

South Dayton Valley Area Drainage Master Plan

Executive Summary



June
2020

prepared for
Lyon County | Carson Water Subconservancy District



Date Signed: June 30, 2020

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1 INTRODUCTION

1.1 PROJECT PURPOSE

The South Dayton Valley Area Drainage Master Plan (SDVADMP) was developed to meet three primary objectives:

1. Evaluate and identify flooding and sedimentation hazards within the project area by completion of a technical study that includes data collection, review of previous studies, information gathering from public agencies and residents, hydrologic and hydraulic modeling, geomorphic assessments, and field surveys.
2. Develop a series of alternatives to either partially or wholly mitigate the hazards identified in the first objective.
3. Provide stakeholder coordination and public outreach of the project through a series of public meetings to inform of the existing hazards and to present the mitigation alternatives.

Each major task of the project is presented herein with a description of the technical approach, analysis results, interpretation of results, and applicability to the overall project purpose. The results of this study can be used as a planning tool and as input to the design of potential future drainage infrastructure and flood mitigation measures that are appropriate for the physical environment for both existing and future development.

1.2 PROJECT LOCATION

The SDVADMP study area is 97 square miles and is located on the northern slopes of the Pine Nut Mountains, approximately 15 miles east of Carson City (Figure 1-1). Most of the study area spans Lyon County, with smaller portions of the upper watershed extending into Carson City and Douglas Counties. The percent study area by county is: Lyon County (75%), Carson City County (16%), and Douglas County (9%). The primary focus area of the SDVADMP is the lower watershed area downstream of the mountains, also shown on Figure 1-1.

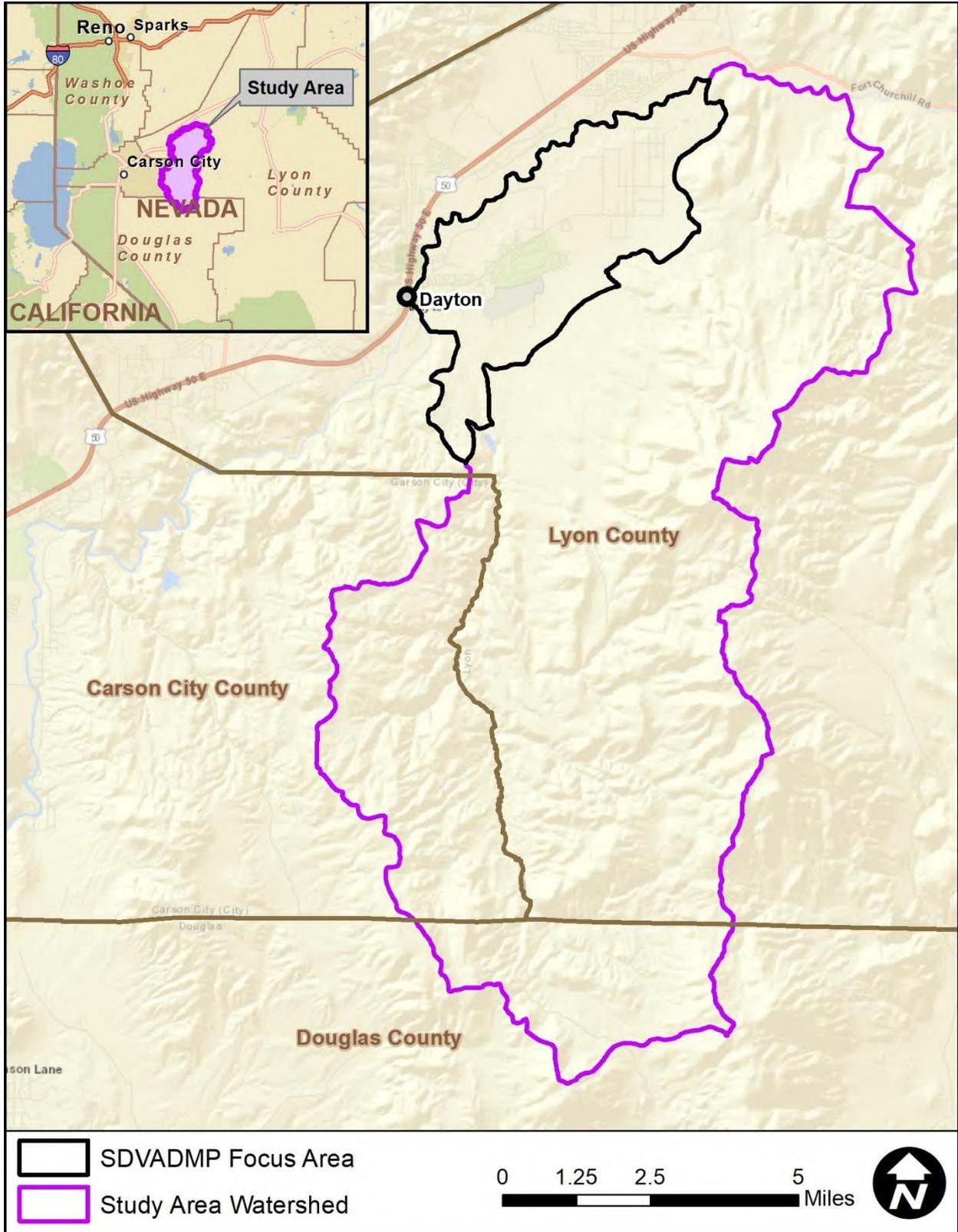


Figure 1-1. Study area vicinity map

1.3 PREVIOUS STUDIES

An early phase of the study included research and collection of previous reports and studies relevant to the ADMP area. These included:

- Subdivision Drainage Reports
- Flood Insurance Studies and FEMA Floodplain Mapping
- U.S. Army Corps of Engineers Alluvial Fan Mapping

1.4 HISTORICAL FLOWPATH ASSESSMENT

A historical flowpath assessment was conducted for the SDVADMP study area to assess the natural flowpaths of the study watercourses with the goal that understanding the natural flowpaths will aid in understanding the current flooding patterns and potential future flooding trends.

The most significant changes in flowpath alignment since 1948/1953 have occurred due to manmade channel realignments (Figure 1-2). Both the historical and modern aerial photography indicate evidence of distributary and active alluvial fan drainage patterns within the project focus area, but many of the main drainage channels have remained laterally stable for at least the past 70 years. This suggests that there may not have been a flood event of sufficient magnitude since at least 1948 to cause major channel avulsions. The major watercourses were investigated during the field verification phase of the ADMP and were not found to be incised or laterally confined within the lower project focus area. In other words, there are no physical constraints that should have prevented historical channel avulsions since 1948, which further suggests that there hasn't been a flood event with sufficient energy to cause a major channel avulsion. As such, flowpath uncertainty scenarios are not recommended for this study area as they were in the Dayton Valley ADMP.

