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South Dayton Valley Development Guidelines

Supplement to the South Dayton Valley Area Drainage Master Plan

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prepared for
Lyon County | Carson Water Subconservancy District

JE FULLER
8400 S Kyrene Rd, STE 201
Tempe, AZ 85284
www.jefuller.com

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1 INTRODUCTION

Natural environmental hazards associated with drainage and storm water runoff exist in all watersheds. Development can adversely affect natural drainage and create flood and erosion hazards, unless adequate planning and management rules are applied. To protect private and public property, and the health and general welfare of the public, naturally occurring drainage hazards and potential hazards related to development need to be identified, and appropriate development standards applied to manage new development.

The South Dayton Valley Area Drainage Master Plan (ADMP) identifies certain drainage hazards for the watersheds in the study area. The development guidelines outlined in this document are a non-structural component of an overall comprehensive flood hazard management plan. Other flood mitigation strategies may be implemented by developers or agencies, such as flood warning systems, at-risk property acquisition, or structural flood control measures. The development guidelines identify drainage issues, recommend development practices, identify required engineering analysis, and describe best management practices for floodplain management and drainage engineering. Figure 1-1 shows the focus area of the ADMP and the contributing watershed.

Implementation of development guidelines for drainage hazards has been shown to reduce public expenditures for structural flood control measures, decrease the level of maintenance needed for flood control facilities, and lessen the need for acquisition of public right-of-way for flood control. In addition, application of development guidelines reduces the potential for flood damage to private and public property and reduces the need for public funding for flood mitigation.

The guidelines presented in this document are intended to be used by Lyon County as a tool in assessing the flooding risk impacts of future small- (individual lot) and large- (master planned community) scale development. The policies presented in the guidelines are intended to be used by Lyon County at their discretion when deemed warranted during the permit review process. The guidelines are intended to be used concurrently with data from the ADMP to determine existing conditions flood risk, and appropriate mitigation procedures. The guidelines are also intended to assist Lyon County in determining when additional engineering analyses are needed for future development approval.

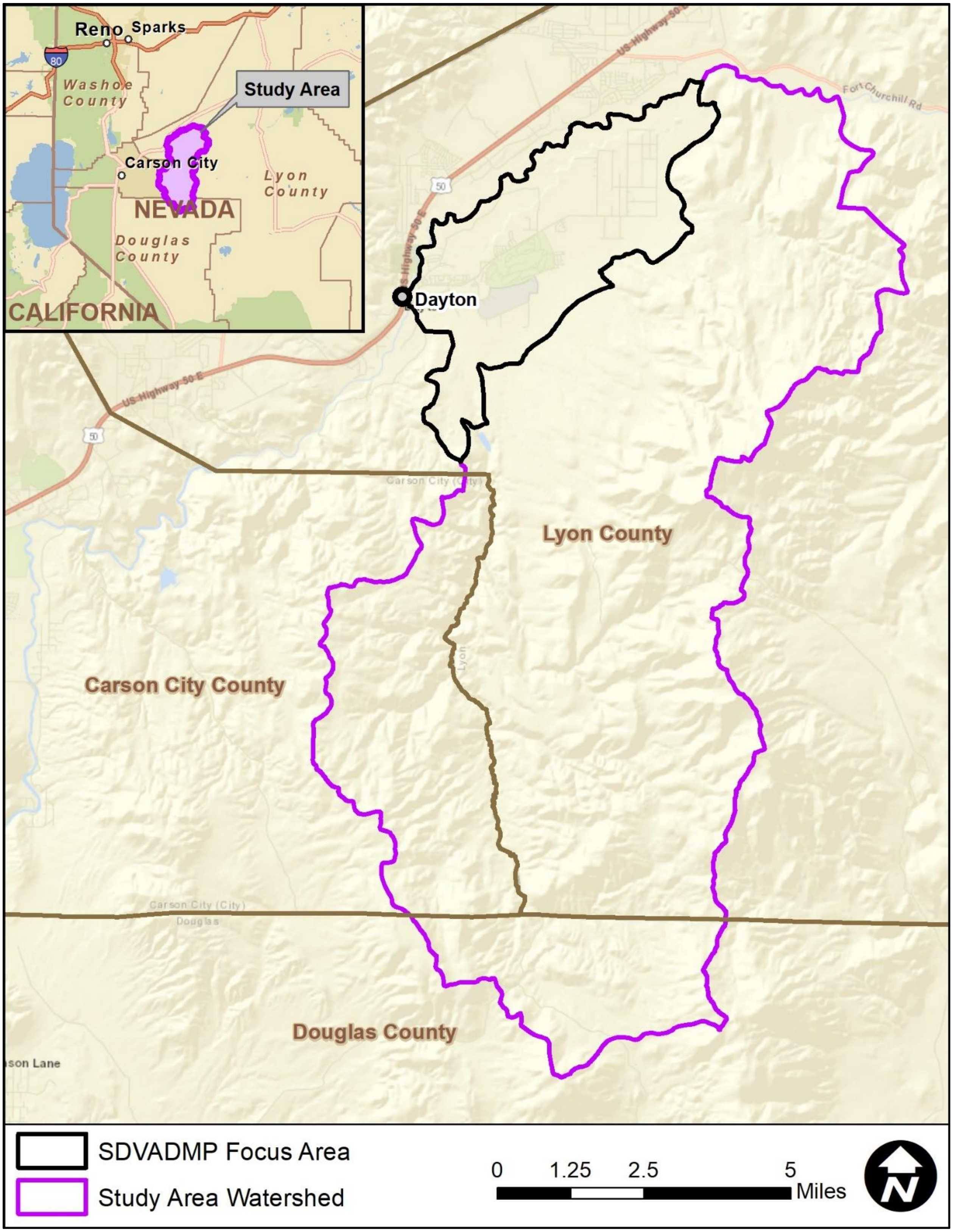

Figure 1-1. ADMP focus area and contributing watershed

1.1 Background and Rationale

Historically, governmental agencies have developed floodplain management measures such as floodplain ordinances, drainage ordinances, and development standards intended to mitigate the flood impacts of urbanization. If these measures are not adequate or are not adequately enforced, the consequences may include flooding of homes and businesses, displacement of existing natural flood flows, increased flood depths, and flooding of lands previously not in a floodplain. The adverse impacts of urbanization on drainage often include the following:

