical Study
PROJECT NUMBER 22.07445
PROJECT LOCATION Unicorporated Tooele County
DATE STARTED 4/12/23 **COMPLETED** 4/12/23
GROUND ELEVATION _____ **TEST PIT SIZE** ~1' wide
EXCAVATION CONTRACTOR Direct Push
GROUND WATER LEVELS:
EXCAVATION METHOD Mini Excavator
AT TIME OF EXCAVATION --- Groundwater was not observed
LOGGED BY RM **CHECKED BY** RM
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION
0			
			Brown Silty Topsoil; Vegetation Roots
0.5			Moist Brown Silt with Gravel, Cobbles, and Boulders
5			
8.0			

Bottom of test pit at 8.0 feet.

GENERAL BH / TP / WELL - GINT STD US.GDT - 5/31/23 14:52 - S:\GEO\PROJECTS\ATC PROJECTS\22.07445 GRANTSVILLE WEST BANK\FIELD\GRANTSVILLE TEST PITS.GPJ

ATLAS
358 South 700 East, B518
Salt Lake City
Telephone: (801)935-4917

TEST PIT NUMBER TP-3

CLIENT Jones and DeMille Engineering
PROJECT NAME Grantsville West Bank Geotechnical Study
PROJECT NUMBER 22.07445
PROJECT LOCATION Unicorporated Tooele County
DATE STARTED 4/12/23 **COMPLETED** 4/12/23
GROUND ELEVATION _____ **TEST PIT SIZE** ~1' wide
EXCAVATION CONTRACTOR Direct Push
GROUND WATER LEVELS:
EXCAVATION METHOD Mini Excavator
AT TIME OF EXCAVATION --- Groundwater was not observed
LOGGED BY RM **CHECKED BY** RM
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION
0			
			Brown Silty Topsoil; Vegetation Roots
		0.5	
			Brown Sandy Silt
		1.5	
			Moist Brown Silt with Gravel, Cobbles, and Boulders
5			
		5.0	
			Moist Light Brown Sandy Silt with Gravel, Cobbles, and Boulders
		8.0	

Bottom of test pit at 8.0 feet.

GENERAL BH / TP / WELL - GINT STD US.GDT - 5/31/23 14:52 - S:\GEO\PROJECTS\ATC PROJECTS\22.07445 GRANTSVILLE WEST BANK\FIELD\GRANTSVILLE TEST PITS.GPJ

ATLAS
358 South 700 East, B518
Salt Lake City
Telephone: (801)935-4917

TEST PIT NUMBER TP-4

CLIENT Jones and DeMille Engineering
PROJECT NAME Grantsville West Bank Geotechnical Study
PROJECT NUMBER 22.07445
PROJECT LOCATION Unicorporated Tooele County
DATE STARTED 4/12/23 **COMPLETED** 4/12/23
GROUND ELEVATION _____ **TEST PIT SIZE** ~1' wide
EXCAVATION CONTRACTOR Direct Push
GROUND WATER LEVELS:
EXCAVATION METHOD Mini Excavator
AT TIME OF EXCAVATION --- Groundwater was not observed
LOGGED BY RM **CHECKED BY** RM
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION
0			Brown Silty Topsoil; Vegetation Roots
		0.5	Brown Sandy Silt
		2.0	Moist Brown Silt with Gravel, Cobbles, and Boulders
5			
		8.0	Bottom of test pit at 8.0 feet.

