Castle Valley, Utah

Hazard Mitigation Plan: 2015

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Town of Castle Valley Overview

DEFINITIONS

Catastrophic Disaster: An event that results in large numbers of deaths and injuries; causes extensive damage or destruction of facilities that provide and sustain human needs; produces an overwhelming demand on State and local response resources and mechanisms; causes a severe long-term effect on general economic activity; and severely affects State, local, and private-sector capabilities to begin and sustain response activities. Note: the Stafford Act provides no definition for this term. (**FEMA,** *FRP Appendix B*, 1992)

Hazard: "A potential event or situation that presents a threat to life and property." (**FEMA**, *Hazards Analysis for Emergency Management (Interim Guidance)*, September **1983**, p. 5)

BACKGROUND

INTRODUCTION:

The Castle Valley Hazard Mitigation Plan is a localized plan that details the several natural and manmade hazards that are specific to Castle Valley and the Town of Castle Valley municipality, located in Grand County in the State of Utah. (See Appendix A1 –A2) This plan fulfills the requirements set forth by the Disaster Mitigation Act of 2000 (DMA 2000). The DMA 2000 requires a hazard mitigation plan in order to be eligible for mitigation grants made available by the Federal Emergency Management Agency (FEMA).

PURPOSE:

The Castle Valley Hazard Mitigation Plan is designed to evaluate and identify local hazards that would negatively affect Castle Valley. The plan outlines mitigation strategies for each hazard with an assessment to the potential benefit, the financial viability and community acceptance /political viability. The plan will be an important step in outlining and recommending government roles, public participation, regulations and emergency systems to create a safer environment for citizens and efficient emergency response.

SCOPE:

The Castle Valley Hazard Mitigation Plan includes all incorporated and unincorporated areas in Castle Valley. The plan addresses all natural hazards identified by the Federal Emergency Management Agency. All hazards that may affect Castle Valley and its residents are analyzed. Hazard mitigations are discussed in both long and short term goals in mind. The implementation of each mitigation strategy is discussed and possible resources and funding options are identified.

FUNDING:

Funding for the mitigation planning process has been largely by volunteer hours. Minimal costs for office supplies, such as paper, ink, and hours worked by the town clerk will also be included.
Funding for mitigation strategies include budgeting by the Town of Castle Valley and the Grand County Service Area for Castle Valley Fire Protection District (Castle Valley Fire Protection District and possible grant and loan sources. Possible Grant and loan sources include: C.I.B., USDA, Rural Development Grants, credit unions, and other Grant Websites.
Recruiting volunteers for some of the mitigation efforts was also considered.
Volunteer hours will be counted at $22.50 per hour
Town Clerk hours are counted at $20.00 per hour

PROFILE

General:
Castle Valley was initially a large ranch which was subdivided into five-acre minimum lots (now Town of Castle Valley municipal boundaries) platted, and recorded on May 11, 1973. The Town of Castle Valley was officially incorporated on July 26, 1985.

The 2010 US Census stated that the population of the Town of Castle Valley was 319 as compared to the 2000 US Census which stated a population of 349 for the Town. The 2010 US Census also showed the following demographics for Town residents:

Male	166	White	310
Female	153	African American	0
Under 18	26	American Indian or Alaska Native	1
20-34 years old	23	Asian	2
35-49 years old	42	Native Hawaiian and Pacific Islander	0
50-64 years old	159	Other	2
65 years old and over	62	Identified by two or more	4

Castle Valley is surrounded by large tracts of open space and minimally developed public land that provides a natural setting, integral to the character of the Town. The sensitive nature of the land and water of Castle Valley and the effects of climate change call for creative and new ways of managing Town and surrounding lands and our local and global environments.

Government:
The Town of Castle Valley has a 5 member Town Council including a Mayor. The Town also has a Planning and Land Use Commission, a Road Committee and the Hazard Mitigation Committee that meet monthly in open and public meetings in accordance with Utah Code 52-4. The Town Council adopts Ordinances and Resolutions with recommendations and public hearings presented from each committee and works together to ensure the health and safety of Valley residents. 85-3 is the Town's governing Land Use Ordinance and governs and protects the resources and natural setting of Castle Valley. Ordinance 95-6 outlines processes and forms that make residents aware of natural hazards when going through the building process. Ordinance 2007-6 Prohibits Fire Hazards in periods of high fire danger. Ordinance 1996-1 protects the Town's Watershed. The Town also adopted Ordinance 2013-1 which created the Hazard Mitigation Committee. Many regional Hazard Mitigation

plans have been adopted in the past by Resolutions by the Town Council as well as a "Firewise Standard" Resolution.

Land Use:
Castle Valley is a rural residential and agricultural community, made up of five-acre minimum lots with single-family homes and accessory buildings in association with low-impact livestock and agricultural uses. The Town currently allows home and premises businesses, but no other commercial or industrial activity is permitted.

The Town has a modest level of public facilities and services. A community building was built on the Town lot in 2004 and serves as a gathering place for community and Town government events. The Town building is the only non-affiliated public facility in the Town and houses the Town office, meeting rooms, and a branch of the Grand County Public Library. The Town lot is home to a fire station owned and managed by the Castle Valley Fire Protection District, a shed for Roads Department equipment, a basketball court, and an outdoor picnic area. The Town has a small, part-time staff. The Town has a cemetery that it maintains with Grand County funds. There is no municipal water delivery system or wastewater treatment facility nor is there any municipal garbage removal service for residents.

Water:
Water is provided through individual wells and waste is managed by individual septic wastewater disposal systems. Castle Valley's aquifer is the sole source of drinking water for its residents and an irreplaceable resource.

The Castle Valley Aquifer has been declared as a Sole Source Aquifer by the Federal Environmental Protection Agency in 2001[1] and classified by the Utah Division of Water Quality as "pristine" in certain areas, however water quality varies in different parts of the Town. About 40% of the Town's lots have very hard water that must be purified in order to drink. The aquifer is extremely vulnerable to contamination. It is an unconsolidated valley-fill type and exposed at the surface with no overlying confining geologic formation. This allows contaminates to move more quickly downward to the water supply. The Town now has six monitoring wells for measuring water quality changes over time and In 2014 the Town Council set aside funds and voted to have a Water Study done for the Watershed in order to further it's protection and create a water budget.

Two streams originating from the La Sal mountains pass through the town boundaries: Castle Creek which is perennial and Placer Creek which is intermittent. There are several users with water rights for Castle Creek that use the partially spring fed creek for irrigation purposes.

Transportation and Roads:
Castle Valley is served by County Road 96. State Highway 128, which is about 1.7 miles outside of the Town's municipal boundary, is the principal transportation access to the Town. Castle Valley Drive serves as the main road leading in and out of the Town. Shafer Lane has been dedicated as an emergency ingress and egress road for emergency responders and for the public should Castle Valley Drive become impassable. Castle Valley Drive is the only paved (chipped sealed) Town road and is paved for the first 3.64 miles. The remaining portion of Castle Valley Drive is gravel and dirt. All other Town roads are either crowned dirt and/or gravel and are approximately 17 miles in combined length. Roads on the west side of Castle Valley Drive proceed to the base of Porcupine Rim. This results in progressively steeper grades, some exceeding 20%, making winter maintenance difficult and in some cases impossible.

[1] Environmental Protection Agency, August 6, 2001, Sole source aquifer Notice of final determination for the Castle Valley Aquifer System, Castle Valley, UT: Environmental Protection Agency, (FRL-7024-2).

The Town Roads Department is responsible for maintenance and improvements of all Town roads and for all drainages within the Town's easements. This includes flood control, dirt work, paving/chip sealing of Castle Valley Drive, signage for all Town roads, snow removal for dirt roads that receive winter maintenance, and Town vehicle and equipment maintenance and repair. Castle Valley contracts with Grand County Road Department to provide winter snow removal from Castle Valley Drive.

Fire Protection and Emergency Preparedness:
Castle Valley is a Wildland Urban Interface - a place where residential areas border and interact with undeveloped wildland vegetation. The Town and outlying areas are served by the Grand County Service Area for Castle Valley Fire Protection District (Castle Valley Fire Protection District), which funds and manages the Castle Valley Volunteer Fire Department. Castle Valley has received Firewise Communities/USA recognition status. On behalf of the Castle Valley community, the Castle Valley Fire District maintains this status with annual membership in Firewise Communities, a project of the National Fire Protection Association.

Until recently residents with medical emergencies experienced an approximate 30 to 45 minute response time from Grand County EMS who travel from Moab. The Grand County EMS and the Castle Valley Fire District established an Emergency Medical Response (EMR) team for more rapid, first response to medical emergencies. These trained EMR's cannot do transports, but do have a non-transport ambulance with medical supplies to treat patients until Grand County EMS arrives. The EMR team also received training involving the emergency helicopter contractor that recently established itself in the Moab area.

PLANNING PROCESS

Section Contents

1. Town of Castle Valley planning participation and Plan adoption.
On December 18, 2013 in open session the Town of Castle Valley passed Ordinance 2013-1 creating a local Hazard Mitigation Committee. The Town of Castle Valley will formally adopt the plan upon the recommendation by the Hazard Mitigation Committee.

2. Hazard Mitigation Planning Process
The Castle Valley Hazard Mitigation Plan was developed through interaction between the Hazard Mitigation Planning Committee for the Town of Castle Valley, the Town of Castle Valley Municipality and Planning and Land Use Commission, Grand County Service Area for Castle Valley Fire Protection District, CERT, the Grand County Emergency Manager and the local community.

The tasks of the Hazard Mitigation Planning Committee:

- Attend Meetings
- Represent interests of Castle Valley and its residents
- Collect information on jurisdiction's resources
- Identify and prioritize the threat of local hazards
- Facilitate development of jurisdiction's mitigation strategy.
- Create local hazard mitigation plan according to FEMA's guidelines set forth in "State and Local Mitigation Planning How-To-Guide"
  dated September 2002 FEMA 386-1

The Hazard Mitigation Planning Committee met on the 2nd Wednesday of each month in open and public meetings beginning on November 13th, 2013. The Hazard Mitigation Committee will continue to meet until a draft is ready for approval. They will review and update the plan every 4 years or as new information becomes available and will hold public hearings to seek community input.

3. Public and Other Stakeholder Involvement

All Hazard Mitigation Committee meetings were open to the public and were posted in accordance with the Open and Public Meetings Act (Utah Code 52-4-202). The Hazard Mitigation Meeting Agendas and Minutes are posted to the Town's website as well as Utah's Public Notice Website. All Agendas, Minutes and meeting documents are kept in a book which will remain a permanent record in the Town office.

The Hazard Mitigation Committee Meetings on September 10th and October 8th, 2014 had regional Rocky Mountain Power representatives participate to discuss power outages and protocol between the Town and private power company. Members of the Castle Valley Fire Protection District, local CERT members and Planning and Land Use members were also a part of the Hazard Mitigation Committee.

The Hazard Mitigation Committee Members reached out to local groups such as the Day Star Academy, Sorrel River Ranch, Red Cliffs Lodge, Castle Valley Irrigation Company, Frontier Communications and Rocky Mountain Power to receive input and seek support in creating the Hazard Mitigation Plan for Castle Valley Utah.

Public Hearings will be held to review preliminary drafts as well as the final draft of the Castle Valley Hazard Mitigation Plan. Notice of Public Hearings for input on the drafts will be posted with a minimum of 2 weeks before the hearings will be held.

4. Integration with Existing Plans

Data was reviewed from the Town of Castle Valley records including: The Drainage Master Plan, Water Studies, UGS geologic studies, the Town's General Plan, Grand County's Regional Plan, and the Southeastern Utah Hazard Mitigation Plan, The Utah Division of Forestry, Fire and State Lands local Community Fire Plan, private records, newspaper articles and the Castle Valley Fire Protection Districts records were all used in the development of the Castle Valley Hazard Mitigation Plan.

4 Step Planning Process:

1. Organize resources:

Assess community support- Introduced the idea and through public meetings determined if there was enough support to begin the planning process.

Build the planning team- Public invitations went out through gatherings, word of mouth and public meetings for those interested in participating in the planning process. After a group was established an ordinance was adopted forming the Hazard Mitigation Committee.
Members include:
Jazmine Duncan- Chair, Town Council member, Fire Dept. member, CERT member
Greg Halliday- Co- chair, Fire Dept. member, former Town of Castle Valley Road Supervisor, current Road Committee member
Ron Drake- Fire Chief, Castle Valley Service District for Fire Protection, CERT member, Castle Valley Comments- Times Independent
Dave Erley- Mayor Town of Castle Valley, Road committee member
Pat Drake- Community member, CERT member
Leta Vaughn- Fire District Commissioner and Fire Dept. member, EMR member
Bob Russel- Fire District Commissioner and Fire Dept. member, EMR member, CERT member
Bob Lippman- Fire District Commission Chair and Fire Dept. member
Bill Rau- Planning and Land Use Commission- Chair
David Smith- Community member, CERT member
Rick Bailey- Grand county emergency manager
Steve White- Grand county sheriff
Ali Fuller- Town of Castle Valley Clerk, CERT member

Engage the public- Public hearings were held May 13, 2015 and Oct. 14, 2015. All meetings were open public meetings with members of the community attending and contributing on the May 13th, 2015 and Oct. 14, 2015 Public hearings held by the Hazard Mitigation Committee.
Input was also taken via letters and email throughout the entire planning process.

Identify and profile hazards- As a group we listed all hazards which affect the community, we prioritized the list in order of most probable to occur and which have the greatest impact on the community or have the greatest probability of affecting the community.

Inventory assets and estimate losses- We created a list of resources and assets. Taxable values of private property were obtained from the County Clerk which provides a base for possible losses within each hazard area. The average assessed taxable home value in Castle Valley in November 2015 is $73,659 it would however cost substantially more to replace a household in a disaster. Since property owners maintain their own wells for water, septic tanks, and propane tanks, the main infrastructure that the town maintains are roads. The maintenance, construction and rebuilding of roads and drainages is a part of the town's annual budget.

Benefit cost review- A list of priority projects was created based on actions which were seen as having the greatest impact using resources the community currently has available, or we felt could

be budgeted for. Cost analysis was done on each project using known costs for certain items and amounts given by the FEMA schedule for some unknown costs.