1.1.1 More Frequent Flooding

As the land area within a watershed is converted from natural rangeland to rooftops and pavement, less rainfall infiltrates into the ground and more rainfall becomes runoff. This results in more frequent runoff events and increased nuisance flooding.

1.1.2 Larger Flood Peaks

The change from natural pervious land surfaces to urbanized impervious surfaces also causes the size of floods to increase, as more runoff leaves the watershed. Urbanized watersheds generate not only large flood peaks, but also larger flood volumes and floods of longer duration, both of which increase flood damages. As flood peaks increase with urbanization, existing drainage structures become inadequate and have a greater risk of failure.

1.1.3 Scour and Erosion

Because more land area is covered by homes, streets and landscaping as a watershed urbanizes, the natural sediment supply to streams is decreased, which causes floods to be more erosive. This erosion leads to loss of homes, property and farmland due to riverine bank erosion, scour damage to bridges and culverts, and adverse impacts to flood control facilities and natural river habitat.

1.1.4 Flow Diversion

Unmanaged development can block natural flowpaths, diverting runoff toward areas that were previously not flooded.

1.1.5 Flow Concentration

Development in riverine or sheet flow floodplains blocks natural overland flowpaths, concentrating runoff through narrower conveyance corridors. Flow concentration leads to higher flood peaks, higher flood velocities, and accelerated scour and erosion.

1.1.6 Expanded Floodplains

Increased flood peaks and flow diversion increase flood water elevations and expand floodplain widths, inundating properties previously safe from flooding and expanding the number of homes and business at risk for future flood damage.

1.1.7 Reduced Surface Storage

Reducing surface storage area by grading individual lots to reduce ponding areas or soggy soils, by erecting structures within former ponding and flood-prone areas, increases both the peak flow and the volume of runoff generated by a given storm, and may also result in a loss of vegetation that further increases runoff rates.

1.1.8 Decreased Ground Water Recharge

Increased impervious surface area in an urbanized watershed inhibits ground water recharge and reduces soil moisture, with adverse consequences to long-term water supply, subsidence, and vegetation.

1.1.9 Loss of Riparian Habitat

Increased erosion due to increased flood peaks and reduced sediment supply leads to degraded habitat along river corridors, with adverse impacts to wildlife and public recreation.

Adherence to the development guidelines will lessen the adverse impacts of urbanization and decrease the cost of flooding for the public.

1.2 Objectives

Communities develop drainage ordinances, policies, and standards with the intent to mitigate/minimize flooding impacts due to urbanization of a watershed. The overall objective of the ADMP development guidelines is to minimize the occurrence of losses, hazards, and conditions adversely affecting the public health, safety, and general welfare that occur due to flooding.

The general objectives of the development guidelines include the following:

- Enhance public safety by guiding development in the watershed to protect current and future residents from the effects of flooding.
- Reduce adverse drainage impacts due to development in the watershed by guiding activities of new construction.
- Guide future development in a manner consistent with the floodplain management objectives of South Dayton Valley.

The following specific objectives were established to guide the development of criteria and the means of implementation:

- Develop development guidelines that have been tested on the actual environmental and development conditions within the study area.
- Develop development guidelines consistent and compatible with existing statutes, ordinances, and regulations.
- Limit the development guidelines to solely those necessary to address watershed-specific problems not adequately covered by existing Floodplain and/or Drainage Regulations.

The proposed Development guidelines for the ADMP are consistent with the general and specific objectives set forth above.

1.3 AUTHORITY

1.3.1 National Flood Insurance Program

Under the National Flood Insurance Program (NFIP), federal laws require the State of Nevada, Lyon County, and the Carson Water Subconservancy District (CWSD) to manage and regulate all development in flood zones. The NFIP regulations are outlined in the Code of Federal Regulations (44 CFR Chapter 1 Part 59-80).

1.3.2 Nevada Revised Statutes

Local governmental entities are limited in their powers to those expressly granted by the State, as codified in the Nevada Revised Statutes[1] (NRS).

1.3.3 Local Drainage Regulations

Any development within Lyon County is subject to the drainage regulations within which the development is proposed.

1.3.4 Local Jurisdiction Hazard Mitigation Plan Documents:

- Lyon County Multi-jurisdictional Hazard Mitigation Plan – 2018:

Section Eight Mitigation Strategy	Goal 3 (Actions 3A - 3C): Reduce the possibility of damages and losses due to dam/canal failure. Goal 7 (Actions 7A – 7K): Reduce the possibility of damages and losses due to flooding.
Section Eight Mitigation Strategy	Goal 4 (Actions 4A - 4C): Reduce the possibility of damages and losses due to flood and flash flood.