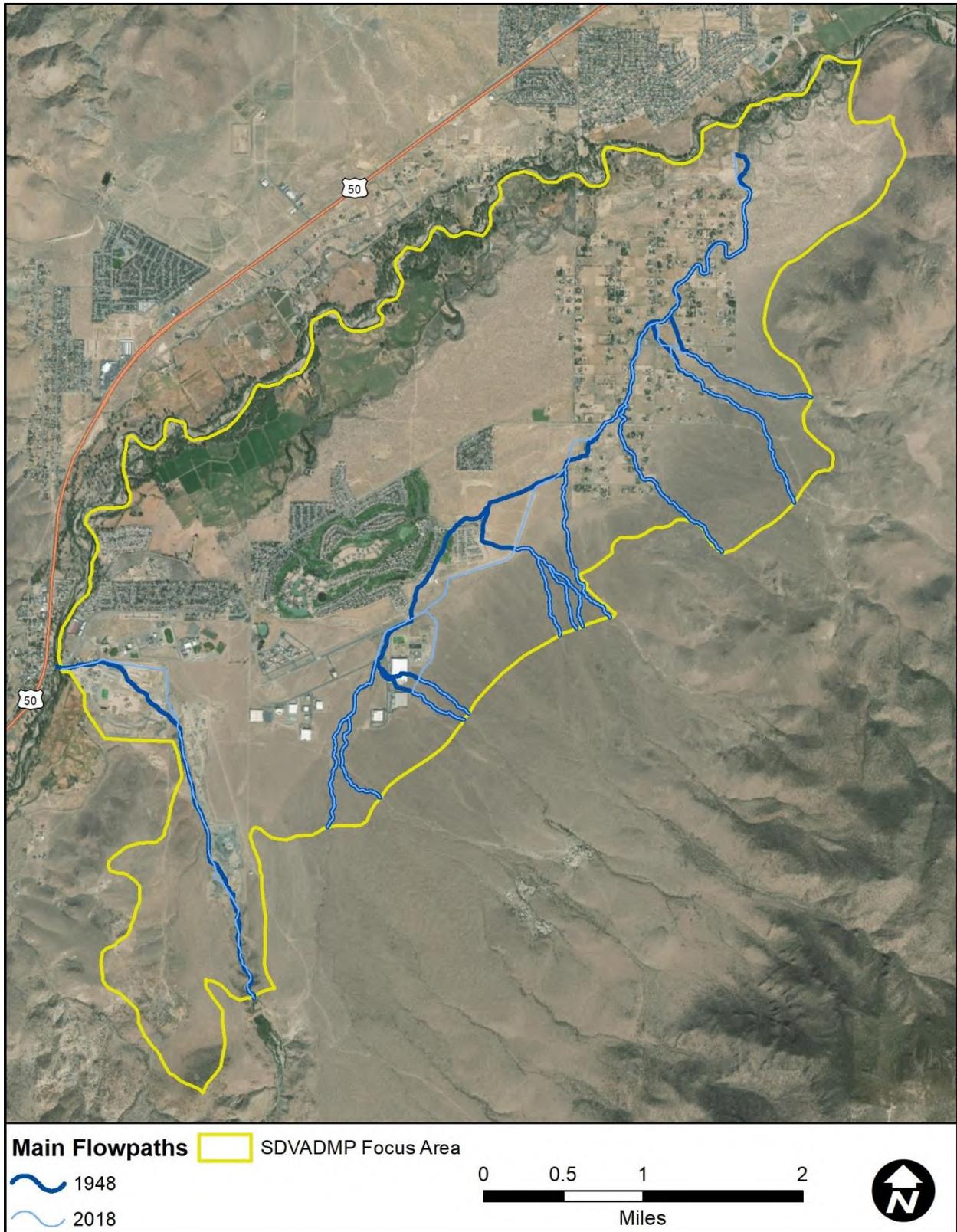


Figure 1-2. Historical flowpath comparison

2 HYDROLOGIC AND HYDRAULIC MODELING

2.1 METHOD DESCRIPTION

To maintain consistency with the adjacent Dayton Valley Area Drainage Master Plan (DVADMP), the same general procedures were used in model development. The procedures that were used for hydrology and infiltration for the SDVADMP are as follows:

- Infiltration was simulated using runoff curve number (CN) methodology per the Lyon County Drainage Guidelines (2018).
- Rainfall depths were based on the NOAA Atlas 14 (NOAA14) precipitation estimates.
- The hyetograph for the 6-hour storm was based on the balanced mass curve, while the hyetographs for the 24-hour storms were based on the Nevada Department of Transportation (NDOT) 90th percentile maximum intensity with smoothing by the generalized logistic equation (GLE) (NDOT, 2015).

All modeling, both hydrologic and hydraulic, was done using the FLO-2D Pro software¹ package, Build No. 16.06.16 with an executable dated February 28, 2017. This version has been used for multiple area drainage master studies and has functioned adequately. FLO-2D was selected for the SDVADMP due to the following: 1) to maintain method consistency with other ADMPs and drainage studies in the area (Manhard, 2012; JEF, 2019), 2) to streamline model development since there are many small subbasins that would require individual analysis if a lumped parameter model, such as HEC-HMS were used, and 3) FLO-2D is a combined rainfall-runoff model (i.e., both hydrologic and hydraulic processes are simulated within the model).

2.2 HYDROLOGY OVERVIEW

As a part of the SDVADMP, three design storms were simulated:

- 25-year, 24-hour
- 100-year, 24-hour
- 100-year, 6-hour

The 24-hour durations were chosen to be consistent with the County's drainage regulations, while the 6-hour duration was chosen because this higher intensity duration usually results in higher peak flow estimates for smaller (i.e., < 20 square miles) drainage areas.

NOAA Atlas 14 (NOAA14) precipitation depth estimates were downloaded from the National Weather Service (NWS) website (2018) as raster images.

¹ <https://www.flo-2d.com/>

2.3 MODEL RESULTS

Flow depth and discharge results from the existing conditions FLO-2D modeling are shown on Figure 2-1 through Figure 2-6. These figures are for general illustrative purposes and not practical for obtaining detailed information at site-specific locations. For more detailed information, the digital data are included in Appendix C (of the main report).