2. Develop mitigation plan:

Develop goals and objectives- As a group we decided what we wanted to achieve with our planning process. The committee used FEMA's guidelines set forth in "State and Local Mitigation Planning How-To-Guide" dated September 2002 FEMA 386-1.

Identify and prioritize mitigation actions- As a group we went through each hazard and came up with a list of possible mitigation strategies for each one, we then rated each strategy based on Potential Benefit, Financial Viability and Political Viability. Potential Benefit was given a high, medium or low rating. Financial and Political Viability were rated 1-5 with 1 being easy and 5 being very difficult.

Prepare implementation strategy- We are going to mitigate potential impacts from hazards thru executing the Action Plan Projects and thru community awareness and policy development.

Document the planning process- Each member of the committee was assigned a hazard to profile and research histories on. Each member or team working on a hazard then prepared a summary and history to add to the final plan. Agendas, Minutes and meeting documents were kept of every meeting.

3. Implement the plan and monitor progress:

Adopt the Hazard Mitigation Plan-

Plan was adopted by the Town of Castle Valley on November 18th, 2015.?

Implement Plan recommendations-

The group will work with the Town and stakeholders to continue to implement parts of the plan and implement priority project within the next 5 years.

Evaluate planning results-

Continual evaluation of planning progress will be ongoing and reviewed with plan every 4 years.

Review and Revise the Hazard Mitigation Plan-

The Hazard Mitigation Committee will review and revise the Hazard Mitigation Plan every 4 years .

RESOURCES

Town of Castle Valley:

- Town hall and library
- Road shed
- Maintenance shed
- Fuel storage
- Staff
- Town Council
- Planning and Land Use Commission
- Hazard Mitigation Committee
- Road department
- Roads equipment
- 8332 Grader moldboard 14ft. $70pr/hr
- 8393 Loader wheel bucket 3 cubic yds. $40pr/hr
- 8573 Loader …..wheel 1.7 cubic yds. $38 pr/hr
- 8720TruckdumpStruckcap 8cubic yds$35 pr/hr
- Road committee
- Insurance

Castle Valley Fire District:

- Station 1
- Station 2
- 20 Volunteer personnel
- Commissioners
- Equipment
- Engine 35 brush truck
- 33 Hummer
- 34 duce 1/2
- Water tender
- 8-structure
- 37-structure
- 38 chiefs truck
- 31 brush truck
- 30- structure
- Mack
- Radios
- Satellite phone
- Cots

Church Groups:

- Day Star Academy and Farms
- LDS
- Buildings
- Tables and Chairs

Grand County UT:

- Roads Department
- Snow plow
- Emergency Medical Services
- C.V. EMRs
- Non transport ambulance
- CERT-Kris Hurlburt
- Emergency Manager - Rick Bailey
- Sheriffs' Department – mobile command post and repeater
- County Council

Interagency Fire:

- Forestry Fire and State Lands- Ben Huntsman, Jason Johnson, Mark Marcum

State of UT:

- Planning support- Brad Bartholomew/ FEMA
- CIB – Bruce Adams
- USU- Mike Jones/Roads
- Regional engineer- Mark Stiltson
- State Roads and Highway patrol
- Health department
- Agriculture extension- Mike Johnson

Federal Government:

- Rural development USDA
- FEMA
- EPA
- NRCS-Don Andrews
- Soil Conservation Agency

Private Sector:

- C.V. business owners
- Private property owners who volunteer
- Privately owned equipment: chainsaws, tractors, etc.
- Local doctors and nurses
- Water hand pumps on wells
- Frontier Communications
- Rocky Mountain Power
- Red Cliffs Lodge
- Sorrel River Ranch
- School bus
- Outbuildings and spare bedrooms

FIRE

BACKGROUND

Castle Valley is a Wildland Urban Interface - a place where residential areas border and interact with undeveloped wildland vegetation. This presents a number of fire-fighting challenges due to Town and residential proximity to large areas of fire-prone vegetation. Trees, shrubs, grasses, and weeds all provide significant fuel for fires; winds, topography, and difficulty of access add to fire hazards. Periods of drought, invasive vegetation, and modern fire suppression practices have helped to increase heavily overgrown areas of dry combustible vegetation. During "monsoon" season, frequent thunderstorms and cloudbursts occur, posing a threat to life and property from lightning triggered wildfires and debris flow (flood) events. These variables make Castle Valley very vulnerable to Fire however several mitigation efforts are in place and due to more development there are more firebreaks throughout the municipality.

Over the past 35 years, the Castle Valley Fire Department responded to approximately 100 fires, an average of just under three fires per year. Some years the area experiences a lot of fire activity like 1984, 2009, and 2011, which had eight and nine fires and some years like 1982, 1983 and 2010, for instance, only two fires were reported. Lightning is the leading cause of fires at nearly one third followed by human caused fires at 26 percent and controlled fires that got out of control at 22 percent. Forty-four percent of the fires occur within the Castle Valley Town area and fifteen percent each are in the Castleton area and along State Route 128 and 16 percent of the fires are on State or BLM lands. There have been fires reported in every month but nearly a quarter of the responses occur in July followed by June with 19 percent and August with 13 percent. Grass, brush and trees are the most common source of fire at 75 percent followed by structure fires at 23 percent and vehicle fires at six percent and other sources, like power poles, at four percent. Some fires will burn two or more of these categories.

HISTORY

There were not many inhabitants in Castle Valley when the Castle Valley Fire Department was formed in 1976 but the young community had already experienced some disastrous fires and fatalities. Included in those events was a fire involving an A-frame structure near Castle Creek and Castle Valley Drive where a child perished in the building. Former Castle Valley resident and County Fire Warden Robin Donoghue said that he remembered helping Grand County Sheriff Heck Bowman sift through the rubble to find the remains of the young boy's body.
Donoghue and Dave Durrant, another early settler to the valley recognized the need for local fire protection and approached District Ranger Dick Buehler for help in organizing the fire department and acquire equipment. During the summer of 1977 the fire department acquired an excess military 2.5-ton fire truck and obtained a state lease on the property, which now houses Fire Station One on the Castleton Road. Fire department volunteers eventually built a fire house with money collected by hosting barbeques and other fund raising activities and, when there were enough residents in Castle Valley to form a tax base, formed the Castle Valley Fire Protection District.

Donoghue served as the first fire chief followed by Durrant, Frank Mendonca, John McGann, Dave Seibert, Floyd Stoughton, and Ron Drake. The fire department bought their first engine, a used, refurbished American LaFrance pumper engine in 1994 and took possession of a new International 2,000 gallon pumper/water tender in 2007, which was purchased with a CIB grant. Currently the fire department maintains nine structure and wildland fire vehicles, five of which are owned by the fire district and four are excess military vehicles on loan from the State of Utah. In 2003, the district built a second fire station, which is located behind the Castle Valley Town Hall and in December, 2010 purchased the property where Fire Station I is located, both with funds furnished by CIB grants.

EVENTS:* (Last ten years)

Mar 3, 2005	Grass	Human	Buchanan Lane
Jun 30, 2005	Structure	Lightning	Castleton
May 22, 2006	Brush Fire	Lightning	Buchanan Lane
Jun 15, 2006	Brush	Lightning	Round Mtn Fire, 213 ac.
Jun 22, 2006	Brush	Lightning	Upper Castle Valley
Aug 31, 2006	Brush	Lightning	34 Rim Shadow Lane
May 21, 2007	Tree Fire	Lightning	Taylor Lane
Aug 5, 2007	Structure	Lightning	Lazaris Lane
Sep 30, 2007	Brush	Human	Lazaris Lane, 15 ac.
Oct 9, 2007	Brush	Human	Homestead Lane
July 19, 2008	Grass	Human	Loop Road
Aug 11, 2008	Structure	Electrical	DayStar Academy
Aug 27, 2008	Brush	Lightning	Porcupine Ranch, 4K acres
Apr 12, 2009	Power Pole	Weather	Lower Pope Lane
May 18, 2009	Power Pole	Failed Equip.	SR 128
May 19, 2009	Trees	Lightning	Castleton
July 16, 2009	Tree	Lightning	Loop Road
July 19, 2009	Power Pole	Lightning	Lazaris Lane
Aug 6, 2009	Trash	Human	Red Cliff Lodge
Aug 13, 2009	Tree	Lightning	Keogh Lane
Aug 13, 2009	Trees	Lightning	Upper 80s section
Sep 30, 2009	Tree Fire	Lightning	Keogh Lane
Mar 18, 2010	Structure (pole)	Lightning	Castle Valley Drive/Keogh Lane
Aug 5, 2010	Brush Fire	Lightning	Between Pope and Miller Ln.
Jan. 7 2011	Structure Fire	Electrical cause	Sorrel River Ranch
May 18,2011	Tent fire	Human cause	Mile 21, SR 128
Jun 8, 2011	Trash Fire	Human cause	Sorrel River Ranch
Jun 18, 2011	Arson Fire	Human cause	SR 128

Jul 17, 2011	Brush Fire	Lightning	159 Buchanan Lane
Jul 19, 2011	Brush Fire	Lightning	Porcupine Ranch
Jul 30, 2011	Brush fire	Lightning	Shafer Lane
Dec 8, 2011	Structure/Grass	Human, hot ashes	447 Castle Valley Drive
Feb 10, 2012	Straw fire	Human	SR 128
Apr 19	Dryer fire	Mechanical	Sorrel River Ranch
May 26, 2012	Structure/Brush	Unknown/weather	413 Cliffview Lane
July 13, 2012	Brush Fire	Lightning	Castleton Road #1
Jul 13, 2012	Brush Fire	Lightning	Castleton Road #2
Jul 20, 2012	4 Trees	Lightning	Porcupine Ranch Rd.
Jul 21, 2012	Free Fire	Lightning	Upper 80s section
Aug 23, 2012	Grass Fire	Human	Creekside Lane
Sep 24, 2012	Brush Fire	Lightning	Adobe Mesa (Assist USFS)
Sep 1, 2013	Cedar Trees	Lightning	Upper 80s/BLM
May 30, 2014	Brush	Lightning	South Round Mountain
Jun 15, 2014	Brush	Arson Fire	Mile 13, SR 128
Jul 11, 2014	Tree Fire	Lightning	Castleton Road
Jul 15, 2014	Single Trees	Lightning	272 Pope Lane/350 Taylor Lane
Aug 25, 2014	Tree Fire	Lightning	Gravel Pit, Castleton
Sep 14, 2014	Structure/Dryer	Human	Sorrel River Ranch

*During those years when there were few fire events the Castle Valley Fire Department was still busily involved in responding to false alarms, controlled burn stand-by, medical assists, requested to assist with vehicle accidents and many other important requests.

Fire Probability Analysis

Potential Magnitude		**Negligible**	**Less than 10%**
	X	**Limited**	**10-15%**
		Critical	**25-50%**
		Catastrophic	**More than 50%**
Probability	**X**	**Highly likely**	
		Likely	
		Possible	
		Unlikely	
Location	**Anywhere there is fuel**		
Seasonal Pattern or Conditions	**May- Sept. – Wildfires, Year Round – Structure fires**		
Duration	**Hours to days.**		
Analysis Used	**Documented events C.V.F.D., identifying resources available currently.**		

Risk Assessments and Mitigation Strategies:

While the community can do little to temper the extreme weather that causes fires, much can be done to mitigate the effects of those weather related events. Human caused fires can also be mitigated with public awareness programs and continued participation with the Firewise Program.

(1 =Easy – 5= Difficult)

1. Mowing Roads to expand the firebreak.
   Potential benefit= High
   Financial viability= 1 [24 hrs for all roads, 2-3x a year]
   Political viability=1

2. Policy changes to require property owners to keep fuel down.
   Potential benefit= High
   Financial viability=4
   Political viability=5

3. Increase FireWise campaign to increase public awareness
   Potential benefit=High
   Financial viability=2
   Political viability=1

4. Small controlled burning on private properties.
   Potential benefit= High
   Financial viability=4
   Political viability=4

5. Reduce fuel around power poles and ground transformers; get in touch with Rocky Mountain Power.
   Potential benefit= High
   Financial viability= 2
   Political viability= 3

7. Identify water sources with and without power sources. Determine usability and viability for fighting fires and refilling trucks.
   Potential benefit= High
   Financial viability=3
   Political viability=1
8. Create a program for the emergency siren located on C.V. Drive
   Potential benefit=High
   Financial viability= 2
   Political viability= 3

9. Create pre-planned fire breaks in the town and along its boundaries.
   Potential benefit= High
   Financial viability=4
   Political viability= 5

10. Review Town policies for the storage and disposal of fuels and hazardous materials.
    Potential benefit= High
    Financial viability= 1
    Political viability= 3

11. Use goat or sheep herds for fuel reduction.
    Potential benefit= High
    Financial viability = unknown
    Political viability= 3

12. Have certified Fire Inspector perform structure inspections on request.
    Potential benefit= High
    Financial viability= 2
    Political viability=3

13. Identify lots with overgrowth, use Forestry Fire State Lands assessments and teach property owners defensible space.
    Potential benefit= High
    Financial viability= 2
    Political viability= 3

14. Invest in specialized Town equipment to reduce fuels.
    Potential benefit= Medium
    Financial viability= 5
    Political viability= 4

15. Burning piles of weeds and spot burning fuel on private lots with proper education first.
    Potential benefit= High
    Financial viability= 0
    Political viability= 2

15. Encourage alternatives to burning such as pickups or mulching/chipping.
    Potential benefit= High
    Financial viability= 0
    Political viability= 0

FLOOD

BACKGROUND

The Town of Castle Valley occupies the lower (northwestern) portion of Castle Valley, extending from the gorge of Castle Creek to the southern side of Round Mountain, Porcupine Rim on the west, the Castle Valley loop road on the east, comprising 448 five acre properties. According to the Town's Drainage Master Plan done in 1988 there are 52 square miles of drainage basins. The Valley ranges in elevation from approximately 4,500 to 5,500 feet above sea level with the adjacent mountains to the southeast rising to approximately 12,000 feet. Vegetative cover on a watershed has a major effect on the amount of precipitation that runs off, an affects the storm water in several ways. Both the foliage and the litter of the plants can retain water for longer thereby lengthening the time of concentration and reduces the peak discharge rate. Castle Valley is vulnerable to flooding in severe concentrated rain events, when the water comes over a longer period of time the multitude of drainages can handle the water quite well, however more and more isolated cloudburst are effecting Castle Valley in very destructive short lived storms. The Castle Valley Road Department works to mitigate and mend the effects of storm water runoff from drainages along the Porcupine Rim, Parriott Mesa, Castle Rock, Adobe Mesa, Placer and Castle Creeks (elevations surrounding Castle Valley).