[1] https://www.leg.state.nv.us/NRS/

2 Development Guidelines

2.1 Floodplains and Special Consideration Areas

2.1.1 General Considerations

Development guidelines for the following types of natural hazards are presented in this chapter:

- Section 2.2: Riverine Flooding
- Section 2.3: Alluvial Fans
- Section 2.4: Sheet Flow

For each hazard type, a definition and example photographs are provided, several key technical references are provided, followed by the hazard specific development guidelines. A generalized map of the flooding hazard types within the ADMP is shown in Figure 2-1. One of the flooding types shown in Figure 2-1 is Development Modified. These are areas where development has significantly altered the natural drainage pattern. These areas fall under County drainage standards and ordinance requirements.

For any specific development parcel in the ADMP study area, general information regarding flood hazards impacting the site can be identified using the ADMP FLO-2D modeling results. The FLO-2D modeling provides comprehensive, but generalized hazard information. It is highly recommended that individuals developing property in the study area also contact qualified registered professional engineers, geologists, and/or hydrologists for more site-specific information regarding the hazards at specific development parcels.

In case of conflict between the development guidelines and other policy or regulatory guidelines, the following two guiding principles for development should be considered to apply universally:

- **No Adverse Impact**. All development shall have no adverse impact on the pre-development hazard level on any adjacent property.
- **Existing Regulations Enforced**. All development shall comply with all existing local, state and federal floodplain regulations.

For the purposes of this document, development means any man-made change to property, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, or storage of materials or equipment.

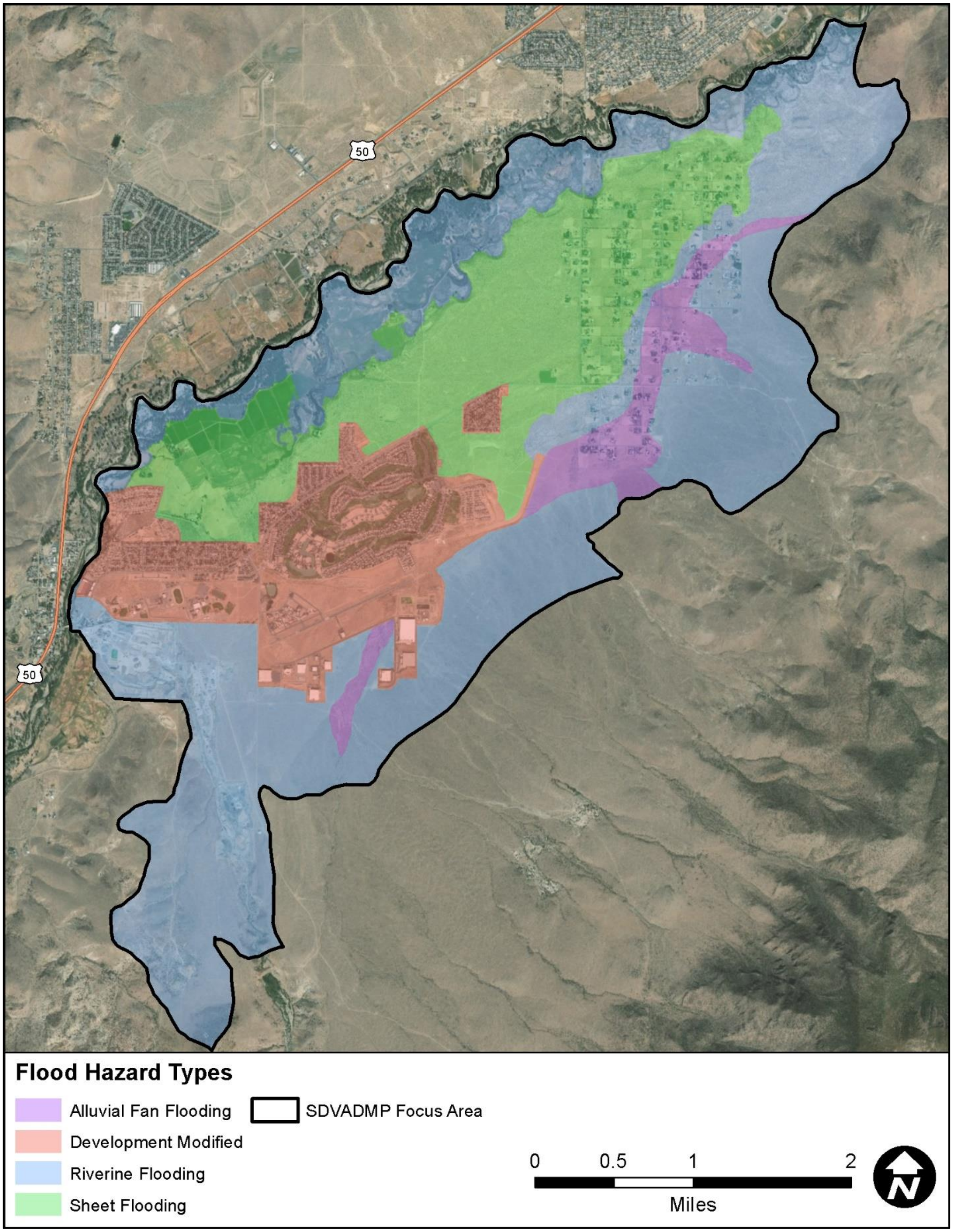

Figure 2-1. Flooding hazard types

2.2 RIVERINE FLOODING

Riverine flooding is generally the most common and is caused by channel bank overtopping when the flow capacity of channel is exceeded locally. The rising water levels generally originate from heavy high-intensity rainfall creating soil saturation and large runoff - locally or in upstream watershed areas. Riverine areas are characterized by a tributary (or dendritic) drainage pattern in which there are many contributing streams (analogous to the twigs of a tree), which are then joined together into the tributaries of the main river (the branches and the trunk of the tree, respectively). They develop where the river channel follows the slope of the terrain (Figure 2-2 and Figure 2-3).