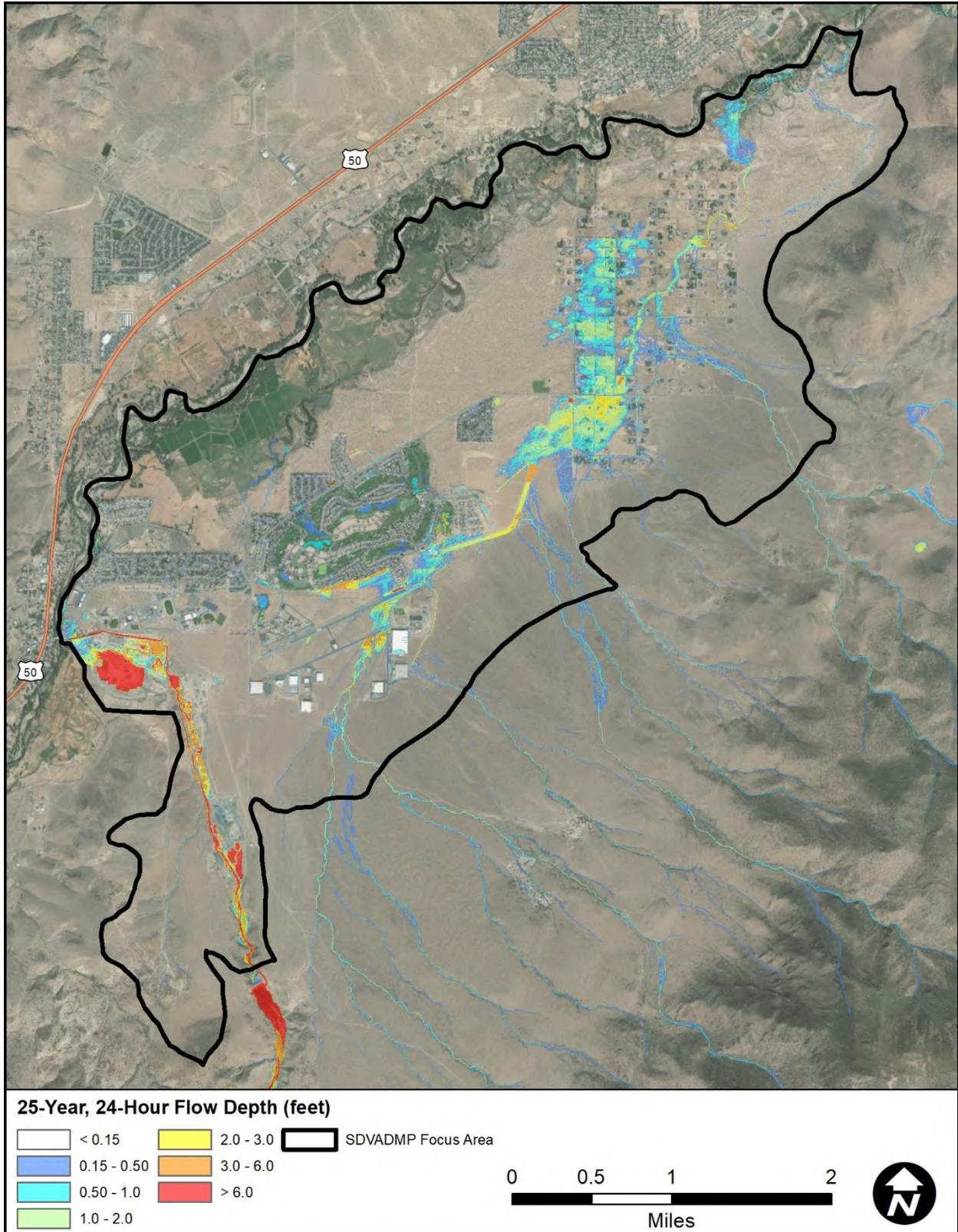


Figure 2-1. Existing conditions 25-year, 24-hour flow depth results

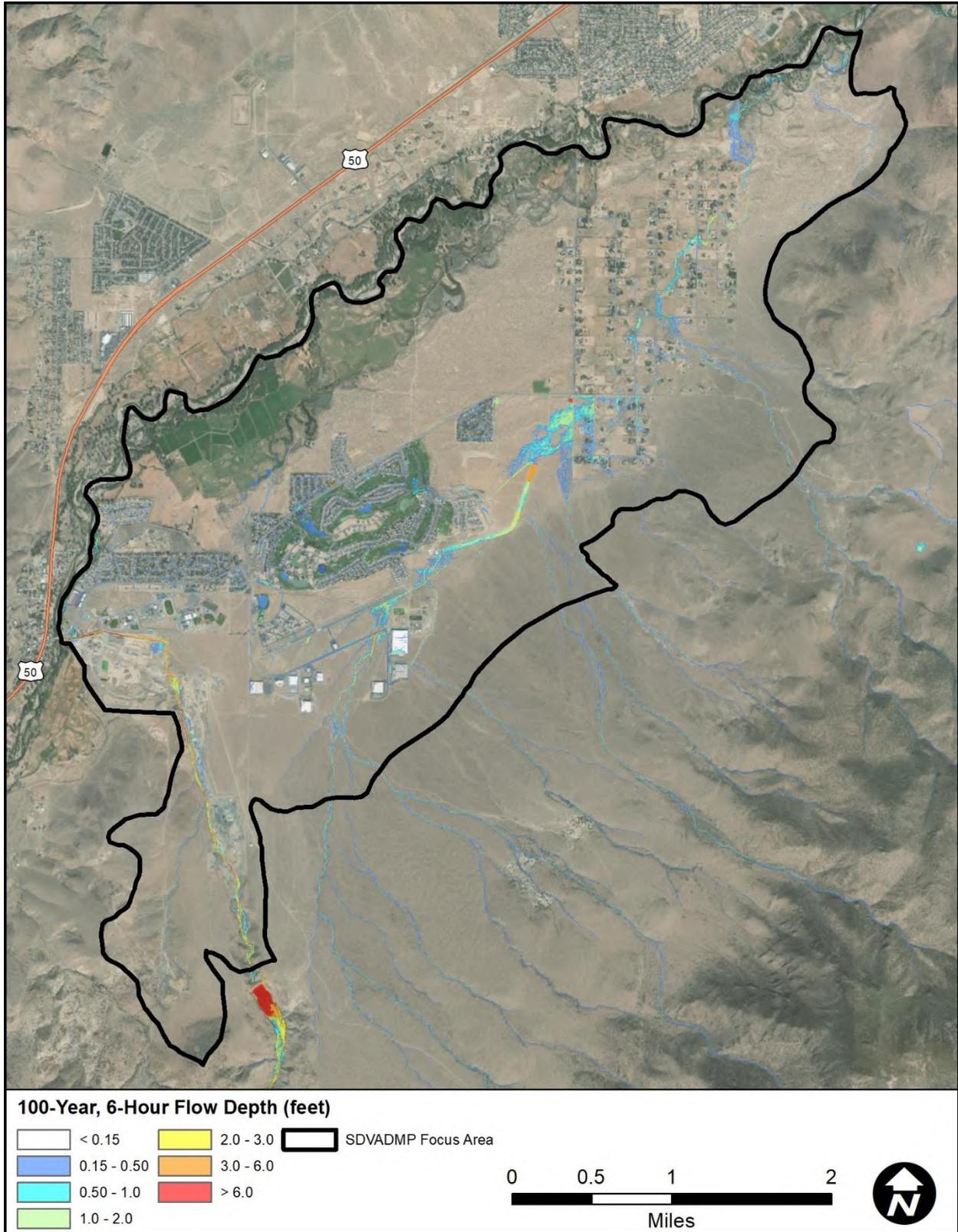


Figure 2-2. Existing conditions 100-year, 6-hour flow depth results

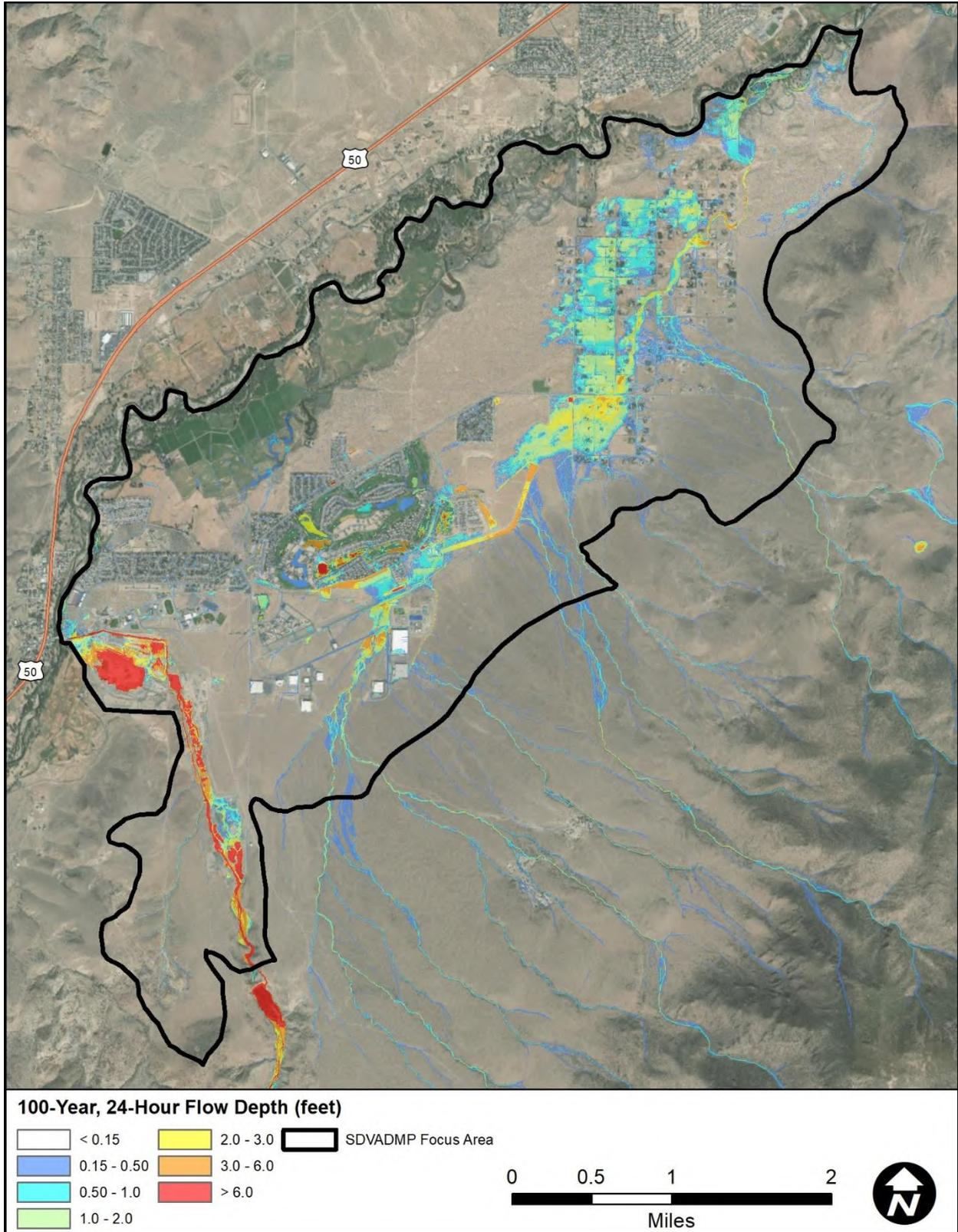


Figure 2-3. Existing conditions 100-year, 24-hour flow depth results

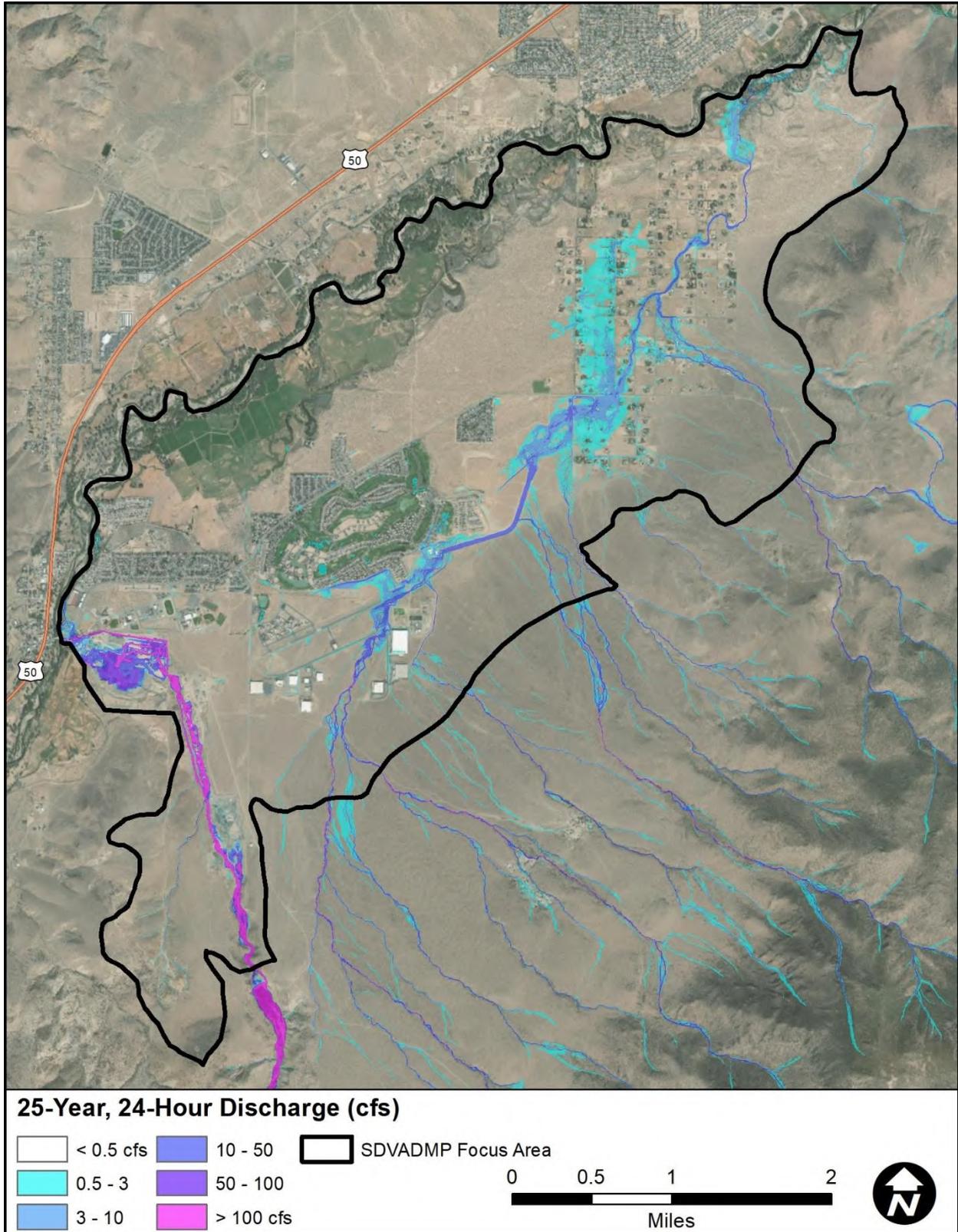


Figure 2-4. Existing conditions 25-year, 24-hour discharge results

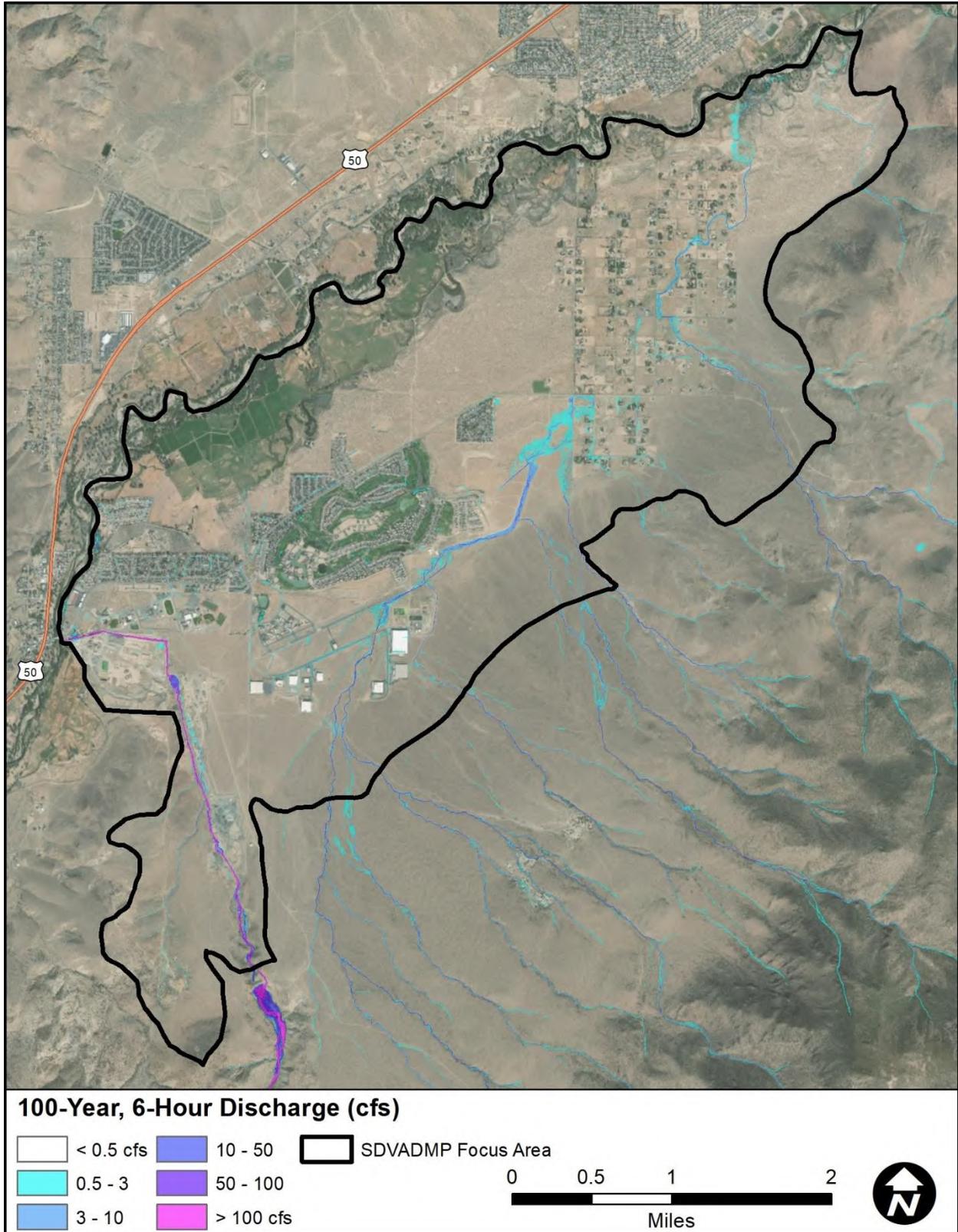


Figure 2-5. Existing conditions 100-year, 6-hour discharge results

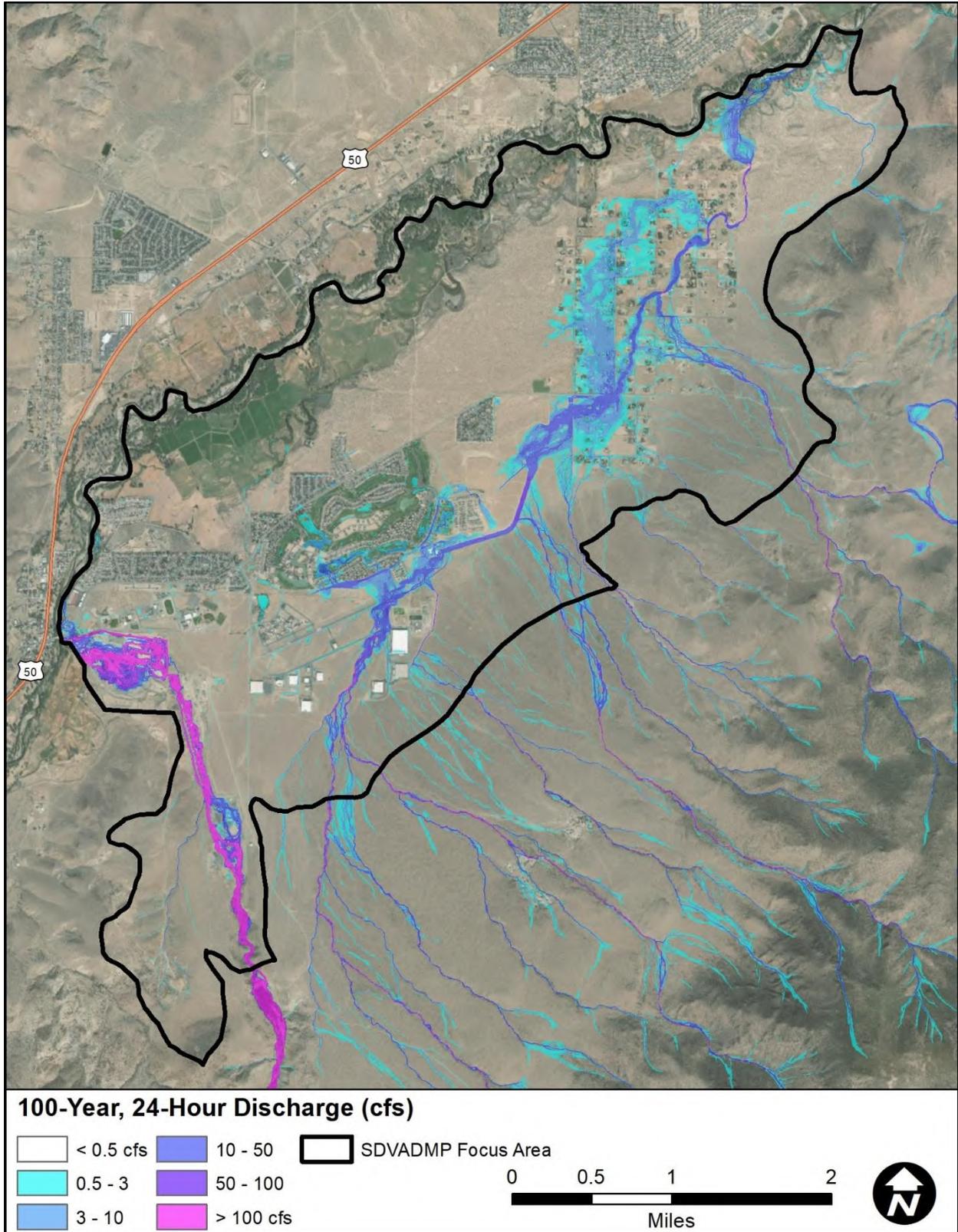


Figure 2-6. Existing conditions 100-year, 24-hour discharge results

2.4 VERIFICATION OF RESULTS

Model verification was conducted using the following sources:

- USGS Regression Equations
- County staff experience
- Resident flooding experience (photographs and videos)
- Eldorado Canyon Dam Hydraulic Modeling

2.5 SUMMARY

The existing conditions FLO-2D models were created using the best available information for land cover, land use, topography, and hydrology. Every effort was made to ensure the models represented existing conditions as of the date of the LiDAR survey and the NEXTMap data. However, the NEXTMap did not provide near the resolution of the LiDAR data, and areas along the LiDAR/NEXTMap seam were smoothed to prevent erroneous ponding. Therefore, flow patterns and peak discharges in areas within the NEXTMap limits should be verified before being used for future projects.

Photographs and anecdotal information collected from both Lyon County and the residents within the community were used to help calibrate and verify the modeling results. Like all models, the SDVADMP FLO-2D models are a simulation of potential conditions that could occur during a range of storm events. The models cannot exactly duplicate actual, observed storm events at all locations within the community due to the vast number of variables that change with each unique storm event.