HISTORY

Within the last 10 years there have been significant rain events that have exceeded the flow of the Colorado River during one period of time on just the Placer Creek drainage. Placer Creek drains into Castle Creek, which flows under Castle Valley Drive through a 10-foot culvert at lot 447. According to the Drainage Master Plan dated September 1988, by Armstrong Consultants, Inc., this area should have had two (2) 10-foot culverts instead of one. This culvert also was never designed to function as a check dam, however due to only one 10 foot culvert, storm water has come within a few feet of exceeding the carrying capacity of this culvert, should storm water overtop the road above this culvert, significant damage may occur to Castle Valley Drive including loss of road surface and underlying earthen fill as well as damage to downstream structures and creating a significant safety hazard.
(See Appendix A3)

Currently the Town of Castle Valley does not have a second exit that can handle the volume of traffic that Castle Valley Drive does now. This creates a situation of significant isolation and safety concerns. The Town of Castle Valley commissioned a Drainage Master Plan dated September 1988 by Armstrong Consultants, Inc. The recommendations in that Master Plan have yet to be implemented. The facilities designed for the Master Plan are based on a 10 year storm which is a reasonable level of risk for the planned facilities (culverts and channels).
Currently the Town of Castle Valley is not participating in the National Flood Insurance Program since the area is not mapped by FEMA.
(See Appendix B1-B2)

Events: **6 Oct. 2011 to 10 Feb. 2014**

Flash Flood	6 Oct 2011	Placer Creek crossings Placer Ditch	Upper eighty east Pope	erosion/mud
Flash Flood	26 Oct 2011	Porcupine Rim Drainage	Buchanan	erosion
Flash Flood	14 Jul 2012	Rim Drainage	Keogh/CVD	mud/erosion
Flash Flood	25 Sep 2012	Rim Drainage	Keogh/Pope Holyoak/Miller	mud/erosion
Flash Flood	12 Oct 2012	Placer Drainage	Rimshadow/Pace Miller/Pope/Holyoak Keogh/Taylor/Connector	mud/erosion
Flash Flood	23 Oct 2012	Placer Drainage	Miller/CVD/Keogh Holyoak/Buchanan/Pace	mud/erosion
Runoff	17 Jul 2013	Rim Drainage	Keogh/Taylor	mud/erosion
Flash Flood	19 Jul 2013	Placer Drainage	Keogh/Connector	erosion
Flash Flood	29 Jul 2013	Placer Drainage	Placer crossings Holyoak/Miller/Keogh	mud/erosion
Runoff	30 Jul 2013	Placer Drainage	Upper 80/Holyoak	erosion
Runoff	1 Aug 2013	Placer Drainage	Rimshadow/Shafer Miller/Holyoak	mud/erosion
Storm Runoff	1 Sep 2013	Placer Drainage	Connector	road washout
Flash Flood	12 Sep 2013	Placer Drainage	Crossings/Keogh Miller	mud/washout
Flash flood	14 Sep 2013	Placer/Cain Hollow	Upper 80/Chamisa Rimshadow/Shafer Miller/Pope/Keogh	mud/washout
Storm Runoff	18 Sep 2013	Placer Drainage	Crossings/Keogh Miller/Meadow	mud/washout
Storm Runoff	10 Oct 2013	Placer/Cain Hollow	Crossings/Miller	mud/rock, erosion
Storm Runoff	30 Oct 2013	Placer Drainage	Crossings/Miller	mud/rock, erosion
Storm Runoff	10 Feb 2014	Placer Drainage	Lower crossing	erosion

Flood Probability Analysis

Potential Magnitude		**Negligible**	**Less than 10%**
		Limited	**10-15%**
	X	**Critical**	**25-50%**
		Catastrophic	**More than 50%**
Probability		**Highly likely**	
		Likely	
	X	**Possible**	
		Unlikely	
Location	**All drainages and creeks.**		
Seasonal Pattern or Conditions	**June- Oct.**		
Duration	**Initial flow not more than a few hours, event including clean up would take days.**		
Analysis Used	**Historic documentation of events, Town of C.V. road department and the Grand County regional plan. Available resources. Town of Castle Valley Drainage Master Plan 1988**		

FLOOD:

Risk Assessments and Mitigation Strategies:

(1 =Easy – 5= Difficult)

1. Re-enforce or replace the Castle Creek culvert that flows under Castle Valley Drive, the Town's main ingress and egress.
   Potential benefit= High
   Financial viability= 4-5
   Political viability= 2

2. Build and maintain large catchment ponds in strategic places on both of the main drainages. One above the Upper 80 on the Placer Creek drainage and another on the Castle Creek drainage.
   Potential benefit= High
   Financial viability= 5
   Political viability= 3

3. For road crossings in the Upper 80 continually washed out, document and map all affected areas and tie in with Natural Resource Conservation Service study.
   Potential benefit= High
   Financial viability= 1
   Political viability= 1

4. Evaluate and consider engineering structural options for armoring major drainage crossings including concrete slips, aprons, culverts and spans.
   Potential benefit= High
   Financial viability= 5
   Political viability= 5

5. Design and build pre-fabricated bridges for crossings on upper and lower Placer Creek.
   Potential benefit= High
   Financial viability= 5
   Political viability= 5

6. Obtain needed easements in all areas where there currently isn't one granted. Enabling the Town of Castle Valley road department to legally work on flood effected areas.
   Potential benefit= High
   Financial viability= 3
   Political viability= 5

7. Put in 10 foot culverts at upper and lower Placer Creek crossings and Cain Hollow.
   Potential benefit= High
   Financial viability= 5
   Political viability= 5

8. Remove dead trees, garbage and other debris from Castle Creek above the Castle Valley Drive culvert.
   Potential benefit= High
   Financial viability= 4
   Political viability= 5

9. Maintain all road crossings and diversions by monitoring and clearing culverts of weeds and sediment and keeping clear, excavating channels, reinforcing and extending berms and maintaining road surfaces.
   Potential benefit= High
   Financial viability= 3
   Political viability= 1

10. Continue to inform residents and buyers on safe building practices for flood prone areas and ensure land use codes allow for proper flood safety building.
    Potential benefit= High
    Financial viability=3
    Political viability=3

SEVERE WEATHER

BACKGROUND

High winds, thunderstorms and severe winter weather are all forms of severe weather which affect our area. High winds typically accompany thunderstorms and frontal systems. They have been responsible for various damages to property. Tornadoes are not a regular occurrence but dust devils which are much lesser tornadoes are sometimes formed. Hail and lightning also accompany thunderstorms. Hail has caused damage to crops on multiple occasions. Lightning is probably the number one severe weather hazard in our area. Lightning has been responsible for numerous fires, both wild and structural. Severe winter weather can include heavy snow fall and prolonged periods of below freezing temperatures. Some homes would need to have heavy snow removed from roofs to prevent roof failure. Castle Valley does not have a municipal water system, people use individual wells for water. Many residents have been without water during prolonged periods of cold because of frozen pipes and pressure systems.

IMPACT ON COMMUNITY

The impacts of severe weather on the community would depend on the event and duration of the event. Heavy hail can destroy crops, Daystar Farms provides produce for many of Castle Valleys' residents. Severe hail, winds or flooding affecting their farm would also hurt them financially. Many residents also rely on their own crops for food storage.
Any severe weather event causing residents to be displaced would impact the community, currently there are not adequate plans in place for temporary housing and backup power for municipal buildings.
High winds and thunderstorms can also cause power and communication outages which slow emergency response times and also have potential to destroy food storage for many residents. Most personal wells are also run on electricity, so outages can leave residents without water, this could impact large portions of the community in event of a fire accompanying thunderstorms.
Heavy snow fall can leave many residents unable to get out for hours while limited staff, work to open roads. This also slows emergency response times. Castle Valley has an aging population and many would need help to clear their own roofs and driveways, and there are limited resources for them to find this help. Residents who experience prolonged water outages because of frozen pipes and systems would not have anywhere in Castle Valley to fill water storage containers until their systems are thawed, they would have to rely on neighbors who may allow them to fill or take containers to Moab. All parts of the community are vulnerable to severe weather hazards.

GOALS TO REDUCE AND AVOID LONG TERM VULNERABILITIES

Goals for reducing long term vulnerabilities to severe weather include developing an emergency operations plan that will include the Town of Castle Valley, Castle Valley Fire District, Grand County EMS, Grand County Roads, Grand County Emergency Management, Daystar Academy and Farms, Red Cliffs Lodge, Sorrel River Ranch, members of the community and surrounding communities.

Installing back up power for all municipal buildings and equip at least one municipal building with enough supplies to temporarily house up to 20 people is another goal.

HISTORY

Recorded Severe Winter Weather events

12/7/1997 Winter Storm
12/19/1997 Winter Storm
12/21/1997 Extreme Cold
12/24/2000 Heavy Snow
01/28/2001 Winter Storm
11/28/2006 Heavy Snow
12/19/2006 Winter Weather
01/12/2007 Winter Weather Heavy Snow
12/10/2007 Winter Weather
02/03/2008 Winter Weather Heavy Snow
12/13-24/2008 Winter Weather Storm
02/24/2009 Dense Fog
10/27/2009 Winter Weather
12/07/2009 Winter Storm and Blizzard
12/13,18/2009 Dense Fog
12/22/2009 Winter Weather
01/26/2010 Winter Weather
01/28,29/2010 Dense Fog
02/02-04/2010 Dense Fog
02/06/2010 Winter

Recorded severe thunder storm events

06/2003 lightning
07/2003 lightning
09/16/2002 wind over 50mph
06/25/2005 thunderstorm
09/23/2005 thunderstorm
04/05/2006 thunderstorm
06/09/2006 wind over 50mph
06/2006 lightning
07/10/2006 quarter size hail/arches
08/26/2006 wind over 50mph
08/2007 lightning
08/2008 lightning
10/06/2010 wind over 50mph
08/23/2013 thunderstorm/G.C.

Note: info from weather.gov

Grand County

Note: lightning events were recorded

fire events from CV CWPP 2/14/13

Weather
02/08,16/2010
Dense Fog
02/19/2010 Winter
Storm
03/15/2010 Dense
Fog
12/29/2010 Winter
Storm
Note: taken from regional mitigation plan
Grand
County

Severe Weather Probability Analysis

Potential Magnitude		**Negligible**	**Less than 10%**
	X	**Limited**	**10-15%**
		Critical	**25-50%**
		Catastrophic	**More than 50%**
Probability	**X**	**Highly likely**	
		Likely	
		Possible	
		Unlikely	
Location	**Anywhere**		
Seasonal Pattern or Conditions	**Anytime, depending on season, winds in spring and fall, heavy snow fall in winter. Lightning with monsoons**		
Duration	**Hours to days**		
Analysis Used	**State of Utah hazard plan** **Grand County regional plan** **Weather.gov** **Weather.com/encyclopedia** **Resources available, response times observed**		

SEVERE WEATHER:

Risk Assessments and Mitigation Strategies:

(1 =Easy – 5= Difficult)

1. Backup power sources at municipal buildings. Including propane alternatives for generators.
   Potential benefit= high
   Financial viability=5
   Political viability=3

2. Create an Emergency Operations Plan and train staff on power outage protocol.
   Potential benefit=high
   Financial viability=3
   Political viability=3

3. Fire and Emergency Medical Responders provide presence at Town building when communications are out.
   Potential benefit= high
   Financial viability= 2
   Political viability=1

4. Public education on dealing with various severe weather issues.
   Potential benefit= high
   Financial viability= 3
   Political viability= 1

5. Develop and make use of warning systems i.e. Town Siren, social media, reverse 911, weather stations etc.
   Potential benefit= high
   Financial viability= 4
   Political viability= 2

6. Have Utility Company clear trees and snow from power lines and propane tanks.
   Potential benefit= high
   Financial viability= 3
   Political viability= 2

7. Assure availability of backup water supply and other resources such as fuel, food, firewood, cots, etc.
   Potential benefit= high
   Financial viability= 5
   Political viability= 3

8. Power infrastructure map and grid available for Fire, Town and Mitigation.
   Potential benefit= medium
   Financial viability= 2
   Political viability= 5

9. Have Town Road Department clear roads of trees.
   Potential benefit= high
   Financial viability= 2
   Political viability= 2

COMMUNICATION/POWER OUTAGES

BACKGROUND

ELECTRICTY

Electricity to Castle Valley is provided by Rocky Mountain Power, a subsidiary or Pacific Corp. Electricity for Castle Valley "originates from the Rattlesnake substation southwest of [the town of] La Sal and travels over the top of the [La Sal] mountain[s], over Porcupine Rim [above Castle Valley] to [the settlement] of Castleton then to Castle Valley. It continues on to Cisco then follows the river to Colorado – a total of 125 miles, and is the longest cul-de-sac power line of all of Rocky Mountain Power's electrical lines."[2] The length of the power transmission lines and the difficult terrain it follows adds to the potential for disruptions. Castle Valley is very vulnerable to losing power and modes of communication for at least short periods of time with longer outages occurring less frequently in comparison.

Disruptions in electricity service are periodic. Disruptions often are associated with adverse weather events, such as high winds and heavy or wet snow falls, or technical failures on the power lines or poles. It is not uncommon for electricity to go out in part or all of Castle Valley at least once a month. Outages can be momentary (although disruptive of electrical equipment), a couple hours in length, or multiple hours and into more than a full day. For example, during the weekend of November 23, 2013, electricity was out for 30 hours "as a result of the wet and heavy snow from the storm that dropped 8 to 10 inches beginning last Friday afternoon."[3] In May 2012, high winds were responsible for the electricity outage which also coincided with a structure and brush fire in Castle Valley. The lack of electricity caused "additional problems for firefighters since nearby water sources required electrical power to pump water from the ground."[4]

In most instances, short disruptions in power are an inconvenience to most residents of Castle Valley. However, longer disruptions impact different residents in different ways. Some residents rely on digital phones (rather than landlines). When the electricity goes out, their phone service is lost. This can be a serious situation if a medical or fire emergency should occur. All residents who have an internet connection (provided by Frontier Communications) receive service via DSL and an in-home modem. The modem needs electricity to operate. Without the modem, wireless internet connects are lost. For residents who work from home, that is likely to mean disruption in their work. Also, the loss of the internet reduces the communications options for learning about or reporting an emergency situation.