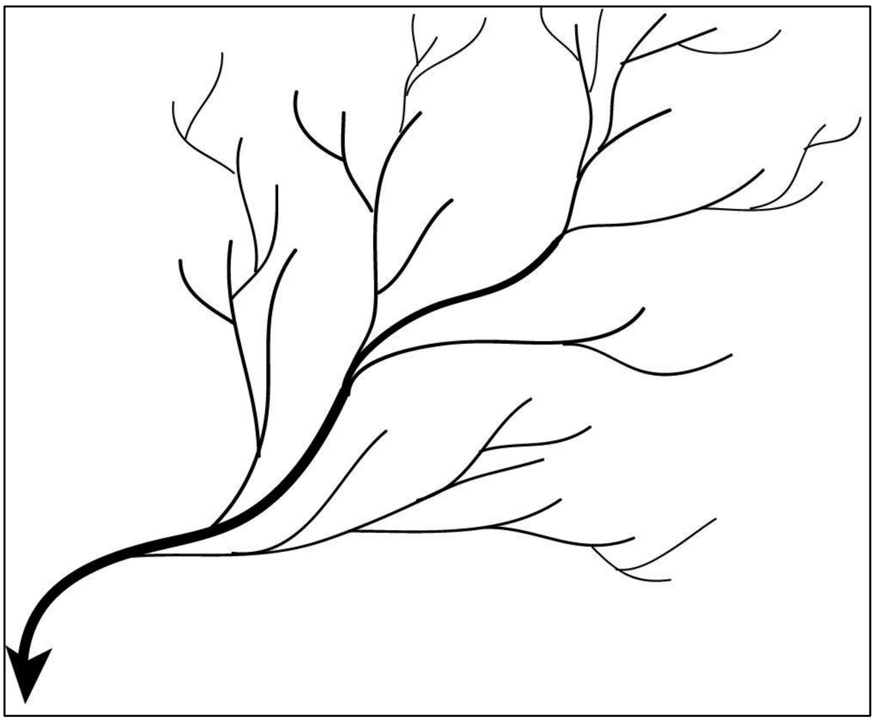

Figure 2-2. Example of tributary (dendric) drainage pattern

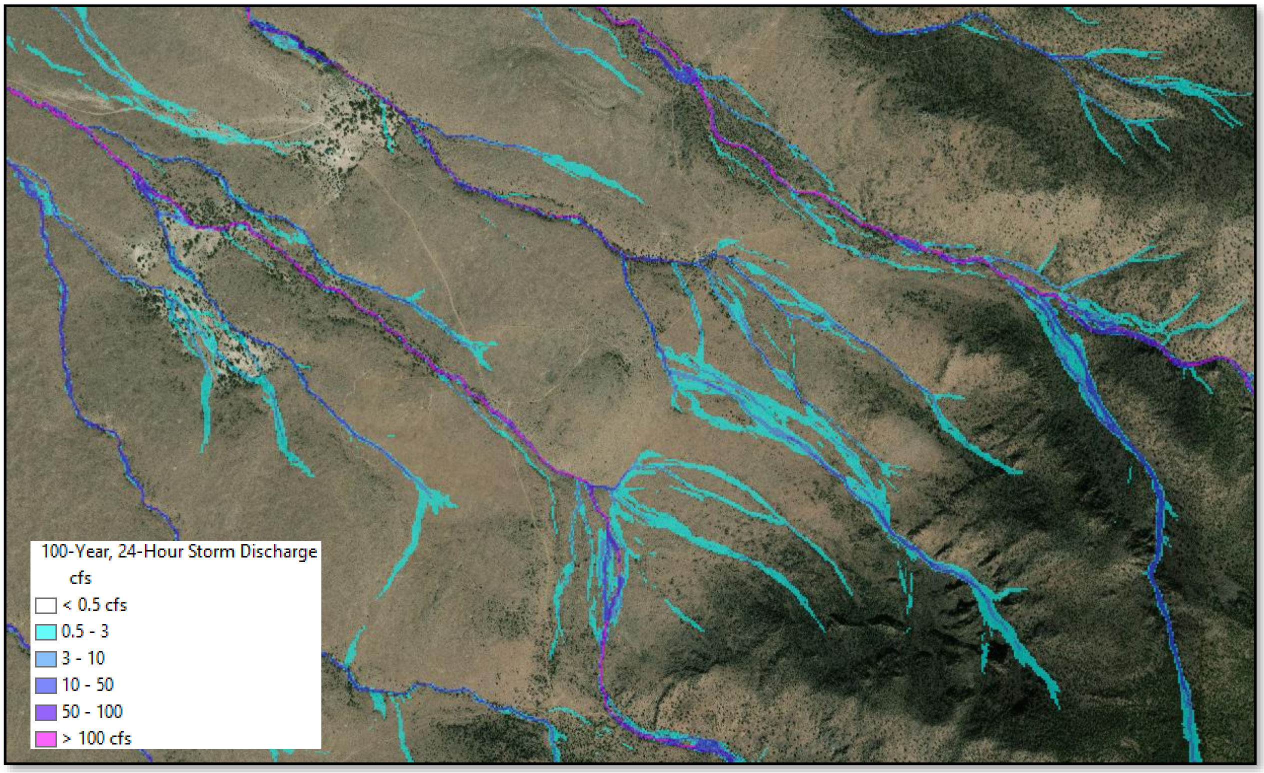

Figure 2-3. Example of riverine flooding in the ADMP study area

Areas defined by riverine flooding are shown in Figure 2-1. Future development within the riverine areas are subject to current County drainage standards and ordinances and/or FEMA guidelines for riverine flooding hazard mapping (for FEMA floodplain delineation).