The modeling results reflect the complex flooding and sedimentation hazards that exist within the South Dayton Valley study area. The results provide valuable, quantitative, detailed information from which future planning and development decisions can be based. The existing conditions models also serve as a foundation from which potential mitigation alternatives can be assessed (Section 5).

Although the ADMP FLO-2D modeling effort was not intended to replicate an actual historical flood event, the comparison of the modeling results with USGS regression equations, anecdotal flood information, and independent hydraulic calculations indicate the project FLO-2D models suitably depict storm runoff conditions – indicating that the underlying input parameters are reasonable. Given the distributary nature of the flooding within the community, and the high sediment transport rates (see Section 5), flooding characteristics (e.g., depth, discharge, location) are likely to change from one flood event to the next. Even small anthropogenic changes to the landscape (e.g. dirt piles, berms, construction of outbuildings, landscaping debris piles, etc.) will result in sediment accumulation, channel scour, and changes in flowpath directions that may not be represented in the project FLO-2D modeling. In other words, the results of the modeling represent potential flooding conditions as of the date of the project topographic mapping. Updated mapping and FLO-2D modeling are recommended if major changes to the landscape occur in the future.

3 SEDIMENTATION ANALYSES

3.1 SEDIMENT SAMPLING AND TRANSPORT ANALYSES

The Sedimentation Analyses included the following major elements:

- 12 sediment samples collected, and gradation curves developed.
 - Median D50 grain size was 6.4 mm.
 - Average D50 grain size was 12.0 mm.
- Sediment Transport Analysis