The following summary of outages, major causes and number of customers impacted is provided by Rocky Mountain Power.[5] A total of 79 electricity outages were noted by the company between 2008 and 2013.

2 "Castle Valley Comments," *Moab Times-Independent*, November 29, 2007.
3 "Castle Valley Comments," *Moab Times-Independent*, November 28, 2013.
4 "Castle Valley Comments," *Moab Times-Independent*, May 31, 2012.
5 Information provided in email, January 2, 2014

Castle Valley, Utah – Rattlesnake 22 Power Line

Top 3 outage causes: January 1, 2008 – December 16, 2013

Cause	Number of Instances	average duration	average customers impacted
Lightning	32	3.5 hours	76
Wind	29	3 hours	72
Snow, Sleet and Blizzard	17	3 hours	330

It should be noted that these figures do not include momentary and short outages. Also, experiences of residents in Castle Valley do vary from the averages provided by the utility company.

The cost of electricity outages is difficult to determine. For people who rely upon electricity for their home occupations, any outage over one hour begins to assume some cost impact. The BandB in Town has lost customers during overnight power outages. For people dependent on electricity for home medical purposes, lengthy outages can become life-threatening. Also, loss of telephone service (through the DSL service) raised adverse issues of safety and health to residents. As noted above, the loss of power hindered the ability of the Castle Valley Fire Department to respond to a fire in the valley in 2012.

It is possible to estimate the costs of electricity outages to Castle Valley, using the data provided by Rocky Mountain Power and hypothetical dollar figures. Two categories are suggested: an inconvenience cost of $10 per hour and a major disruption cost of $50 per hour. For example, lightning caused outages for the five year period for which data is available resulted in the following costs:

32 instances x 3.5 hours per outage x $10/hour of outage x 76 customers = $85,120

Or the cost as a major disruption to customers' home electrical equipment, work, food storage, purchase of backup generators, etc can be determined as:

32 instances x 3.5 hours per outage x $50/hour of outage x 76 customers = $425,600

Total costs to Castle Valley customers of outages over the same five year period from the three causes noted by Rocky Mountain Power come to:

At $10/hour as an inconvenience cost = $ 316,060
At $50/hour as a disruption cost = $1,580,300

Rocky Mountain Power reports that technology upgrades it has made over the past year will make it easier and quicker for the company to identify the location of outages and respond with repair crews. In fact, residents have noticed some improvements, with fewer outages. The Town government has established a good working relationship with the utility company which also improves response times to deal with outages.

Telephone

Telephone service is provided in one of two ways in Castle Valley: to customers by Frontier Communications through landline or wireless telephone service; to customers with cell phones who are able to access service.

For the most part, telephone service to Castle Valley as provided by Frontier is fairly reliable. A wireless transmission tower from Bald Mesa in the La Sal Mountains south of Castle Valley relays transmissions into and out of the valley, using a reflector above the valley on Porcupine Rim. The reflector directs a signal to a distribution station located near the center of Castle Valley.

Outages have occurred in the service. The most significant recent outage occurred on November 30, 2013. On that date 911 service was down for 10-15 hours. During much of that time, the company, local residents, nor Grand County emergency services were aware of the outage. Frontier has since responded that similar outages were unlikely to occur in the future.

It is not possible to accurately estimate the cost of disruptions in telephone coverage to Castle Valley residents. However, using the inconvenience cost noted above for electricity outages, a ballpark estimate would be $250,000-$300,000 since 2008. Losses to residents who rely on telephone service to conduct businesses would add to that figure.

For residents with wireless telephones with Frontier service, electricity outages also mean loss of telephone coverage.

Some residents are able to access telephone service with their cell phones. Text messages seem to go through more efficiently than telephone connections. Private cell phone companies have said they are unwilling to invest in building a cell tower in or near Castle Valley.

Internet

Internet service also is provided by Frontier Communications. Service is DSL, coming through telephone lines. Thus, the quality of internet service is similar to that for telephones. However, a number of residents who live further away from the distribution station in the center of the valley have noted a fall-off in both reliability and speed of internet connections. Also, it is not uncommon for customers to have to reboot their modems once, twice, or several times per day, thus disrupting service.

Like wireless telephones, internet service is dependent on electricity. When electrical outages occur, there is no internet coverage.

Frontier's internet system is connected in Moab to a transmission system operated by Emery Telcom. Emery reports that is has sufficient bandwidth to handle all of the areas internet traffic. At the same time, Frontier reports that bandwidth is sufficient to handle all of Castle Valley's traffic. At some point in these statements, it appears to many residents of Castle Valley that a gap remains in reliable and efficient internet coverage.

An estimate of the cost of disruptions to the internet will parallel those of electricity outage costs, although the actual cost is likely to be somewhat lower.

Electronic Communication Summary

For a small, relatively remote rural community, Castle Valley has reasonable communications systems. However, as a small, rural community, Castle Valley is very vulnerable to electricity and telephone outages, especially if those outages coincide with other emergency situations. The major gaps are in always-on electricity and telephone/internet services. Providers of both electricity and telephone/internet services report improvements in their ability to reliably meet the needs of Castle Valley residents, but the vulnerability of the lengthy electrical power line to storms and technical problems continues to place the town at risk of break downs in effective communications. The Town and the Fire District have taken steps to mitigate potential utility outages.

Mitigation Initiatives

The town of Castle Valley, the Castle Valley Fire District, and Grand County emergency services have made several improvements to help mitigation communications issues in the valley.

Both the town and the Fire District have met with electricity and telephone providers to voice concerns and seek solutions to existing problems. On several occasions in recent years, the Town has sought to open communication with cell phone providers, but is regularly told that cell phone infrastructure investments are not in those companies' interests.

The Fire District is in constant contact with the Grand County Sherriff's Office through handheld radios. In addition, the Fire District has acquired one satellite phone for use in emergencies when the handheld radios do not function. The Sherriff's Office has been very responsive to the potential emergency needs of the town. In the past it has brought in portable communication equipment. Finally, the Fire District and town have collaborated to set up an emergency communication system available to all residents during prolonged electrical or telephone outages. Notices have been posted to inform residents how they can access that assistance.

Mitigation Goal

The goal is to assure that all Castle Valley residents are aware of communication options during emergency conditions.

Objectives to reach that goal include:

- Developing and distributing awareness-raising materials on emergency response options available to Town residents.
- Maintaining the Fire District assistance at the Town Center during power and/or telephone outages.
- Maintaining good working relationships with the Grand County Sheriff's Office for emergency services and with utility companies.
- Assuring that Town ordinances and regulations remain up-to-date so to provide clear guidance for emergency prevention and, when needed, mitigation.

Communications Power Outage Probability Analysis

Potential Magnitude		**Negligible**	**Less than 10%**
		Limited	**10-15%**
	X	**Critical**	**25-50%**
		Catastrophic	**More than 50%**
Probability	**X**	**Highly likely**	
		Likely	
		Possible	
		Unlikely	
Location	**Entire Length of Rattlesnake line**		
Seasonal Pattern or Conditions	**Generally occurs along with severe weather events**		
Duration	**Seconds to days**		
Analysis Used	**History of occurrence, utility company, Times independence column, Ron Drake local reporter and Fire Chief.**		

COMMUNICATION/POWER OUTAGES:

Risk Assessments and Mitigation Strategies:

(1 =Easy – 5= Difficult)

1. Develop protocol for reporting problems with communication.

    Potential benefit= High
    Financial viability= 1
    Political viability= 1

2. Assure a culinary water backup source is available for town residents for at least 72 hours.
    Potential benefit= High
    Financial viability= 5
    Political viability= 3

3. Set up a command post at the Town Hall during prolonged electricity and/or telephone outages.
    Potential benefit= High
    Financial viability= 2 [Volunteer hours]
    Political viability=1

4. Increase public awareness of the need to have available 72 hour emergency kits,
    Potential benefit= high
    Financial viability= 3
    Political viability= 1

5. Install back-up power for all municipal buildings and church. Have supplies for 20 people, including food, water, bedding etc.
    Potential benefit= High
    Financial viability= 4 - However there are potential donations from other agencies.
    Political viability= 1

6. Develop MOUs with surrounding communities and agencies for appropriate support during emergencies. Develop a continuity of government Ordinance and plan to give power to the council if the Mayor is not available during an emergency.
    Potential benefit = High
    Financial viability= 3 [Plan for paying back assistance]
    Political viability= 2

ROCKFALL

BACKGROUND

The study, GEOLOGIC HAZARDS OF CASTLE VALLEY, GRAND COUNTY, UTAH by William E. Mulvey of the Utah Geological Survey, states the following regarding rockfalls:

> "Rockfalls occur along cliffs in Castle Valley. As development advances higher on alluvial fans and slopes below cliffs, the risk from falling rocks will increase.
>
> Rockfalls originate when erosion and gravity dislodge rocks from cliffs or slopes. The most susceptible unit in Castle Valley is the Wingate Sandstone where outcrops are disrupted by bedding surfaces, joints, or other discontinuities that break rock into loose fragments, clasts, or slabs. Rocks in talus and cliffs may dislodge, fall onto steep slopes, and travel great distances by rolling, bouncing, and sliding.
>
> Primary causes of rock falls are weathering, freeze-thaw of water in outcrop discontinuities, and ground shaking during earthquakes. Keefer (1984) indicates that rockfalls may occur in earthquakes as small as magnitude 4.0.
>
> Rock falls present a hazard to structures and personal safety. Homes built on slopes below Porcupine Rim are particularly vulnerable."

A rockfall hazard map is available to the public at the Town Building and their website.

IMPACT ON COMMUNITY

The impacts of Rockfall on the Community would depend on the location and severity of the event. Rockfalls can cause damage to structures, roads, and can alter drainages which could negatively impact other properties and roads. Rockfalls will mostly happen higher up on the rim side of the valley. (See Appendix A4)

HISTORY

Although rockfalls occur often few are documented or cause damage here is a list of witnessed rockfalls:

July 8, 1985 - 48,000 cubic yards of rock fell from Porcupine Rim barely missing a home at the top of Rim Shadow Lane. No damage was reported but an inch of dust covered the surfaces inside the house due to open windows.

July, 2003 a medium sized rockfall was sited between Rim Shadow and Lazaris lanes. No damage to properties was reported.

February, 2004 a small rockfall was sited southeast of Lazaris lane. No damage to properties was reported.

August, 2010 a medium sized rockfall was sited above Holyoak lane. No damage to properties was reported.

November 2015 a large rockfall was sited above Holyoak lane. No damage to properties was reported.

Since 1959, five rock falls on Porcupine Rim have been documented, four of these in the past six years **(W.E.** Case, Utah Geological Survey, verbal communication, November 25,1991).

GOALS TO REDUCE VULNERABILITIES

Typical mitigation measures to reduce the impacts from Rockfalls would be cost prohibitive for property owners and the Town. Strategies to decrease vulnerability include continuing to inform property owners of this hazard through the building permit process, and having the road department continue to clear roads after rockfalls. These strategies should be included in a future emergency operations plan.

Rock Fall Probability Analysis

Potential Magnitude	**X**	**Negligible**	**Less than 10%**
		Limited	**10-15%**
		Critical	**25-50%**
		Catastrophic	**More than 50%**
Probability	**X**	**Highly likely**	
		Likely	
		Possible	
		Unlikely	
Location	**Rim sides of Castle Valley, Pace Hill, Hwy. 128.**		
Seasonal Pattern or Conditions	**Early spring and during rain events, could occur at any time.**		
Duration	**Minutes, with cleanup lasting hours to days**		
Analysis Used	**Observations of residents, recorded events, Grand County regional plan, geologic hazard reports, C.V hazard maps.**		

ROCKFALL:

Risk Assessments and Mitigation Strategies:

(1 =Easy – 5= Difficult)

1. Develop plans for road closure if rock fall closes roads.
    Potential Benefit=High
    Financial viability= 2
    Political viability= 1

2. Continue to provide property owners and renters with hazard information.
    Potential benefit= High
    Financial viability= 2
    Political viability= 1

3. Obtain equipment for stabilization and cribbing.
    Potential benefit= Medium
    Financial viability= 4-5
    Political viability= 1

4. Build deflection berms, slope benches and rock catch fences.
    Potential benefit= Medium
    Financial viability= 5
    Political viability= 5

5. Continue to identify lots affected by rock fall hazard.
    Potential benefit= High
    Financial viability= 1
    Political viability= 1

DROUGHT

HISTORY

The Freemont and Ute people were in the area of Castle Valley long before white settlers arrived in the region. The Martin brothers were the first white settlers and had the first non-native child in the area in 1886. Farming and ranching was the primary focus of the area with many irrigations ditches coming off of springs along Castle Creek irrigating the lower valley and large irrigation wells in the upper valley. Much more water was used for farming than the current residential use that exists present day. According to local irrigation ditch users the flows from the springs and in the ditch have decreased in the last 30 years mostly due to less annual snowpack.

BACKGROUND

The Town of Castle Valley states the following to be our Goal with regard to water: *To maintain or enhance water quality and quantity in the Castle Valley watershed by improving our knowledge, developing policies, and taking action as needed.*

The source of well water for Town residents, depending on location, is either the valley-fill aquifer or, for those who live closer to Porcupine Rim, the Cutler formation aquifer. The latter tends to have significantly more solids and salts in it, and it impacts the quality of valley-fill aquifer in the lower part of the Valley.

The quality of the water varies in different parts of the Town. The Utah Division of Water Quality has officially classified the water quality based on a classification system focused primarily on total dissolved solids (see Water Classification Map).

IMPACT ON COMMUNITY

The Valley-fill aquifer is fed from a large watershed in the La Sal Mountains whose boundaries were defined by the Federal Environmental Protection Agency in 2001 (see Watershed Map) when it declared the watershed to be a sole source aquifer. This means that the aquifer system is the sole and principle source of drinking water for the residents of the Town and that contamination or depletion of this aquifer system would be detrimental to the health and safety of the town residents.

In 1996, the Town passed a Watershed Protection Ordinance. The Town is committed to working with private landowners, agencies and authorities that own property in the Town's watershed to protect water quality and quantity. The Town also tries to use the EPA sole source aquifer designation as much as possible in these interactions.