2.3 Alluvial Fans

2.3.1 Hazard Description

Alluvial fans are gently sloped, fan-shaped landforms created by the deposition of sediment eroded from an upstream watershed (Figure 2-4). Active alluvial fans are unique flood hazards in that they experience not only flash flooding and erosion common to all arid region streams, but they can also experience dramatic shifts in channel location that make floodplain management and flood hazard mitigation challenging.

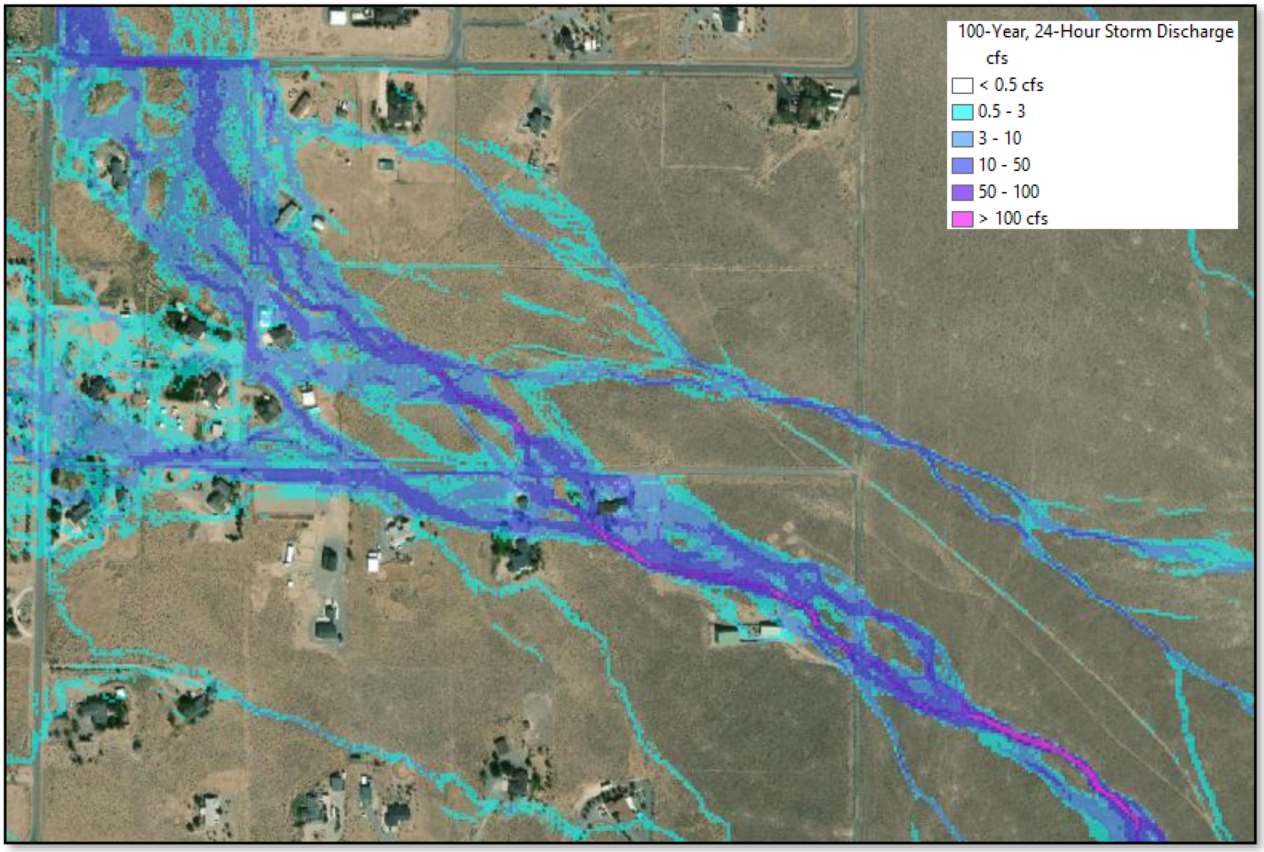

Figure 2-4. Example of alluvial fan flooding within the ADMP study area

2.3.2 Definitions

- **Alluvial Fan** means a sedimentary deposit located at a topographic break, or sudden loss of lateral confinement, such as the base of a mountain, escarpment, or valley side, is composed of streamflow and/or debris flow sediments, and that has the shape of a fan either fully or partially extended. Alluvial fans may be active or inactive. The development guidelines described in below apply primarily to active alluvial fans.

- **Alluvial Fan Flooding** occurs only on alluvial fans and is characterized by flowpath uncertainty so great that this uncertainty cannot be set aside in realistic assessments of flood risk or in the reliable mitigation of the hazard. The presence of alluvial fan flooding is indicated by three key criteria:
    - Flowpath uncertainty below the hydrographic apex
    - Abrupt deposition and ensuing erosion of sediment as a stream or debris flow loses its competence to carry material eroded from a steeper, upstream source
    - An environment where the combination of sediment availability, slope and topography creates an ultra-hazardous condition for which elevation on fill will not reliably mitigate the risk.