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ATLAS
358 South 700 East, B518
Salt Lake City
Telephone: (801)935-4917

TEST PIT NUMBER TP-7

CLIENT Jones and DeMille Engineering
PROJECT NAME Grantsville West Bank Geotechnical Study
PROJECT NUMBER 22.07445
PROJECT LOCATION Unicorporated Tooele County
DATE STARTED 4/12/23 **COMPLETED** 4/12/23
GROUND ELEVATION _____ **TEST PIT SIZE** ~1' wide
EXCAVATION CONTRACTOR Direct Push
GROUND WATER LEVELS:
EXCAVATION METHOD Mini Excavator
AT TIME OF EXCAVATION --- Water Flowed Into Excavation at ~5 ft
LOGGED BY RM **CHECKED BY** RM
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION
0			Light Reddish Brown Clayey Topsoil
		0.5	Moist Reddish Brown to Dark Brown Silt
		3.5	Moist Light Brown Clay
		4.0	Moist to Wet Light Grey Silt; Blocky with Rust Staining
5			
		8.0	Bottom of test pit at 8.0 feet.

GENERAL BH / TP / WELL - GINT STD US.GDT - 5/31/23 14:52 - S:\GEO\PROJECTS\ATC PROJECTS\22.07445 GRANTSVILLE WEST BANK\FIELD\GRANTSVILLE TEST PITS.GPJ

ATLAS
358 South 700 East, B518
Salt Lake City
Telephone: (801)935-4917

TEST PIT NUMBER TP-8

CLIENT Jones and DeMille Engineering
PROJECT NAME Grantsville West Bank Geotechnical Study
PROJECT NUMBER 22.07445
PROJECT LOCATION Unicorporated Tooele County
DATE STARTED 4/12/23 **COMPLETED** 4/12/23
GROUND ELEVATION _____ **TEST PIT SIZE** ~1' wide
EXCAVATION CONTRACTOR Direct Push
GROUND WATER LEVELS:
EXCAVATION METHOD Mini Excavator
AT TIME OF EXCAVATION --- 4
LOGGED BY RM **CHECKED BY** RM
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION
0			Light Reddish Brown Clayey Topsoil (0.5)
			Moist Reddish Brown to Dark Brown Silt (3.0)
			Moist Light Brown Silty Clay (4.0)
5			Wet Light Grey Silt; Blocky with Rust Staining (6.0)

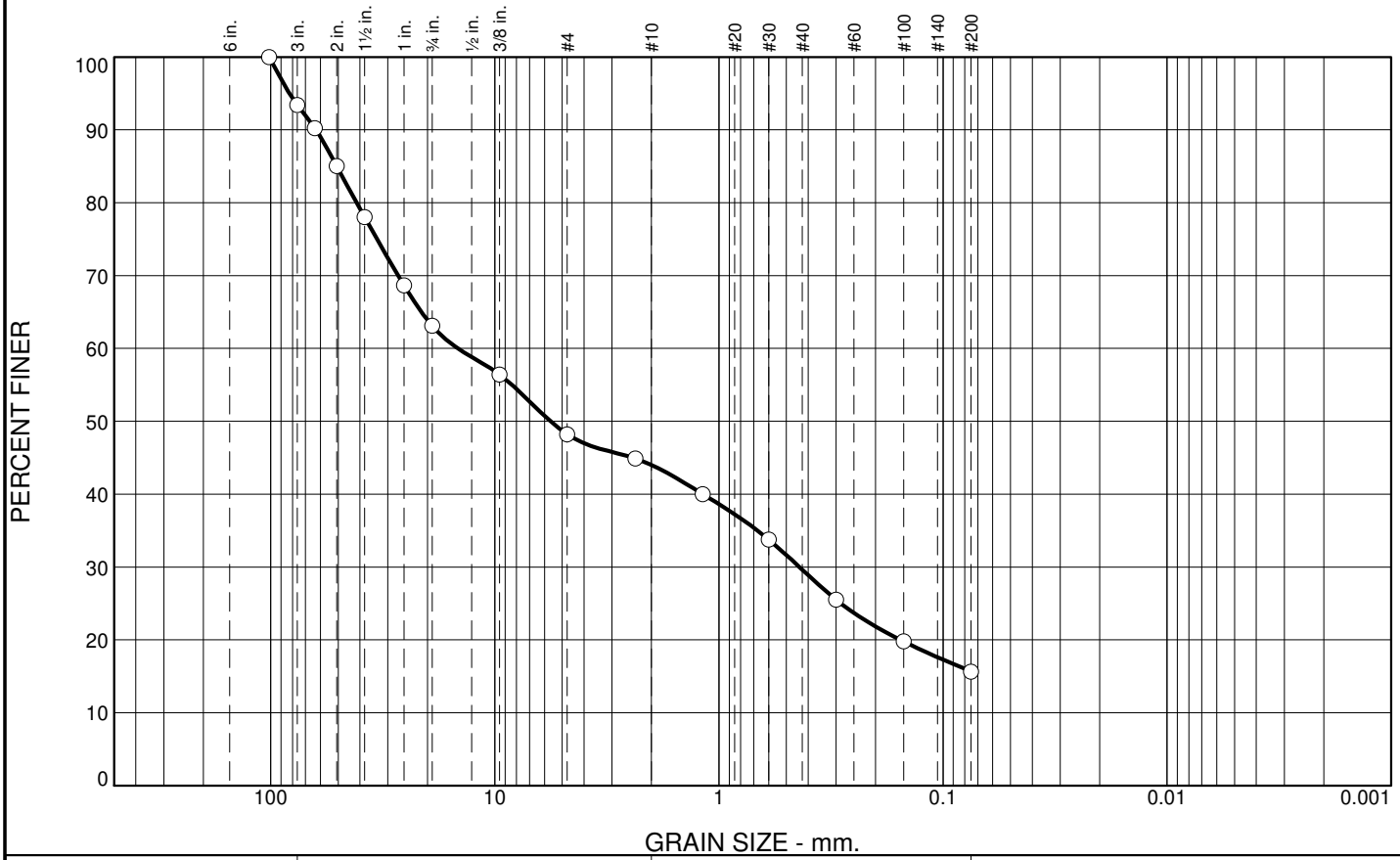
Bottom of test pit at 6.0 feet.