At this point, there are no good firm estimates of the Valley's overall water capacity, i.e. size of aquifer, quantity of recharge, amount of usage. The Town now has six monitoring wells for measuring water quality changes over time. A number of publications regarding what we know and don't know about our watershed and its process are gathered in the Town Building and are available to the public.

GOALS TO REDUCE VULNERABILITIES

In 2006, Alice Drogin formed a Watershed Protection Group, which is in a series of groups and task forces which have looked into how to best protect the quality and availability of Castle Valley's water. Work continues today for watershed protection as the Town is currently having another Water Study done to determine the Water budget for the Town and further protect the Castle Valley aquifer.

The following are the highlights from two papers, one from the Utah Climate Center, the other from the Colorado College. Using information from instrumental records dating back 60 years, Great Salt Lake shoreline data dating back a century, and tree ring data dating back 900 years, the UCC concludes that:
1) in the context of the past thousand years, 20th-century Utah - and the latter half in particular - has been exceptionally wet. The commonly assumed "30-year average" cycle is misleading, because the year-to-year deviation from the average is high. While dry periods in the late 20th century usually lasted less than a decade, drought lasted during most of the 13th and 17th centuries.

2) they found a clear 12-year pattern for northern Utah (which fades in the south) but also two more strong patterns - a 40-year cycle and a 150-200 year cycle. These appear to be linked to a climate pattern in the Pacific Ocean called the Pacific Quasi-Decadal Oscillation which affects the path of the jet stream and hence the moisture we receive.

The Colorado College study also showed a "Little Ice Age" running from about 1300 A.D. to the early 1800's, preceded by a "Medieval Warm Period" from about 800 A.D. to the mid-1200's.

Looking forward, the study projects
(1) a reduction of 6% and 20% in annual runoff between 2041-2060 for the Colorado River Basin, principally because of markedly lower snowpack.
(2) a slight increase in average annual temperatures.
(3) increased desertification resulting in an increased number and severity of wildfires: fire risk rising by 30%-60% under current greenhouse emission rates.
(4) the 21st century may "be nasty".

If the floods don't get us, the fires probably will.....

DROUGHT:

Risk Assessments and Mitigation Strategies:

(1 =Easy – 5= Difficult)

1. Monitor water depths in Castle Valley wells.
   Potential benefit= High
   Financial viability= 1
   Political viability= 1

2. Determine the point at which the Town would implement a groundwater drought management plan.
   Potential benefit= High
   Financial viability= 5
   Political viability= 3

3. Build large retention ponds above the community.
   Potential benefit= High
   Financial viability= 5
   Political viability= 5

4. Install rain water catchment systems.
   Potential benefit= Medium high
   Financial viability= 5
   Political viability= 1

Drought Probability Analysis

Potential Magnitude		**Negligible**	**Less than 10%**
		Limited	**10-15%**
		Critical	**25-50%**
	X	**Catastrophic**	**More than 50%**
Probability		**Highly likely**	
	X	**Likely**	
		Possible	
		Unlikely	
Location	**Everywhere**		
Seasonal Pattern or Conditions	**Long term condition with seasonal breaks**		
Duration	**Years to decades**		
Analysis Used	**Utah Climate Center, Colorado College, National Weather service**		

WATER CONTAMINATION

BACKGROUND

Castle Valley's primary water resources are the aquifer that underlies the valley, Castle Creek and a small number of springs that mostly occur adjacent to Castle Creek. The aquifer is the sole source of drinking water for Castle Valley residents and Castle Creek provides surface water for irrigation, recreation and maintenance of important riparian areas. It is believed that there is significant interaction between the aquifer and surface sources such as Castle Creek, springs and intermittent sources such as Placer Creek. Because of that interaction and because the Castle Valley community has very limited sources of water, contamination of any of the sources could be disastrous. To date there have been no contamination problems, but it is vital that any potential sources of contamination be identified and action taken to prevent or mitigate contamination.
(See Appendix A5-A6)

CONTAMINATION HAZARDS

Contamination of the Aquifer

Widespread contamination of Castle Valley's aquifer would be a major threat to the Castle Valley community and could be extremely difficult to mitigate or cure, therefore the emphasis should be on prevention. An ongoing water quality monitoring program will help identify potential contamination problems before they become widespread, but at the same time it is important to regulate activities or materials that are known to have caused water contamination issues elsewhere. Possible sources of aquifer contamination are:

1) Airborne Pollutants – There are a variety of airborne pollutants that can bond with or dissolve in surface water and then through seepage make their way into an aquifer. Aquifer contamination from airborne VOCs produced by oil drilling activity has occurred in other parts of Utah.

2) Agricultural Chemical / By-Product Seepage – Most agricultural chemicals and by-products are water soluble and if used in large amounts or high concentrations can migrate into aquifers. This is a common problem in areas with a lot of conventional agricultural activity or feedlots.

3) Septic System Seepage – By design, septic system effluent is leached into the adjacent soil and will be cleaned by microbiological action in the soil. However, if the density of septic systems in an area is too high for the cleaning capacity of the soils and / or the water table is relatively close to the surface then an aquifer can become contaminated by the effluent.

4) Industrial / Chemical Spills – There are many products available for industrial, yard or household use that contain high concentrations of chemicals and compounds that could pose a considerable threat to aquifer water. It is not expected that yard, garage or household use of such products would occur on a level that could contaminate an entire aquifer, but there are commercial or industrial activities that might use hazardous chemicals or compounds in volumes and / or concentrations that could pose such a threat.

Contamination of Individual Wells

There are any number of ways that an individual well can become contaminated and in such cases there are generally better opportunities for mitigation and repair. However, due to the movement of water within the aquifer the contamination of any individual well should be considered a serious matter because a high concentration of contaminants introduced in a specific location could become a widespread problem. Possible sources of individual well contamination are:

1) Surface Water Intrusion – Wells that are inadequately sealed (grouted) at the top can be contaminated by surface water intrusion (i.e. contaminated from the top down). Sources of such intrusion are flooding, irrigation runoff or precipitation pooling near the wellhead. More specific threats from such intrusion are covered in the following paragraphs.

2) Agricultural Chemical / By-Product Seepage – Most agricultural chemicals and by-products are water soluble and if present in large amounts or high concentrations near a well could potentially contaminate an individual well by seeping into the water that the well draws. Spills or runoff containing dissolved agricultural chemicals or feedlot by-products could also be a cause of individual well contamination, particularly if the wellhead is not adequately sealed.

3) Chemical Spills – There are many products available for yard, garage or household use that contain high concentrations of chemicals and compounds that could contaminate an individual well if spilled near the well, particularly if the wellhead is not adequately sealed.

4) Septic System Seepage – Septic system effluent could contaminate an individual well if the septic system and well are not adequately separated, particularly if the water table is close to the surface.

Contamination of Castle Creek

Being a surface water body, Castle Creek is more susceptible to contamination. Castle Creek is not a source of drinking water so its contamination may be viewed as less of a threat to the community than contamination of the aquifer, but because there is significant interaction between surface water and aquifer water and because Castle Creek water is distributed and used for flood irrigation contamination of its water could become a serious problem. Possible sources of Castle Creek contamination are:

1) Airborne Pollutants – There are a variety of airborne pollutants that can bond with or dissolve in surface water. Castle Creek could be contaminated by such pollutants if they are present in large amounts or local high concentrations. Such contamination has occurred in other areas where commercial or industrial activity occurs near surface water.

2) Agricultural Chemical / By-Product Runoff – Most agricultural chemicals and by-products are water soluble could contaminate Castle Creek if present in large amounts or high concentrations in areas where there is a large volume of irrigation or storm water runoff into the creek.

3) Industrial / Chemical Spills – There are many products available for industrial, yard or households use that contain high concentrations of chemicals and compounds that could contaminate Castle Creek if spilled or used in areas where there is a large volume of irrigation or storm water runoff into the creek.

4) Septic System Seepage – It is conceivable that septic system effluent could seep into Castle Creek, particularly in areas where there are springs and a high water table.

5) Thermal Wells – Depending on the design and material used in thermal wells they potentially cause a major threat to contamination of underground water.

6) Mining – There are several gold deposits and a long history of mining in the La Sal mountains. Placer Creek in Castle Valley was named after the Placer Gold, such an industry also poses a threat water contamination.

Water Contamination Probability Analysis

Potential Magnitude		**Negligible**	**Less than 10%**
		Limited	**10-15%**
		Critical	**25-50%**
	X	**Catastrophic**	**More than 50%**
Probability		**Highly likely**	
		Likely	
	X	**Possible**	
		Unlikely	
Location	**Would depend on the source of contamination.**		
Seasonal Pattern or Conditions	**Anytime**		
Duration	**Would depend on where and what type and quantity of contaminate.**		
Analysis Used	**Utah Geologic Survey (UGS)**		

WATER CONTAMINATION:

Risk Assessments and Mitigation Strategies:

(1 =Easy – 5= Difficult)

1. Regular water quality monitoring and sampling of selected wells and Castle Creek, to provide an early warning of future issues.
   Potential benefit= High
   Financial viability= 2
   Political viability= 1

2. Delineate and Protect the Castle Valley Watershed . The Town should take whatever legal action is available to create broad protection for the entire Castle Valley watershed.
   Potential benefit= High
   Financial viability= 3
   Political viability= 2

3. Educate Castle Valley residents, agricultural and commercial operators to help them understand how water source contamination can occur and how to prevent it.
   Potential benefit= High
   Financial viability= 2
   Political viability= 3

4. Continue to regulate septic system placement, construction and use done by the State, any indication of water contamination caused by septic systems should trigger action by the Town.
   Potential benefit= High
   Financial viability= 1 to 4 (if the Town is involved)
   Political viability= 1 to 4 (if the Town is involved)

5. Continue to regulate wellhead sealing (grouting) done by the State, any indication that a well has been contaminated by surface water intrusion should trigger action by the Town.
   Potential benefit= High
   Financial viability= 1
   Political viability= 1

6. Use appropriate regulation to limit pollutants used in commercial and industrial activity so sources of VOCs and other concentrated chemical contaminants are prohibited or severely limited.
   Potential benefit= High
   Financial viability= 2
   Political viability= 3

7. Use Appropriate Zoning to Limit Septic System Density (i.e population density)
   Potential benefit= High
   Financial viability= 2
   Political viability= 2

8. Construct a Community Water and Sewer System.
    Potential benefit= High
    Financial viability= 5
    Political viability= 5

9. Contain and clean contaminated sources by through contractor or by obtaining the tools and training needed to flush contaminated wells or contain and clean any contamination of Castle Creek from spills, runoff, etc.
    Potential benefit= High
    Financial viability= 4
    Political viability= 2

10. Consider and research the use of composing toilets and other alternative composting systems.
    Potential benefit= High
    Financial viability= 3
    Political viability= 3

11. Maintain above ground water storage for a back-up water source.
    Potential benefit= High
    Financial viability= 4
    Political viability= 2

SUBSIDENCE

BACKGROUND

Subsidence is the motion of a surface (usually, the Earth's surface) as it shifts downward relative to sea-level. Subsidence is what can creates sinkholes, which typically occur naturally as a result of percolating water and the gradual removal of soluble bedrock. This process creates a void that ultimately results in a collapse of the overlying cave roof. Though most often occurring in regions with heavy limestone deposits, sinkholes also appear in areas of chalk, gypsum, basalt, and where there are underlying salt beds, several of which are abundant in Grand County.

Human activities such as mining, groundwater over-extraction, extraction of natural gas, earthquake, overly dry expansive soils, drainage diversion and failing infrastructure – such as water main leaks, or the collapse of sewer systems and other buried pipes – can also create sinkholes.

HISTORY

Castle Valley is part of a large, regional, collapsed salt anticline that includes Paradox Valley to the Southeast. It is surrounded by Permian to Tertiary sedimentary and igneous rocks. Beneath the Valley is the Pennsylvanian Paradox Formation that contains thick salt layers deposited in a shallow sea. As these salt layer were buried they became mobile and formed diapir in what now Castle Valley. The uplift of the Colorado Plateau in the late Tertiary increased erosion rates and allowed ground water to dissolve the salt layers from the core of the anticline. As a result the overlying rock collapsed and eroded, leaving Castle Valley in the core of the anticline. In 1992 Mulvey mapped a suspected Quaternary fault parallel to Porcupine Rim northwest of Round Mountain. Several sinkholes along this fault are attributed to localized dissolution or piping.

IMPACT ON COMMUNITY

Present day subsidence and sinkholes have yet to make a big impact on the Castle Valley community however the larger concern could be directed at the reason why they appear or increase in size. Many of the activities that are responsible for creating sinkholes could be very detrimental to the holistic health of Castle Valley. Over-mining water in the valley could lead to drought and seriously impact the community. Other activities such as mining in the region could affect Castle Valley's Sole Source Aquifer if sinkholes begin to appear from mining practices.

GOALS TO REDUCE VULNERABILITIES

The Town of Castle Valley has had many geologic and hydrologic studies done in the past which have helped the valley understand more about the local aquifer and the effects the geology plays on the valley as a whole. Continuing to monitor local subsidence and draw conclusions as to why they have formed will protect the community by forecasting possible future problems. The knowledge gained from continual water monitoring and a general understanding of Castle Valley's watershed will help the community create a water budget that will not over mine the valley's water and create sinkholes.