- **Apex** means a point on an alluvial fan below which the flow of the major stream that formed the fan becomes unpredictable and alluvial fan flooding may occur.

2.3.3 Types of Alluvial Fans

A variety of terms are commonly used to describe alluvial fans. The terms are not synonyms, as each type of fan is subject different types of flood hazards. More detailed information on these can be found in the references listed below.

- **Active Alluvial Fan.** Those locations where flooding, erosion, and/or deposition have occurred on the landform such as an alluvial fan in relatively recent time (the historic period), and probably will continue to occur on that part of the landform.

- **Alluvial Plain.** A level or gently sloping tract or a slightly undulating land surface produced by extensive deposition of alluvium, usually adjacent to a river that periodically overflows its banks; it may be situated on a flood plain, a delta, or an alluvial fan.

- **Bajada.** A broad, continuous alluvial slope or gently inclined detritus surface, extending along and from the base of a mountain range out into and around an inland basin, formed by the lateral coalescence of a series of separate but confluent alluvial fans, and having an undulating character due to the convexities of the component fans. A bajada is a surface of deposition, as contrasted with a pediment (a surface of erosion that resembles a bajada in surface form), and its top often merges with a pediment.

- **Inactive Fan.** Those locations where flooding, erosion, and/or deposition have not occurred on a landform such as an alluvial fan in relatively recent time, and probably will not occur on that part of the landform. On inactive alluvial fans flood water typically is conveyed along incised channels and adjacent stable land.

- **Pediment** A broad, flat or gently sloping, rock-floored erosion surface or plain of low relief, typically developed by sub aerial agents (including running water) in an arid or semiarid region at the base of an abrupt and receding mountain front or plateau escarpment, and underlain by bedrock (occasionally by older alluvial deposits) that may be bare but more often partly mantled with a thin and discontinuous veneer of alluvium derived from the upland masses and in transit across the surface. The longitudinal profile of a pediment is normally slightly concave upward, and its outward form may resemble a bajada (which continues the forward inclination of a pediment).

- **Piedmont.** Lying or formed at the base of a mountain or mountain range; e.g. a piedmont terrace or a piedmont pediment. (n.) An area, plain, slope, glacier, or other feature at the base of a mountain; e.g. a foothill or a bajada.

2.3.4 Technical References:

- Federal Emergency Management Agency (FEMA), 2003, Guidelines and Specifications for Flood Hazard Mapping Partners –Appendix G: Guidance for Alluvial Fan Flooding Analyses and Mapping. Available at: www.fema.gov/mit/tsd/dl_cgs.htm.

- National Research Council, 1996, Alluvial Fan Flooding, National Academy Press, Washington, D.C. Available for purchase at: http://www.nap.edu/

- Arizona Department of Water Resources (ADWR). State Standards for Floodplain Management: http://www.azwater.gov/AzDWR/SurfaceWater/FloodManagement/StateStandards.htm
    - (SS4-95) Standard for Development Within Sheet Flow Areas

2.3.5 Development guidelines for Alluvial Fans

Policy AF 1: Floodplain Delineation. Any new FEMA floodplain delineation within the ADMP alluvial fan areas must be completed to FEMA standards. For subdivisions, the alluvial fan floodplain delineation must extend from a point above the apex where no flowpath uncertainty exists downstream to the piedmont axial stream (Carson River). In most cases, the floodplain delineation must be submitted to and approved by FEMA prior to the issuance of building permits. For single lot residential development, the floodplain delineation may be limited to the building envelope and does not need to be submitted to FEMA. For all delineations, lateral tie-in upstream and downstream to effective (approved) floodplain delineations and to CLOMR/LOMR delineations that reflect structural flood control measures. Floodplain delineations on alluvial fans shall be completed using the procedures described in FEMA Guidelines.

Policy AF 2: Whole Fan Solution Preferred. Identification of active alluvial fans, control of their apex, and conveyance of flow through the entire fan will be necessary for development within active alluvial fan areas. A a strong preference of whole fan solutions that control the apex of the active alluvial fans is preferred, which provides for flood conveyance through the entire fan (a regional solution), and outfalls into a regional drainageway sized to convey the 100-year discharge.

Policy AF 3: Non-Structural Flood Control. Special consideration should be given to avoiding development within flood prone areas on active alluvial fans, accommodating the unstable and indeterminate flow associated with the alluvial fans, and maintaining existing sediment transport conditions. Consideration should be given to protect the major conveyance channels, and associated banks and vegetation.

Policy AF 4: Flowpath Uncertainty Modeling. An avulsion is the process by which flow is diverted out of an established channel into a new course on the adjacent floodplain[2]. Avulsions divert flow from one channel into another, leading to a total or partial abandonment of the previous channel[3], or may involve simple flowpath shifts in a braided or sheet flooding system. Avulsions are commonly associated with alluvial fan flooding, but are also known to occur on riverine systems and river deltas

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The occurrence of avulsions is what makes an alluvial fan “active.” Avulsions give the alluvial fan the ability to distribute water and sediment over the surface of the landform, which results in the radial “fan” shape. Avulsions influence flood hazards on alluvial fan landforms by changing the location, concentration and severity of flooding on the fan surface. That is, an area not previously inundated by flooding (or inundated only by shallow flow) may in a subsequent flood become the locus of flood inundation, sediment deposition, and/or erosion. If an alluvial fan has no risk of avulsion, flood hazard

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[2] Slingerland, R and Smith, N.D., 2004, River Avulsions and Their Deposits, Annual Review of Earth and Planetary Science, Vol. 32:257-285.