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APPENDIX B

LABORATORY TEST RESULTS

Particle Size Distribution Report



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
7	49	14	14	16	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100		
3	93		
2.5	90		
2	85		
1.5	78		
1	69		
.75	63		
.375	56		
#4	48		
#8	45		
#16	40		
#30	34		
#50	26		
#100	20		
#200	16		

* (no specification provided)

Material Description

Medium brown silty gravel with sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 62.7079 D_{85}= 50.7489 D_{60}= 14.6400
D_{50}= 5.6466 D_{30}= 0.4375 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-1-b

Remarks

MOISTURE: 4.66%

Source of Sample: 22.07445
Sample Number: Test Pit #3

Date: 04-19-23

CONSOLIDATED ENGINEERING LABORATORIES

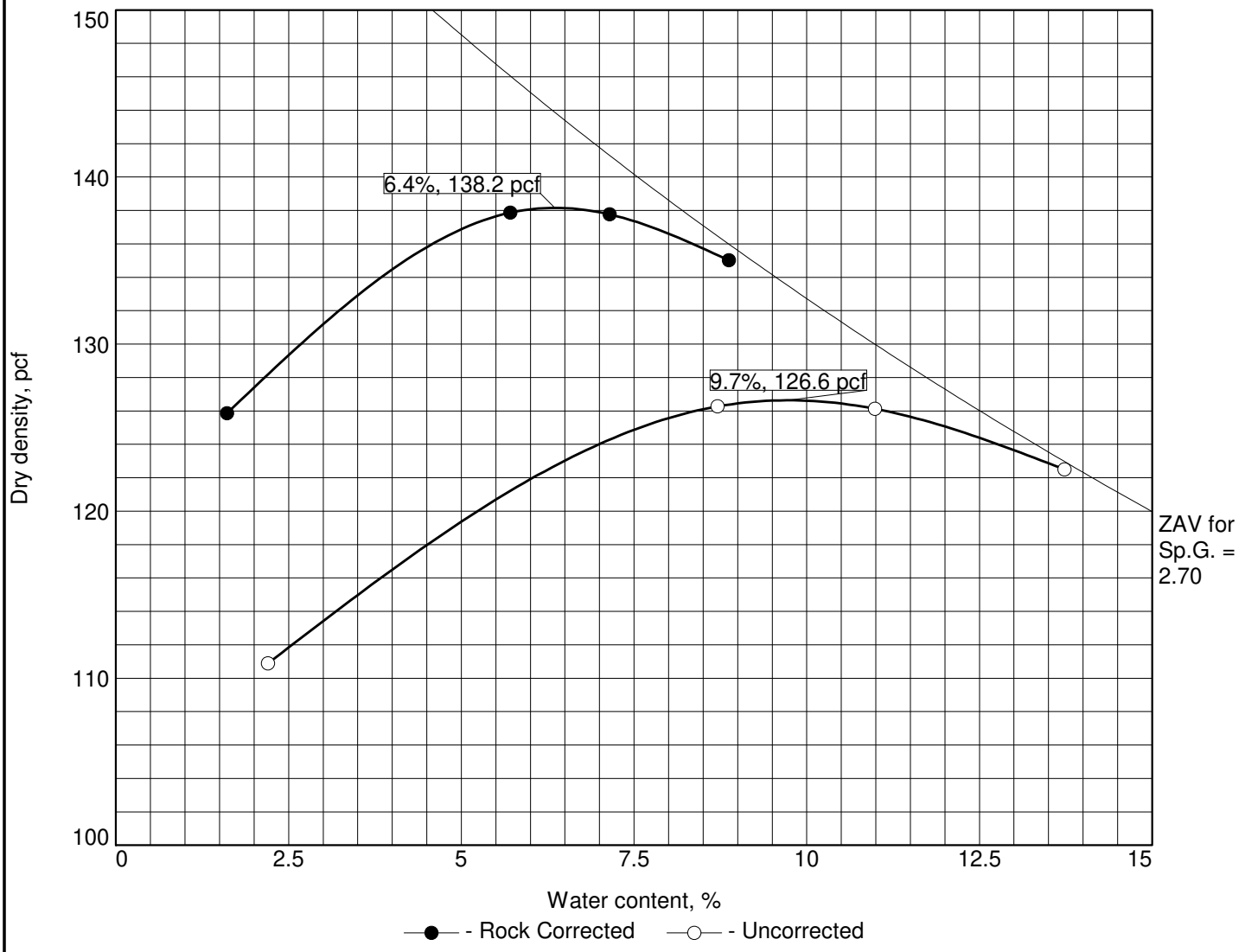
San Ramon, California

Client: Atlas
Project: Grantsville Test Pits

Project No: 22.07445 **Figure**

Tested By: DR **Checked By:** KC

COMPACTION TEST REPORT



Test specification: ASTM D 698-91 Procedure C Standard
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
	GM	A-1-b			NV	NP	37	16

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 138.2 pcf	126.6 pcf	Medium brown silty gravel with sand
Optimum moisture = 6.4 %	9.7 %	