SUBSIDENCE:

Risk Assessments & Mitigation Strategies:

(1 =Easy – 5= Difficult)

1. Monitor water depths in Castle Valley wells.
   Potential benefit= High
   Financial viability= 1
   Political viability= 1

2. Determine the point at which the Town would implement a groundwater drought management plan.
   Potential benefit= High
   Financial viability= 5
   Political viability= 3

3. Create log of current sinkholes and monitor their changes.
   Potential benefit= High
   Financial viability= 3
   Political viability= 2

4. Inhibit any kind of mining in the local region that may create subsidence.
   Potential benefit= High
   Financial viability= 5
   Political viability= 3

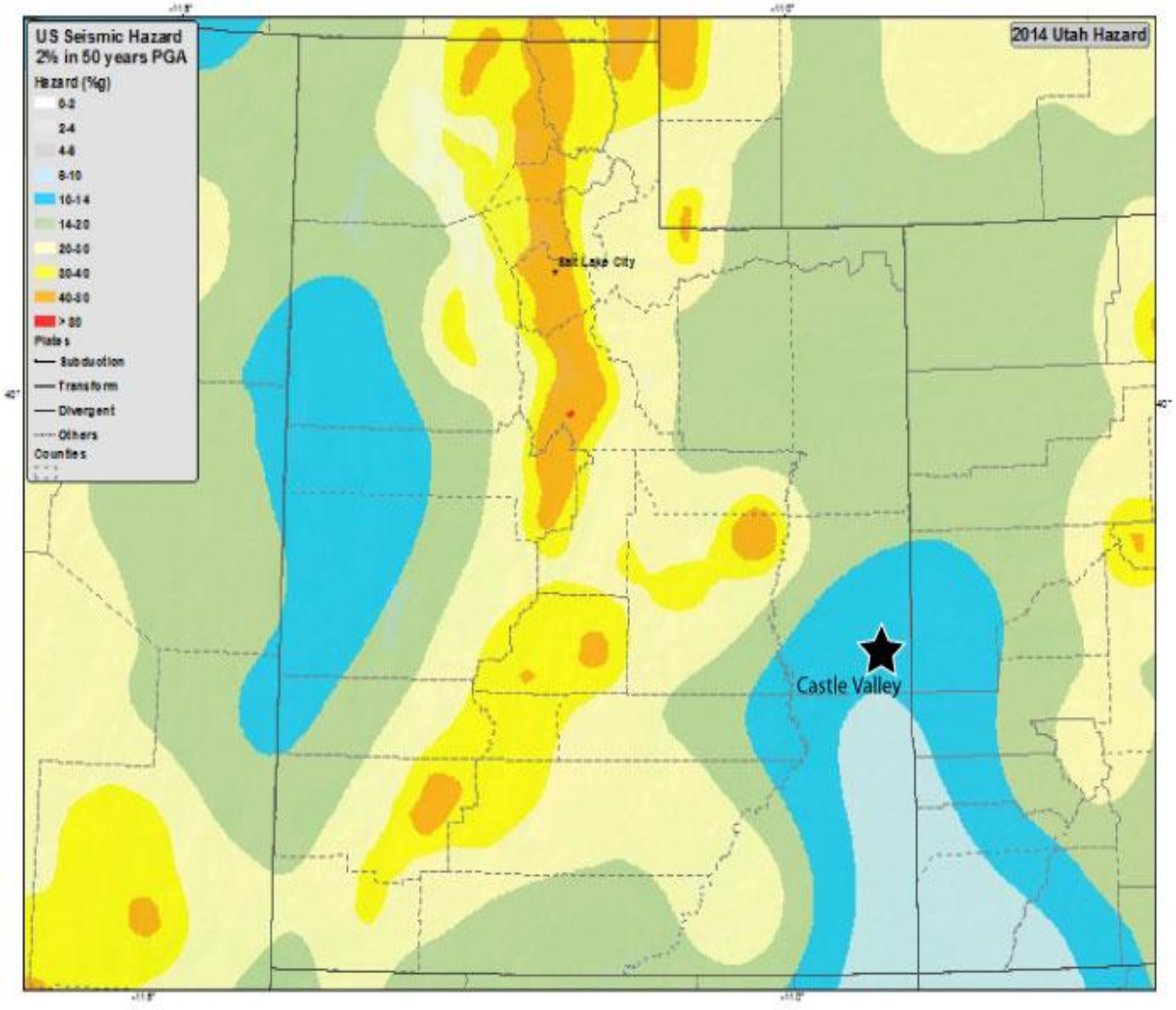
5. Bring awareness and education to subsidence to the community.
   Potential benefit= High
   Financial viability= 1
   Political viability= 1

EARTHQUAKE

BACKGROUND

Earthquakes are not a major threat or hazard to Castle Valley. The underlying geology is stable. However, north of Castle Valley, along the Wasatch Front (see map), a number of faults exist and have produced earthquakes within recorded history.

This is the most recent 2% in 50 year probability map from 2014 data.



Source: http://earthquake.usgs.gov/earthquakes/states/utah/hazards.php

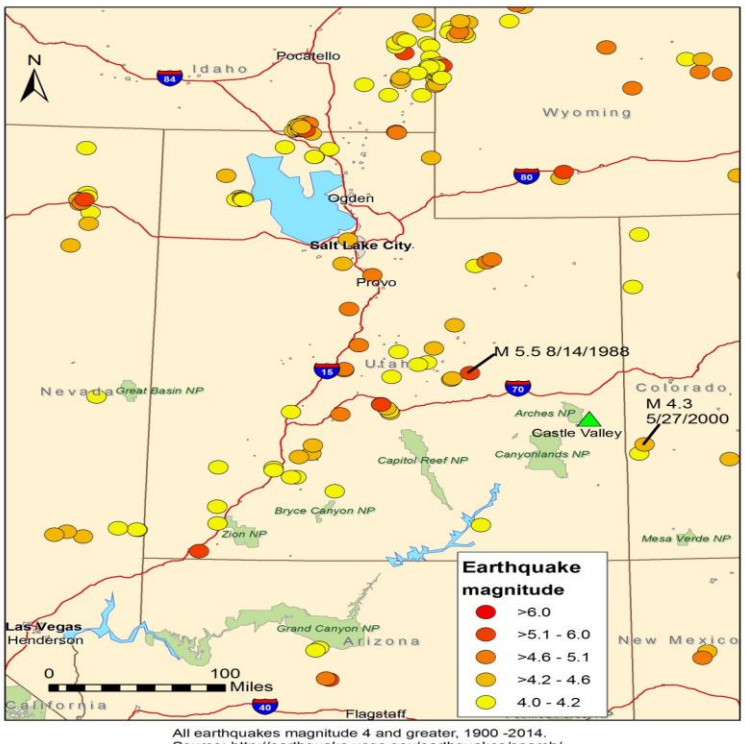
Available at http://earthquake.usgs.gov/earthquakes/states/utah/hazards.php

IMPACT ON COMMUNITY

The map illustrates that Castle Valley has a 2% probability that it will shake harder than 0.10 to 0.14g's every 50 years. It also means that there is a 98% probability that it will not shake harder than 10 -14%g every 50 years.
The probability of exceeding those acceleration values in the next ~2500 years is ~100%.

The table below will help translate the expected acceleration for Castle Valley into relative terms should an event of that size occur.

Instrumental Intensity	Acceleration (g)	Velocity (cm/s)	Perceived Shaking	Potential Damage
I	**< 0.0017**	< 0.1	Not felt	None
II-III	**0.0017 - 0.014**	0.1 - 1.1	Weak	None
IV	**0.014 - 0.039**	1.1 - 3.4	Light	None
V	**0.039 - 0.092**	3.4 - 8.1	Moderate	Very light
VI	**0.092 - 0.18**	**8.1 - 16**	Strong	Light
VII	0.18 - 0.34	**16 - 31**	Very strong	Moderate
VIII	0.34 - 0.65	**31 - 60**	Severe	Moderate to heavy
IX	0.65 - 1.24	**60 - 116**	Violent	Heavy
X+	> 1.24	**> 116**	Extreme	Very heavy



All earthquakes magnitude 4 and greater, 1900 -2014.
Source: http://earthquake.usgs.gov/earthquakes/search/

Earthquakes and Rock Falls

The August 14, 1988 magnitude 5.3 San Rafael Swell earthquake caused numerous rockfalls on the edge of Lockhart Basin.

Source: http://www.seis.utah.edu/lqthreat/nehrp_htm/1988sanr/1988sanr.shtml

Given the rock fall hazard from Porcupine Rim, it is reasonable to say that the rock fall hazard is increased by the seismic potential beyond what would be expected in an aseismic environment. Further, rockfalls can occur by seismic occurrences outside of Castle Valley, including occurrences over 50 miles away.

It is known that landslides have been initiated by earthquakes as low as magnitude 4.
Source: Keefer, D. K, 1984, Landslides caused by earthquakes: Geological Society of America Bulletin, v. 95, p. 402-421.

Induced Earthquakes

The M4.3 Paradox, Colorado, earthquake in 2000 was caused by deep well brine injection and has been the source of over 4,500 small earthquakes since the well was put into operation in 1991. Only 22 earthquakes, about 0.5% of the induced events, have magnitudes greater than or equal to M2.5. It is possible that larger earthquakes could be generated from this known source but well operators have reduced the injection rate since the M4.3 event in 2004 however, a M3.9 earthquake occurred in 2004.

Only 4 induced earthquakes with magnitude greater than or equal to M 3.0 have occurred.
All but one of these occurred prior to the mid-2000 decrease in injection rate, including the largest induced event – the M4.3 event which occurred on May 27th, 2000 (after ~4 years of continuous injection).

Source: http://www.usbr.gov/uc/wcao/progact/paradox/annualRep/PVSN-2008Annual-Rep.pdf

GOALS TO REDUCE VULNERABILITIES

Discourage deep well brine injections that have been known to cause small earthquakes.
Create awareness for the community to a have 72- hour kit with ample food and water storage if roads and passes are shut down due to the effects of an earthquake.

Earthquake Probability Analysis

Potential Magnitude		**Negligible**	**Less than 10%**
	X	**Limited**	**10-15%**
		Critical	**25-50%**
		Catastrophic	**More than 50%**
Probability		**Highly likely**	
		Likely	
		Possible	
	X	**Unlikely**	
Location	**River corridor and along steep slopes and cliffs.**		
Seasonal Pattern or Conditions	**Potential from fracking or injection wells.**		
Duration	**Seconds to minutes with clean-up lasting hours to days.**		
Analysis Used	**USGS and government records**		

EARTHQUAKE:

Risk Assessments and Mitigation Strategies:

1. Culinary water backup- cistern research
   Potential benefit = High
   Financial viability= 5
   Political viability= 3

2. Include information about earthquakes in public awareness publications.
   Potential benefit= medium
   Financial viability=2
   Political viability=2

3. Work with Grand County to keep Loop Road open year around as Hwy 128 is likely to experience excessive rockfall.
   Potential benefit=medium
   Financial viability=2
   Political viability=1

4. Develop community accountability system to ensure no one is left behind.
   Potential benefit=High
   Financial viability= 1
   Political viability=1

RECOMMENDED PRIORITY PROJECTS

Goal	**Priority -** 1
Objective	Have a Emergency Operations Plan in place to be prepared for major disasters.
Action Project:	Develop Emergency Operations Plan. (FEMA FA-197 Appendix B)
Time Frame:	One year.
Funding:	Volunteers based, with support from the Town Clerk under the salary position.
Estimated Cost:	Depends on number of people and time involved, unknown. A Estimation from Rick Bailey, the Grand County Emergency Manager, would to take a trained individual 15 hours to complete the plan.
Jurisdictions Involved:	Town of C.V staff, C.V.F.D, volunteers, County emergency manager, Sheriffs' Department staff. Representatives from surrounding community, including Daystar Academy and Farms, Red Cliffs Lodge, Sorrel River Ranch, residents along river corridor and in Castleton and Willow Basin.

Goal	**Priority -** 2
Objective	Identify in detail issues in the major drainages in Castle Valley to prevent or mitigate major events that may occur.
Action Project:	Annual and interim inspections of Placer and Castle Creek drainages.
Time Frame:	Annual Inspections and after events, beginning immediately.
Funding:	Town of Castle Valley Tax Base
Estimated Cost:	8 hours each inspection at 22.50 per hour for staff labor.
Jurisdictions Involved:	Town of C.V. road department staff.

Goal	**Priority –** 3
Objective	Bring awareness to the community about how to be prepared for and mitigate possible hazards.
Action Project:	Annual - quarterly public awareness publications.
Time Frame:	By the end of 2015
Funding:	Town of Castle Valley Tax Base
Estimated Cost:	$200 per mailing plus Town Clerks regular salary.
Jurisdictions Involved:	Town of Castle Valley Town Clerk will be responsible for the mailing with info from the CV Fire District. and CV Hazard Mitigation Committee.

Goal	**Priority -** 4
Objective	Maintain the ingress and egress roads open for the community in case of an emergency.
Action Project:	Maintain ingress and egress for community, Castle Creek, Shafer Lane and Upper 80 crossings.
Time Frame:	Present and Ongoing
Funding:	Town of C.V. annual roads budget.
Estimated Cost:	
Jurisdictions Involved:	Town of Castle Valley. road department and MOU with Grand County road department.

Goal	**Priority -** 5
Objective	Have back-up generators tied into public buildings for prolonged power outages.
Action Project:	Install back-up power for municipal buildings.
Time Frame:	Two years for all buildings, Town and Fire Department.
Funding:	Possible Grants or from the Town's Tax Base for capital improvements.
Estimated Cost:	Thousands of dollars
Jurisdictions Involved:	Town of C.V and C.V.F.D

Goal	**Priority -** 6
Objective	Create Interlocal agreements to efficiently handle mitigation and disaster recovery efforts.
Action Project:	Advise and seek agreements with other organizations in the community, interagency and government.
Time Frame:	Immediately and ongoing.
Funding:	Town of Castle Valley Tax Base.
Estimated Cost:	Will depend on time of people involved at 22.50 per hour.
Jurisdictions Involved:	Town of C.V. staff and C.V.F.D. along with utility companies , Grand County road department, Daystar Academy and Farms, C.V B and B, Redcliffs Lodge and Sorrel River Ranch, UDOT.