3.2 SEDIMENT TRANSPORT ANALYSES

The FLO-2D hydraulic modeling was used to assess the trends of both flooding and sedimentation throughout the study area. Hydraulic data from FLO-2D inherently includes both discharge and flow depth at each grid element. This hydraulic data was used to estimate sedimentation using the Yang sediment transport equation (1973, 1984) on a cell-by-cell scale. For this study, only the Yang equation was calculated based on the results of the analyses from the previous Dayton Valley ADMP.

For each modeled storm event, the total accumulated (i.e., throughout the entire storm event) sediment transport capacities were calculated at each cell. These accumulated capacities can identify areas where deposition or scour may be expected.

3.3 RESULTS

Since the total accumulated transport is calculated at each cell, an overall map of the study area with sediment transport capacities can be produced similar to the FLO-2D results presented in Section 3. Since the 100-year, 24-hour storm produces the largest amount of flow and sediment, it is used as a representative example. The relative total accumulated sediment transport within the focus area calculated with the Yang equation is shown in Figure 3-1. Note - The colors in both these figures represent relative transport capacity to each other, so green is relatively low compared to red, but green is higher than areas without color.

In general, the results are straightforward. Higher sediment transport rates appear in the channels, while lower rates appear as the flow spreads out over the piedmont. Unsurprisingly, the Eldorado Canyon produces the most sediment because it has the largest drainage area with the longest drain time. Finally, since these sediment results are based on hydraulic conditions, off-site inflows are considered because inflow hydrographs have been input at all major watercourses through the upstream FLO-2D modeling.