Project No. 22.07445 **Client:** Atlas
Project: Grantsville Test Pits

○ **Source of Sample:** 22.07445 **Sample Number:** Test Pit #3

CONSOLIDATED ENGINEERING LABORATORIES

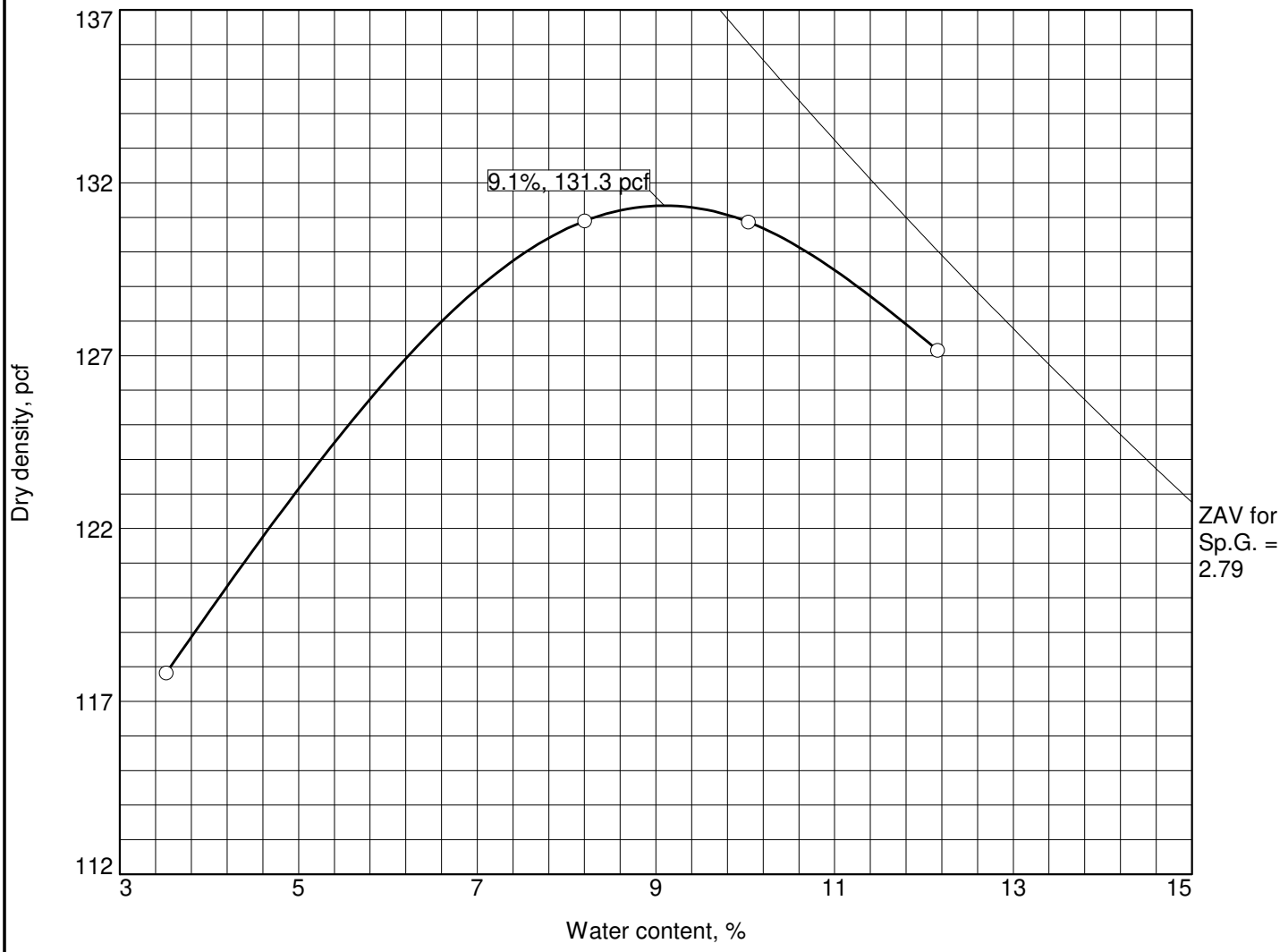
San Ramon, California

Remarks:
MOISTURE: 4.66%

Figure

Tested By: DR **Checked By:** KC

COMPACTION TEST REPORT



Test specification: ASTM D 698-91 Procedure C Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
					NV	NP		

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 131.3 pcf Optimum moisture = 9.1 %	Medium brown silty gravel with sand

Project No. 22.07445 **Client:** Atlas

Project: Grantsville Test Pits

○ **Source of Sample:** 22.07445 **Sample Number:** Test Pit #8

CONSOLIDATED ENGINEERING LABORATORIES

San Ramon, California

Remarks:

MOISTURE: 37.47

** NO ROCK CORRECTION APPLIED **

Figure

Tested By: DR **Checked By:** KC

AGENDA ITEM #3

Adjourn