PLAN MAINTENANCE PROCESS

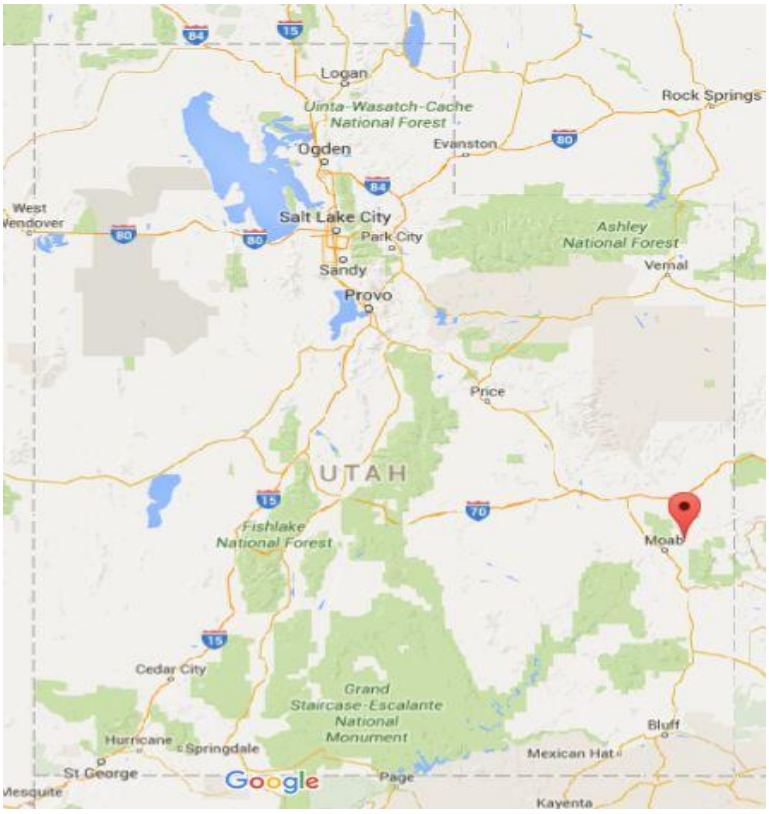
The Hazard Mitigation Committee will update the plan every four years or as determined by events. The plan will be updated by November of 2019. ?
Public hearings will be held prior to updating the plan.

Appendices will be added as information becomes available and as events occur.

Because the majority of committee members involved in the process are, members of the Fire District or of the Town of Castle Valley Public Body, updating the plan every four years will also help maintain continuity in local government.

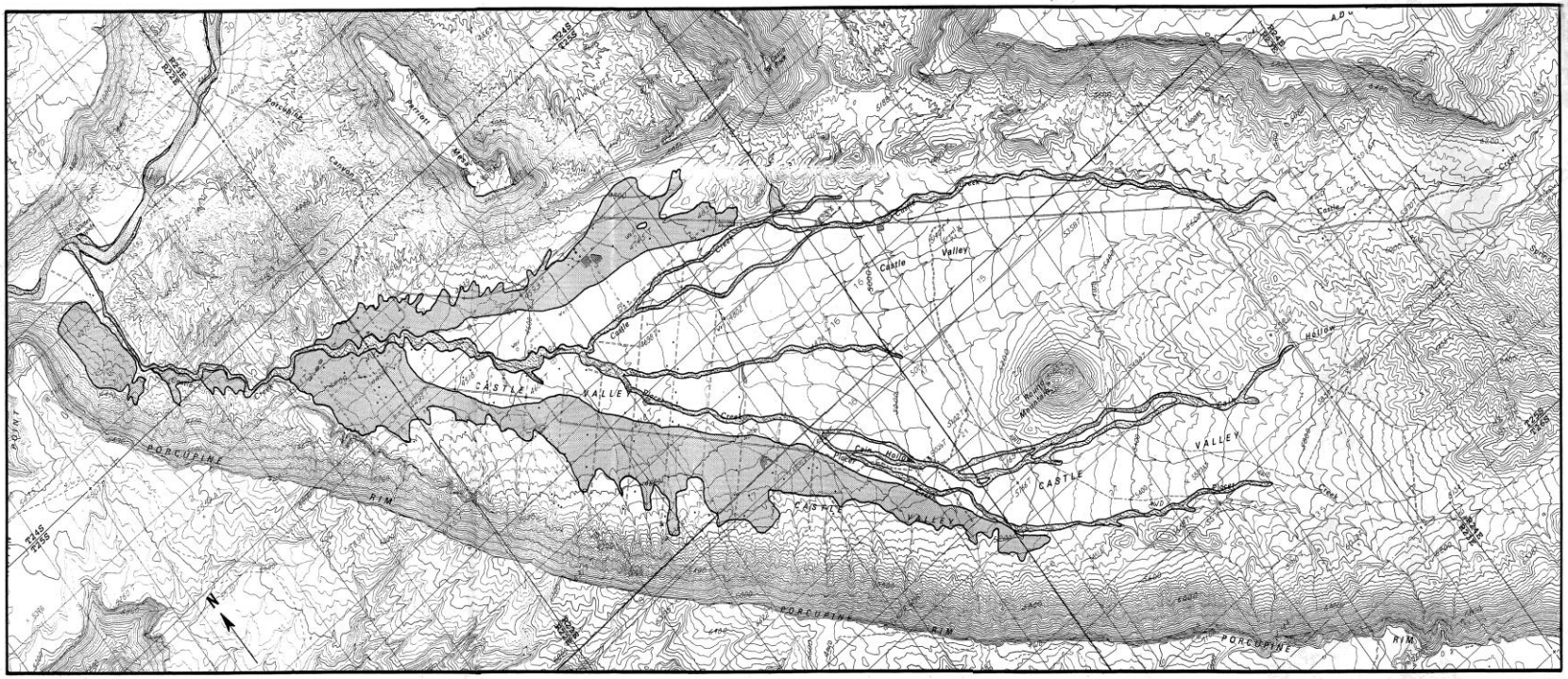
Appendix A:

A1 – State of Utah



A2 - Grand County, Utah

A3



ALLUVIAL-FAN FLOODING, STREAM FLOODING, DEBRIS-FLOW HAZARDS, AND COLLAPSIBLE SOIL IN CASTLE VALLEY, GRAND COUNTY, UTAH

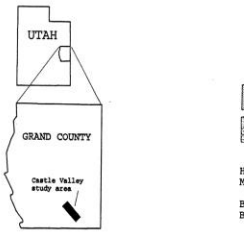
Utah Geological Survey
Open-File Report 238
Plate 2

By

William E. Mulvey

SCALE 1:24 000

CONTOUR INTERVAL 40 FEET



Explanation

Alluvial-fan/debris-flow-flood-hazard areas and collapsible soil.

Stream-flooding-hazard areas.

Hazard map based on unpublished geologic mapping by M.L. Ross and H.H. Doelling.

Base map from USGS 1:24,000 scale topographic maps of Big Bend, Warner Lake, Fisher Towers, and Rill Creek.

DISCUSSION

Flooding in Castle Valley results from cloudburst storms and spring snowmelt. Localized, high-intensity, convective-type thunderstorms centered over tributary areas are most effective in generating alluvial-fan flooding, stream flooding, and debris flows in areas like Castle Valley. Such storms, which last from a few minutes to several hours, generally occur between mid-April and September. Cloudburst thunderstorms are generally characterized by high peaks, high velocity, short duration, and small volume of runoff. The flooding potential of cloudburst rainstorms is dependent upon many factors including: 1) the intensity or amount of rainfall per unit time, 2) the duration or length of time of rainfall, 3) the distribution of rainfall and direction of storm movement over a drainage basin, 4) soil characteristics, 5) antecedent soil-moisture conditions, 6) vegetation conditions, 7) topography, and 8) drainage pattern. Because many of these conditions are generally not known until rain is actually falling on critical areas, the magnitude of flooding from a given cloudburst storm is difficult to predict. Snowmelt floods are characterized by large volume runoff, moderately high peak flows, and marked diurnal fluctuation in flow. They are somewhat predictable because flood levels depend primarily on the volumes of snow in the mountains and temperature. Whether generated by cloudburst storms or snowmelt, three types of flooding may result: (1) alluvial-fan flooding, (2) stream flooding, and (3) debris flows.

Alluvial-fan flooding occurs with little advance warning and can be quite severe and damaging with unpredictable flow paths. Cloudburst storms cause most alluvial-fan flooding, generating high velocity flows that may occupy several different channels on the fan surface at once. These floods can erode some channels and deposit large volumes of sediment in others. Flood waters on alluvial fans can contain large amounts of sediment as suspended and bed loads, including boulders and cobbles.

As with alluvial-fan flooding, stream flooding in Castle and Placer Creeks is caused by cloudbursts as well as seasonal snow- melt. However, the primary cause is rapidly melting snow, usually from late April to early July. Snowmelt floods are characterized by large volume runoff, moderately high peak flows, and marked diurnal fluctuation in flow. They are somewhat predictable because flood levels depend primarily on the volumes of snow in the mountains and temperature. Flood waters are generally contained within the channels of Placer and Castle Creeks, which are incised to depths of 10 to 30 feet (3 to 10 meters).

Debris flows are mixtures of water, rock, soil, and organic material (70-90 percent solids by weight; Costa, 1984) that form a muddy slurry much like wet concrete, and flow downslope due to gravity, commonly in surges or pulses. They generally remain confined to perennial or ephemeral stream channels in mountainous areas, but may reach and deposit debris over large areas on alluvial fans at and beyond canyon or drainage mouths.

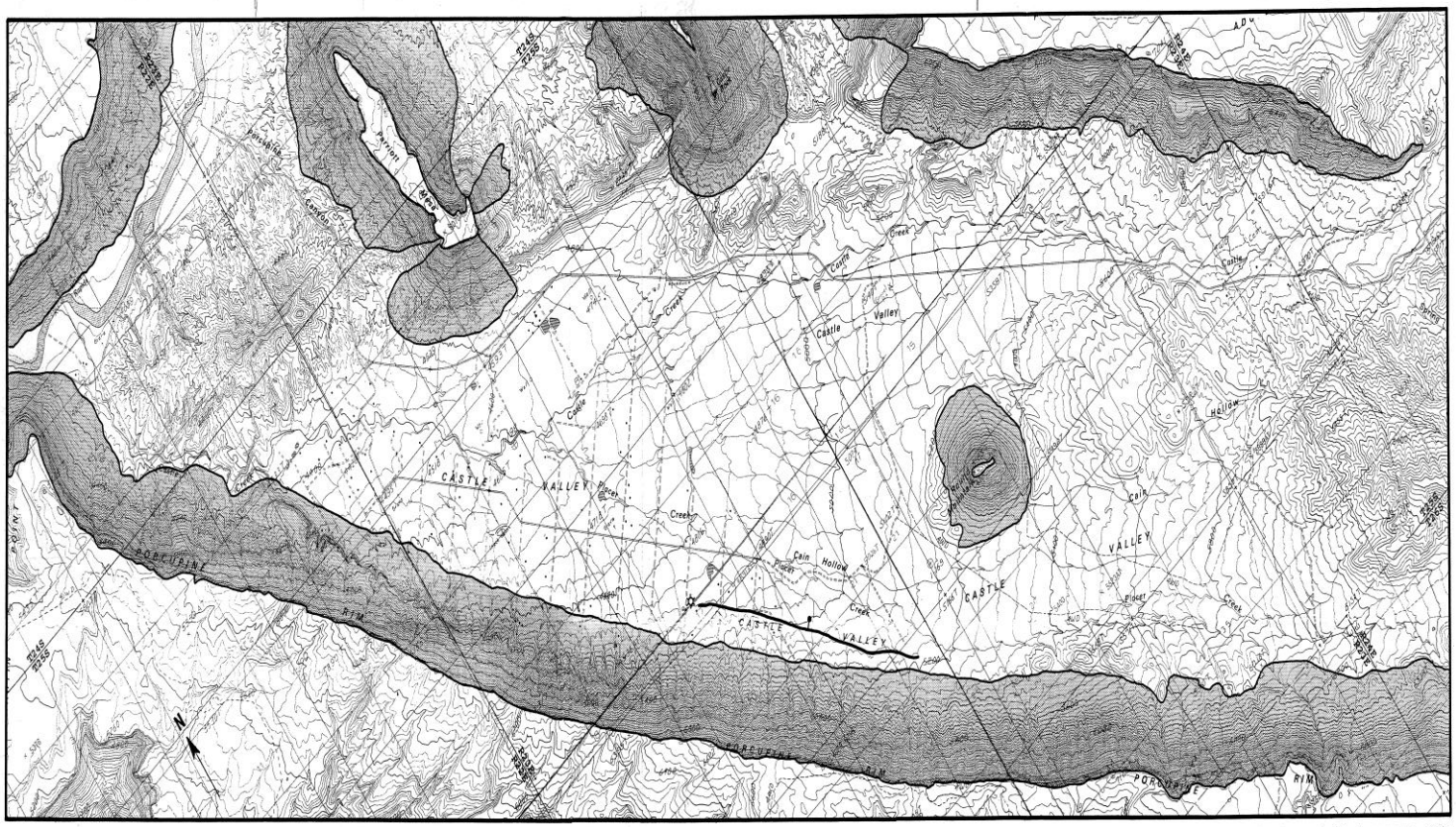
Debris flows can form in at least two different ways: (1) heavy precipitation during cloudburst storms, and (2) directly from debris slides. In the La Sal Mountains and Castle Valley, cloudburst rainstorms are common. Runoff from these storms can scour materials from the ground surface and stream channels, increasing the proportion of soil materials to water until the mixture becomes a debris flow. The size and frequency of debris-flow events generated by rainfall depend on several factors including the amount of loose material available for transport, the magnitude and frequency of the storms, the density and type of vegetative cover, and the moisture content of the soil.

Debris flows also mobilize from debris slides. A debris slide is a type of landslide involving predominantly coarse-grained debris, chiefly colluvium. A debris flow may be generated when the debris slide reaches a stream, or when the water content is increased by some other means until sufficient to flow. Rapid melting of snow during the spring can also increase water content in soils enough to cause debris slides and flows.

Collapsible soils are subject to volume reductions that can damage overlying structures. They are chiefly debris-flow, loess, and alluvial-fan deposits. When wetted for the first time following deposition, collapsible soils lose the internal bonds holding them together, causing the ground surface to subside or collapse. Alluvial fans on the southwestern side of Castle Valley, that are subject to and mapped as debris-flow and alluvial-fan-flood-hazard areas can also be an environment favorable for collapsible soils. Collapsible soils are common in Utah, particularly in alluvial fans with shale in their source areas. The Moenkopi and Chinle Formations contain shale, and contribute sediments to alluvial fans in southwestern Castle Valley.

This hazard map shows areas where alluvial-fan-flooding, stream-flooding, and debris-flow hazards and collapsible soils may occur. The map is designed to show potential hazard areas for planning purposes only. In mapped hazard areas, site-specific studies are needed to evaluate hazards and, if necessary, recommend hazard-reduction measures. The studies must be prepared by qualified professionals (engineering geologists, geotechnical engineers, hydrologists). Because of the relatively small scale of the maps (1:24,000), the possibility exists that some small hazard areas are not shown; studies are therefore recommended for critical facilities even outside the hazard areas.