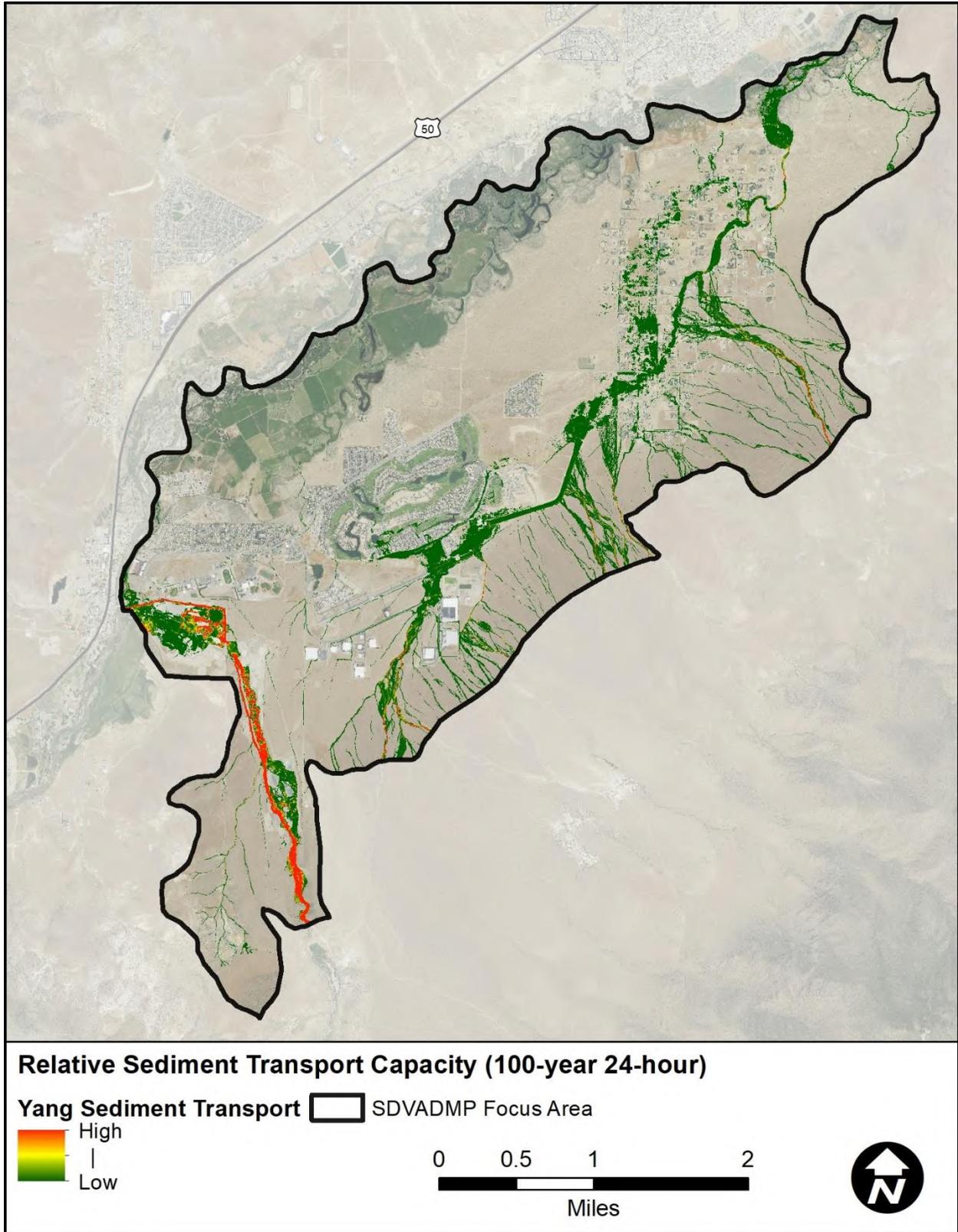


Figure 3-1. Total accumulated sediment transport capacity by the Yang methodology for the 100-year, 24-hour event

3.3.1.1 Sediment Profiles

A sediment transport profile was developed for the major overland flow path within SDVADMP focus area because alternatives will most likely be developed to control this overland flow. Conversely, since Eldorado Canyon is contained within its channel throughout the focus area and does not cause major flooding problems, a profile was not developed for this watercourse. As before, the 100-year 24-hour event is used as the representative example.

To develop these profiles, the total accumulated sediment transport through each station (or cross-section) over the entire storm event was calculated for the Yang equation. This transport profile was plotted and is shown in Figure 3-2.

In this study, these profiles were used in two ways. First, the profiles can be used to identify areas where sediment transport is not in equilibrium or out of balance. This is important because when the sediment transport is out of balance, erosion (degradation) or deposition (aggradation) is occurring within the wash. When sediment transport is increasing (i.e., the slope change is positive), the wash is gathering sediment through degradation. Conversely, when the sediment transport profile is decreasing, and the slope change is negative, the wash is losing sediment through aggradation.

Areas where there can be significant erosion or deposition are highlighted on the profile. The leftmost (or upstream) depositional area occurs where flow exits the confined mountain channels and distributes over a larger area on the piedmont. Below this area, sediment transport significantly decreases until the main flow path becomes confined again near station 5000. Downstream of station 5000, flow spreads out over an agricultural field where sediment transport decreases. These results are consistent with what would be expected given those hydraulic conditions.

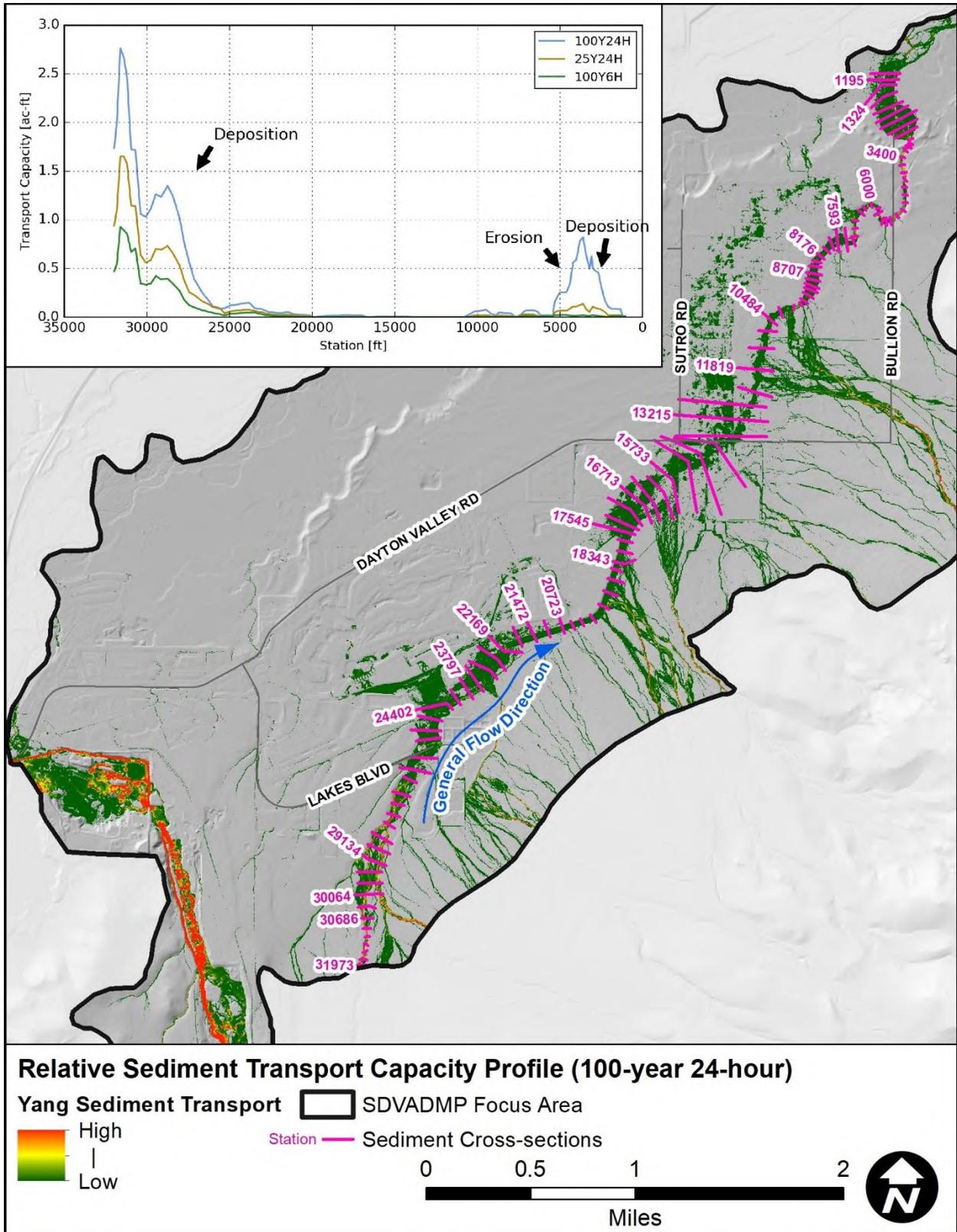


Figure 3-2. Cumulative sediment transport profile for the primary overland flow path throughout the 100-year 24-hour event

4 FLOOD HAZARD CLASSIFICATION

4.1 HAZARD RESULTS

Flood hazards were defined based on the physical characteristics of the flood water: location, depth, and velocity. The results from the hazard assessments are included below:

- Flooding hazards to pedestrians (Figure 4-1)
- Flooding hazards to vehicles (Figure 4-2)
- Flooding hazards at specific roadway crossings
 - 25-year, 24-hour storm (Figure 4-4)
 - 100-year, 24-hour storm (Figure 4-3)
- Flooding hazards to buildings (Figure 4-5)
- Building inundation assessment (Figure 4-6)

These analyses help identify areas that have a higher risk of flooding and which property and infrastructure are most susceptible to damage. Having this information helps focus the mitigation alternative to areas where they are most needed.