[3] Field, John, 2001, “Channel avulsion on alluvial fans in southern Arizona,” Geomorphology, Vol. 37, p. 93-104.

delineation and mitigation become much simpler engineering problems, consisting only of modeling two-dimensional flow and/or normal riverine hydraulic and sedimentation issues.

The occurrence of major avulsions in an alluvial fan drainage system introduces the following complications into an engineering analysis of the flood hazard:

- Uncertain and changing flowpath locations, during and between floods
- Continually changing channel and overbank flowpath topography
- Inundation and/or sedimentation hazards in previously un-flooded areas
- Uncertain and changing flow rate distribution for areas downstream of avulsions
- Uncertain and changing watershed boundaries for areas downstream of avulsions
- Aggrading, net depositional land surfaces and channels with diminishing capacity
- Unsteady, rapidly-varied flow conditions
- High rates of infiltration and flow attenuation across the fan surface

In addition to considering flowpath uncertainty, future development that occurs on an active alluvial fan shall elevate the lowest finished floor elevation of habitable structures to be a minimum of two feet above the 100-year, 24-hour flow depth as determined from the ADMP depth grids to account for potential sedimentation.

2.4 Sheet Flooding

2.4.1 Hazard Description

Sheet flooding is a type of surface water runoff that occurs on broad, unconfined floodplains with low lateral relief (Figure 2-5). Sheet flooding can occur in urban, rural, and natural areas. Because sheet flooding often occurs in areas that lack defined stream channels, identification of sheet flood areas can be difficult.

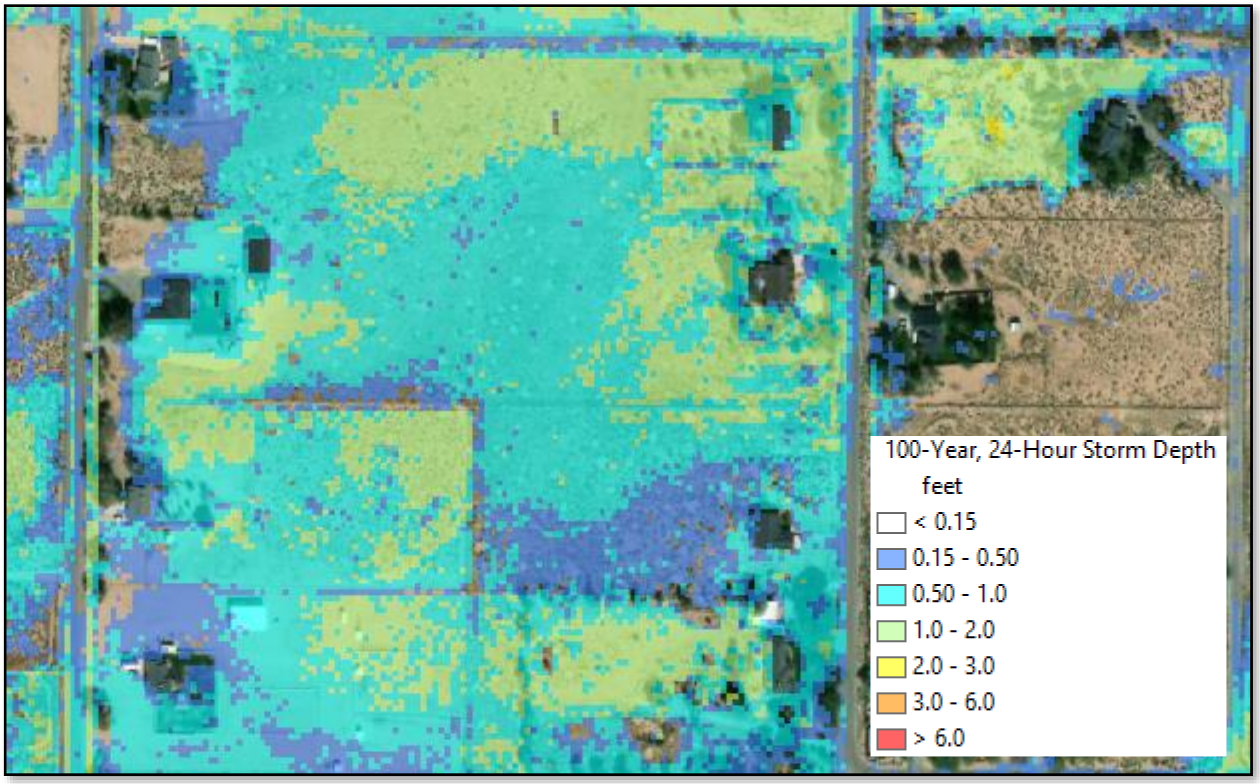

Figure 2-5. Example of sheet flooding within the ADMP study area

2.4.2 Definitions

Sheet flow is a loosely defined term. In general, the term "sheet flow" may refer to any form of unconfined runoff that occurs over a broad, expansive area. This broad definition of sheet flow incorporates several more narrowly defined flow types, including natural (classic) sheet flow, urban sheet flow, agricultural sheet flow, overland flow, perched flow, anastomosing flow, and distributary flow. The variety of terms used for sheet flow probably reflects the variety of flow types that occur within specific geographic regions of the state. For this study, the term "sheet flow" will be used generically, to include all types of sheet flow that occur in South Dayton Valley.