A4



ROCK-FALL AND SURFACE-FAULT-RUPTURE HAZARDS IN CASTLE VALLEY, GRAND COUNTY, UTAH

Utah Geological Survey
Open-File Report 238
Plate 3

By

William E. Mulvey

SCALE 1:24000

CONTOUR INTERVAL 40 FEET

Hazard map based on unpublished geologic mapping by M.L. Ross and H.H. Doelling.

Base map from USGS 1:24,000-scale topographic maps of Big Bend, Werner Lake, Fisher Towers, and Rill Creek.

Explanation

- Rock-fall-hazard areas.
- Area of possible surface fault rupture (bar and ball on downthrown side of fault) and sinkhole formation.
- Sinkhole.

DISCUSSION

Rock falls originate when erosion and gravity dislodge rocks from cliffs or slopes. In Castle Valley, cliffs of Triassic-age Wingate Sandstone are the most common rock-fall source. The most susceptible cliffs are those with outcrops broken by bedding surfaces, joints, or other discontinuities that break rock into loose fragments, clasts, or slabs. Rocks in talus and cliffs may dislodge, fall onto steep slopes, and travel great distances by rolling, bouncing, and sliding.

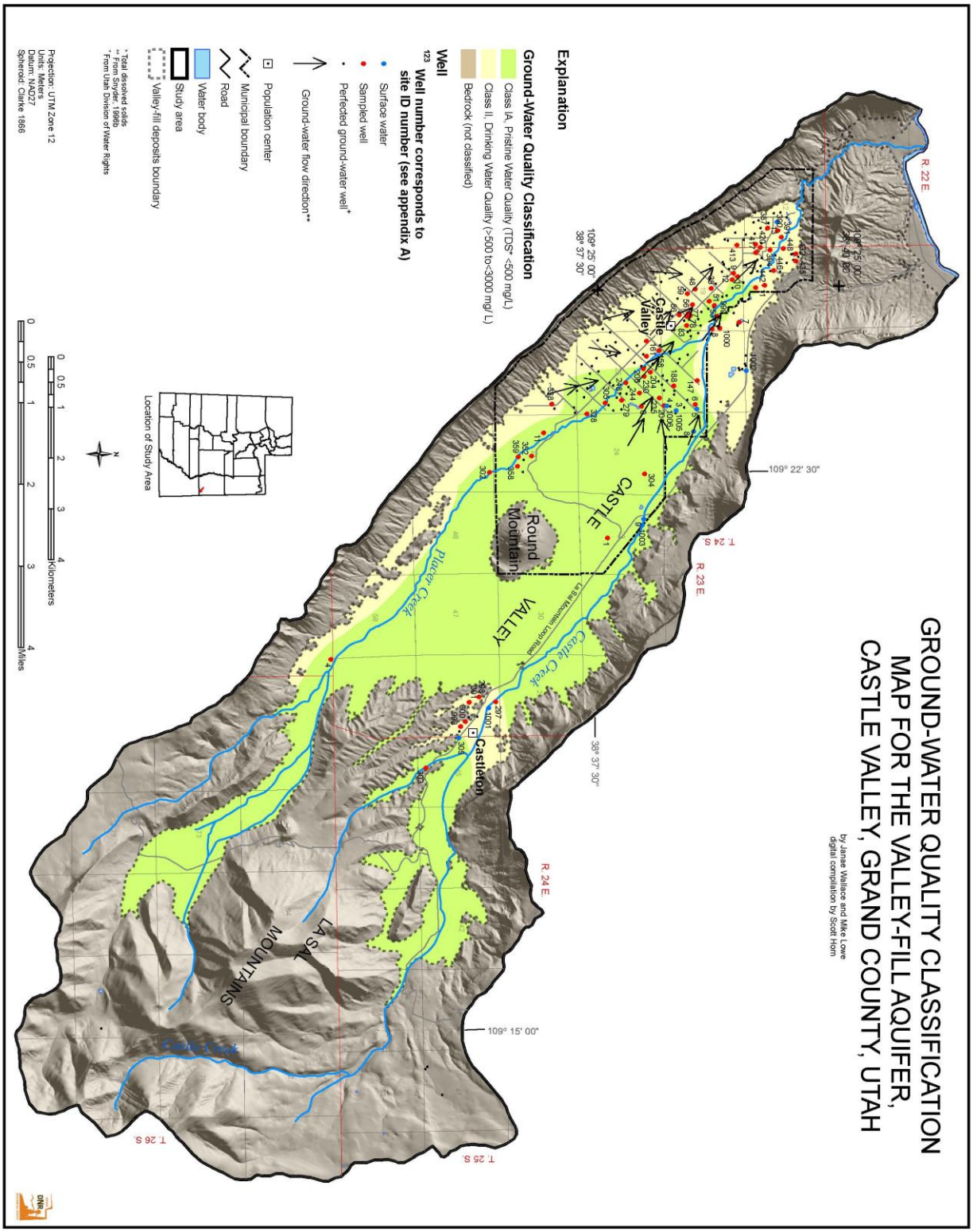
Weathering and freeze-thaw in outcrop discontinuities is responsible for triggering most rock falls. In addition, rock falls can be initiated by earthquakes of magnitude 4.0 or larger.

The region is one of low historical earthquake activity. In general, earthquakes in the Colorado Plateau are small to moderate magnitude, and occur infrequently. The strongest recorded earthquake in the area occurred on February 1, 1967 (magnitude 3.8) near Upheaval Dome in northern Canyonlands National Park.

The surface-fault-rupture hazard is low because no active faults with evidence for Holocene or late Pleistocene activity are present in Castle Valley. However, in the southeastern part of Castle Valley there is a fault of suspected Quaternary age. This fault could have a tectonic origin, but is most likely related to salt dissolution beneath Castle Valley. Although improbable during 50-100 year time frames, surface rupture is possible on this fault. In addition, the sinkhole at the northwest end of the fault indicates dissolution or piping along the fault zone. Such sinkholes may develop elsewhere along the fault in the future, particularly if water is introduced into the zone.

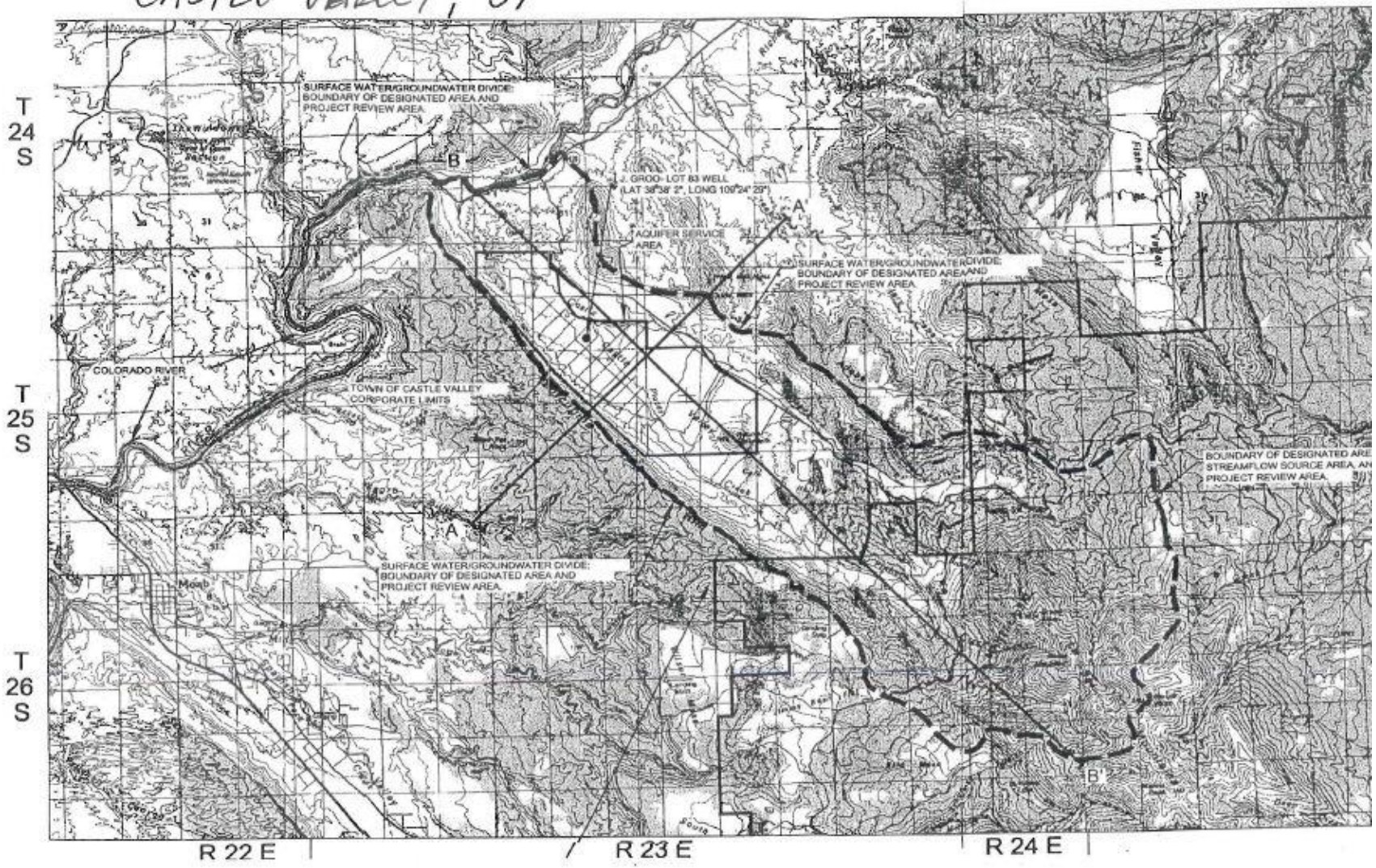
This hazard map shows areas where site-specific studies concerning rock-fall hazards are recommended prior to development. The map is designed to show potential hazard areas for planning purposes only. Site-specific studies should evaluate hazards and, if necessary, recommend hazard-reduction measures. The studies must be prepared by qualified professionals (engineering geologists, geotechnical engineers). Because of the relatively small scale of the maps (1:24,000), the possibility exists that some small hazard areas are not shown; studies are therefore recommended for critical facilities even outside the hazard areas.

A5


GROUND-WATER QUALITY CLASSIFICATION
MAP FOR THE VALLEY-FILL AQUIFER,
CASTLE VALLEY, GRAND COUNTY, UTAH
by Janae Wallace and Mike Lowe
digital compilation by Scott Horn
Explanation
Ground-Water Quality Classification
Class IA, Pristine Water Quality (TDS* <500 mg/L)
Class II, Drinking Water Quality (>500 to <3000 mg/ L)
Bedrock (not classified)
Well
Well number corresponds to site ID number (see appendix A)
Surface water
Sampled well
Perfected ground-water well+
Ground-water flow direction**
Population center
Municipal boundary
Road
Water body
Study area
Valley-fill deposits boundary
* Total dissolved solids
(TDS) in milligrams per liter
+ From Utah Division of Water Rights
Location of Study Area
Projection: UTM Zone 12
Units: Meters
Datum: NAD27
Spheroid: Clarke 1866
Kilometers
Miles
Castle Valley
Round Mountain
CASTLE VALLEY
Castleton
Pluser Creek
Castle Creek
LA SAL MOUNTAINS
R 22 E
R 23 E
R 24 E
T. 24 S.
T. 25 S.
T. 26 S.
109° 25' 00"
109° 22' 30"
109° 15' 00"
38° 37' 30"

A6

CASTLE VALLEY AQUIFER SYSTEM
CASTLE VALLEY, UT



Appendix B:

B1

Castle Valley Drive consists of 3.64 miles of pavement (chip seal x 2) and there are 14 miles of additional dirt and gravel roads. There is a single 10-foot culvert at Castle Creek and Castle Valley Drive, a 10-foot and two 6-foot culverts at Castle Creek and Willoughby Way. There are 5-foot culverts on Placer Creek and Buchanan Lane, Placer Creek and Shafer Lane and Placer Ditch and Miller Lane. There are 3-foot culverts under or parallel to Castle Valley Drive at Amber Lane, Chamisa Lane, Rimshadow, Lazaris, Bailey, Pace, Buchanan, Shafer, Miller, Pope and Holyoak Lanes. As well as 3-foot culverts under other sections of all of the above-mentioned roads to also include Rimrock, Castle Creek, Homestead, Cliffview, Keogh and Taylor Lanes. Additionally, there are numerous culverts that have silted up or are undersized and currently nonfunctional. Originally the ranch that preceded the town had four retention ponds to catch runoff, one located at the eastern end of Pope Lane, one west and north of Castle Valley Drive and Holyoak Lane, one between Buchanan and Shafer Lanes east of Castle Valley Drive on historic Placer Creek drainage and between Bailey and Lazaris Lanes west of Castle Valley drive. All check dams have either been silted in or breeched with the exception of the one between Holyoak and Pope Lanes west of Castle Valley Drive, which is still functional. Two 3 foot culverts one on Placer Creek in the upper eighty at lots 359 and 358 and one on the connector portion of Castle Valley Drive at Placer Creek were washed out or are nonfunctional due to damage by severe storm water events. These two areas are now subject to periods of road closure, until repairs can be made.

B2

The area from east Holyoak to east Buchanan Lanes is relatively flat and is the historic flood plain for Castle and Placer Creeks. There are numerous former channels that these creeks have made in the past. Placer Creek was diverted into a manmade ditch from lot 328 alongside the Bureau of Land Management fence northeast to lot 277 then north to lot 242/233 into a 5 foot culvert under Miller Lane thence across lots 232 and 203 to a 5 foot culvert under Shafer Lane to another 5 foot culvert under Buchanan Lane to lot 369 (Town of Castle Valley, greenbelt lot) to Castle Creek. Should runoff flow exceed the capacity of this ditch, floodwaters have and may breech the berm at lot 328/308 and proceed into the historic Placer Creek channel. This channel can no longer handle the water from Placer Creek, as there is not a culvert across Holyoak and the culverts under Pope, Miller, Shafer and Buchanan Lanes are not sufficient to handle Placer Creek storm water runoff anymore.

Appendix C:

Castle Valley Hazard Mitigation Committee

Approved Meeting Minutes:

November 2013 – November 2015