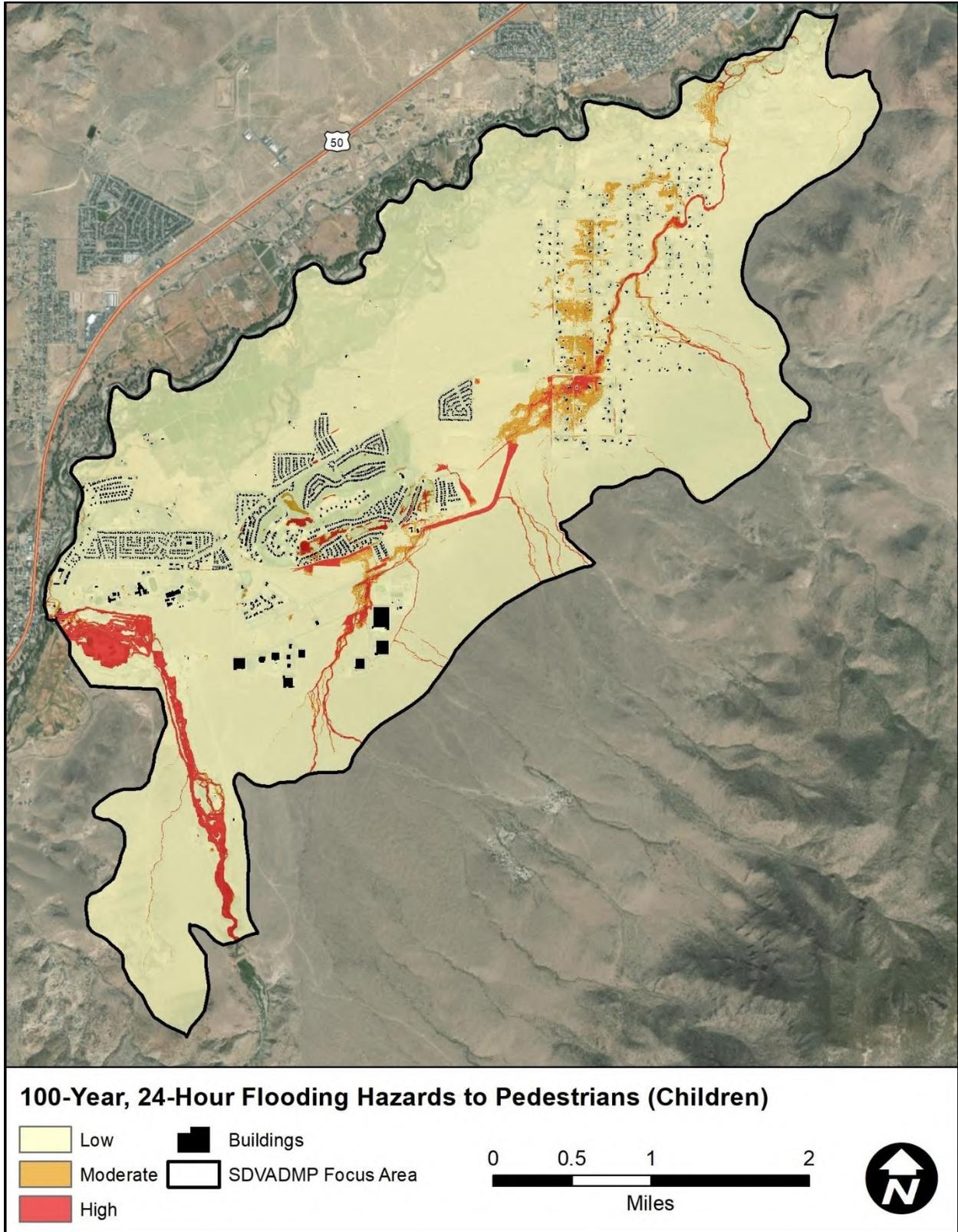


Figure 4-1. USBR criteria flooding hazards to pedestrians based on the 100-year, 24-hour results

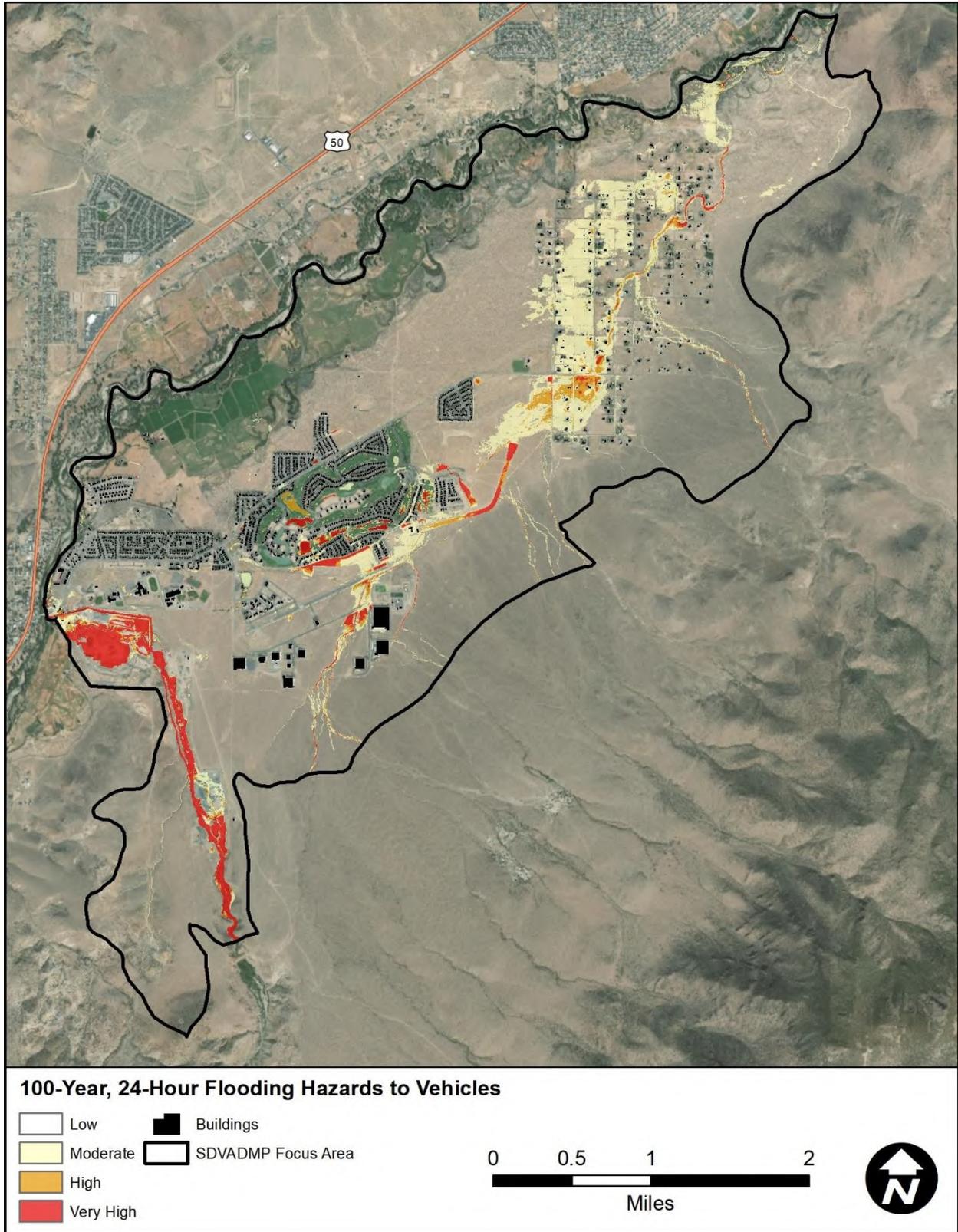


Figure 4-2. USBR criteria flooding hazards to vehicles based on the 100-year, 24-hour results