In general, sheet flooding in South Dayton Valley has the following characteristics:

- The primary identifying characteristic of sheet flow is that a significant part of flood water is not conveyed in a single, well-defined channel. Flood flow is conveyed over the unchannelized land surface.
- Water moving over a smooth stable surface does not move as a uniform film. If the surface is broad, the sheet differentiates into parallel streams of greater depth and relatively rapid flow, separated by shallower bands of relatively sluggish flow; and at the same time, both streams and intervening bands differentiate into series of transverse waves which move forward more rapidly than the body of the undifferentiated sheet.
- Sheet flow over poorly vegetated surfaces often has the ability to transport large sediment particles relatively large distances over low slopes without significant reduction in sediment diameter, angularity, or degree of sorting, such as may be considered typical of most well-defined streams.

- Sheet flooding has markedly different hydraulic characteristics for sediment laden and sediment deprived flows. Sheet flooding may not have gradually varied or steady flow and may have a strong two-dimensional character.
- Significant loss of flow volume may occur during sheet flooding due to infiltration and other abstractions.
- Sheet flow often enters a larger channel or drainage system that intersects its flow, but occasionally dissipates due to infiltration or other loss mechanisms before ever reaching a channel.

2.4.3 Types of Sheet Flow

- Natural sheet flow occurs in undeveloped areas and consists of flowing water characterized by a tendency to spread widely in relatively shallow sheets over gently sloping areas with low topographic relief which lack defined drainage systems.

- Urban sheet flow occurs where development has obscured natural drainage patterns or where urban drainage facilities are severely undersized. Urban sheet flow areas differ from natural sheet flow areas in that the identifying soil and vegetative characteristics may be obscured by development. Urban sheet flow areas are usually identified from historic records of unconfined flooding. Urban sheet flow areas occasionally may be identified by detailed topographic maps that show low relief in known flooding areas.

- Agricultural sheet flow occurs on land surfaces that have been graded or flattened for agricultural use. Lack of topographic variation within the field areas creates sheet flow conditions. Agricultural sheet flow areas differ from natural sheet flow areas in that soil and vegetative identifying characteristics may be obscured by regrading or leveling for irrigation and crop development. Agricultural sheet flow areas may be identified from pre-development photographic or topographic data, or from historic records of flooding.

- Overland flow is the movement of water resulting from rainfall on hill slopes in upper watershed areas prior to entering defined channels. The development guidelines in this document should not be applied to overland flow areas.

- Perched flow originates along well-defined channels where overbank flooding becomes separated from the main flowpath and develops hydraulic characteristics unique from the main channel. Perched flow is not considered sheet flow, unless it meets other characteristics described above.

- Braided flow occurs where flow within a well-defined channel or floodplain is divided into separate flowpaths created by shifting patterns of sediment deposition. Braided flow is not a form of sheet flow.

2.4.4 Technical References:

- Federal Emergency Management Agency (FEMA), 2003, Guidelines and Specifications for Flood Hazard Mapping Partners –Appendix E: Guidance for Shallow Flooding Analyses and Mapping. Available at: www.fema.gov/library.

- Arizona Department of Water Resources (ADWR). State Standards for Floodplain Management: http://www.azwater.gov/dwr/Content/Publications/default.htm
    - (SS4-95) Standard for Development Within Sheet Flow Areas

2.4.5 Development Guidelines for Sheet Flow Areas

Policy SF 1: Single Lot Site Conveyance. For single-lot development in the sheet flow areas, flows should not be concentrated beyond a typical shallow swale around the structure. Swales shall daylight and broaden to the natural flow conditions on the downstream side of the proposed structure.

Policy SF 2: Subdivision Flow Concentration. Drainage design in sheet flow areas shall limit the concentration of flows and preserve overland flowpaths. Where flows are concentrated or channelized, appropriate scour and erosion protection shall be applied to the channelized areas. Concentrated flows shall be returned to the natural flow condition prior to exiting the property. Note that returning channelized flow to a natural sheet flow condition without adverse impacts to downstream properties is difficult to achieve and is therefore not recommended.

Policy SF 3: Drainage Master Plan. A drainage master plan should be developed for any subdivision located in a sheet flow area. Among other requirements, the drainage master plan should demonstrate that the roadway network that serves the divided property has no adverse impact to drainage patterns and runoff concentration. In general, the street layout should be designed to cross perpendicular to the primary flow direction to prevent capture and diversion of overland flow.

Policy SF 4: Finished Floor Elevation. Elevate the lowest finished floor elevation of habitable structures to be a minimum of 1.5 feet above the 100-year, 24-hour flow depth as determined from the ADMP depth grids. Note that significant backwater conditions may occur in sheet flow areas upstream of roadways with drainage structures that are not sized for the 100-year flood. Flood depths resulting from these backwater conditions may exceed depths indicated by local geomorphology or field conditions. In such areas, the finish floor elevations should be elevated at least 0.5 foot above the elevation of the roadway which creates the backwater condition. For subdivisions planned in sheet flow areas, finished floor elevations should be established by detailed engineering analyses, which may require two-dimensional modeling.

Policy SF 5: Structure Alignment. Homes in sheet flow areas should be aligned parallel to the primary flow direction. Streets in sheet flow areas should be oriented perpendicular to the primary flow direction.

Policy SF 6: Development Density. Zoning densities higher than 1 residence per acre (RAC) are not recommended in designated sheet flow areas unless drainage studies that analyze potential concentration of flow and downstream impacts are completed or regional flood control facilities are constructed. Development restrictions in low density sheet flow areas should include restrictions on perimeter fencing and limitation of site grading to specific building envelopes.