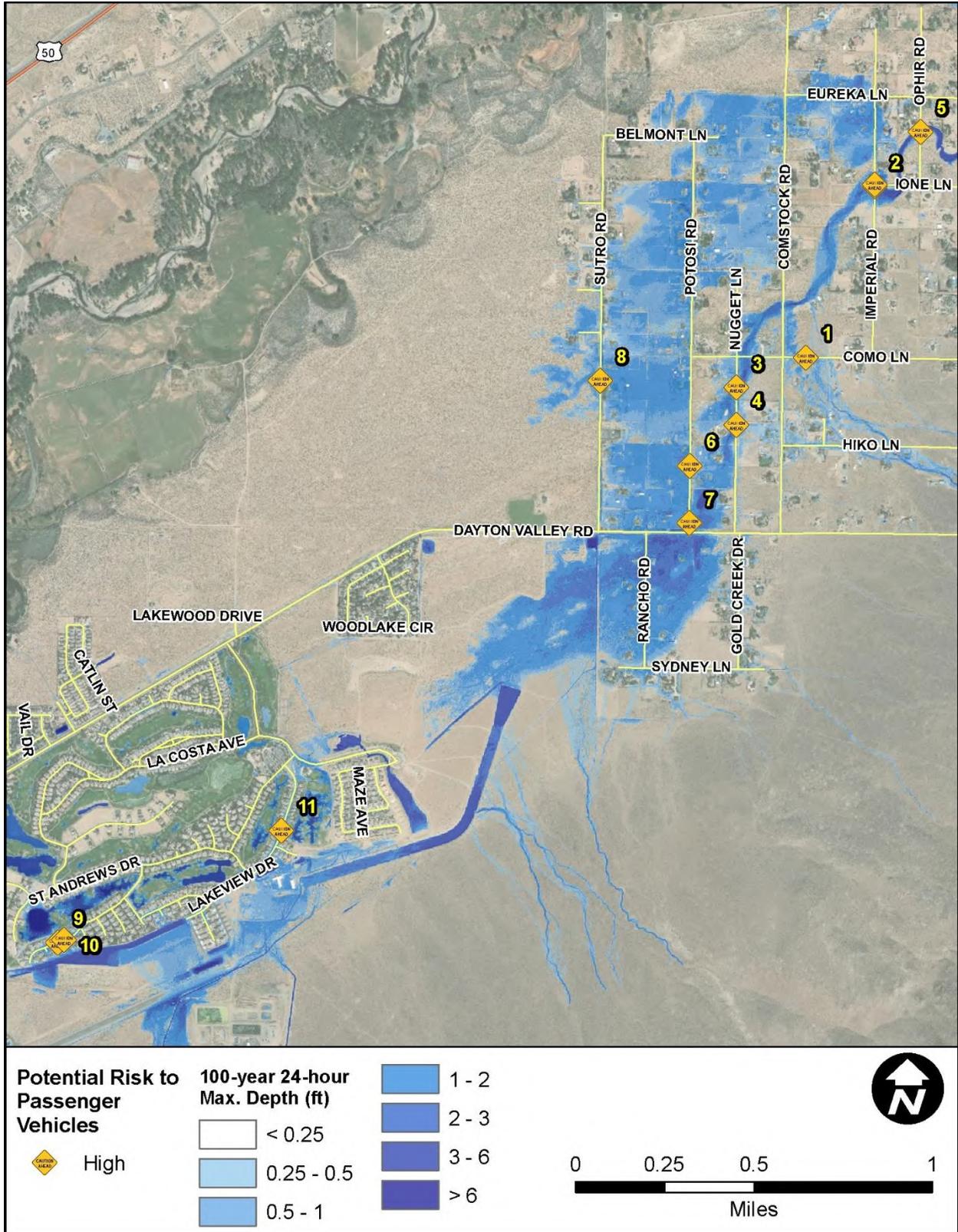


Figure 4-3. Hazardous road crossings during a 100-year, 24-hour storm (USBR criteria)

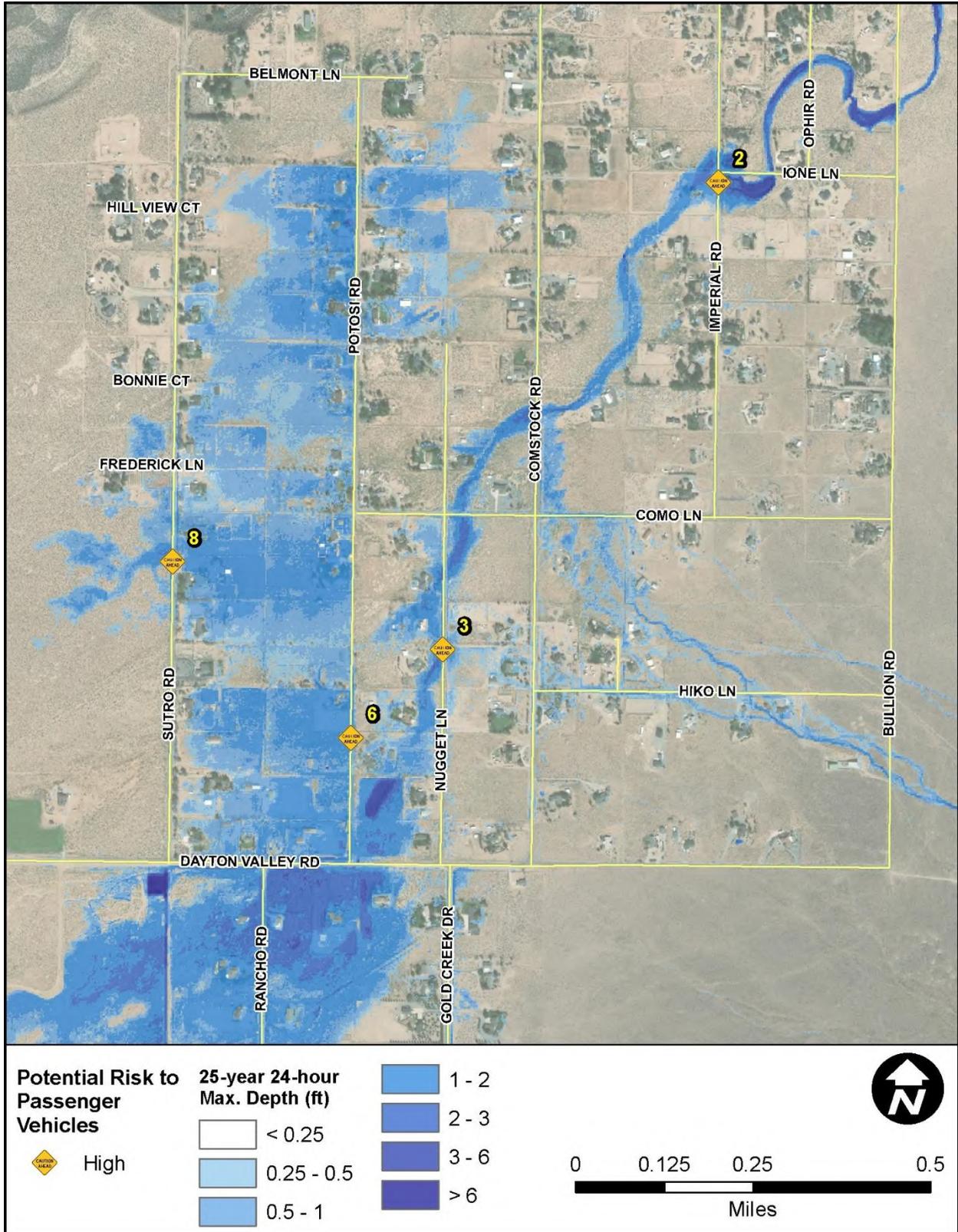


Figure 4-4. Hazardous road crossings during a 25-year, 24-hour storm (USBR criteria)

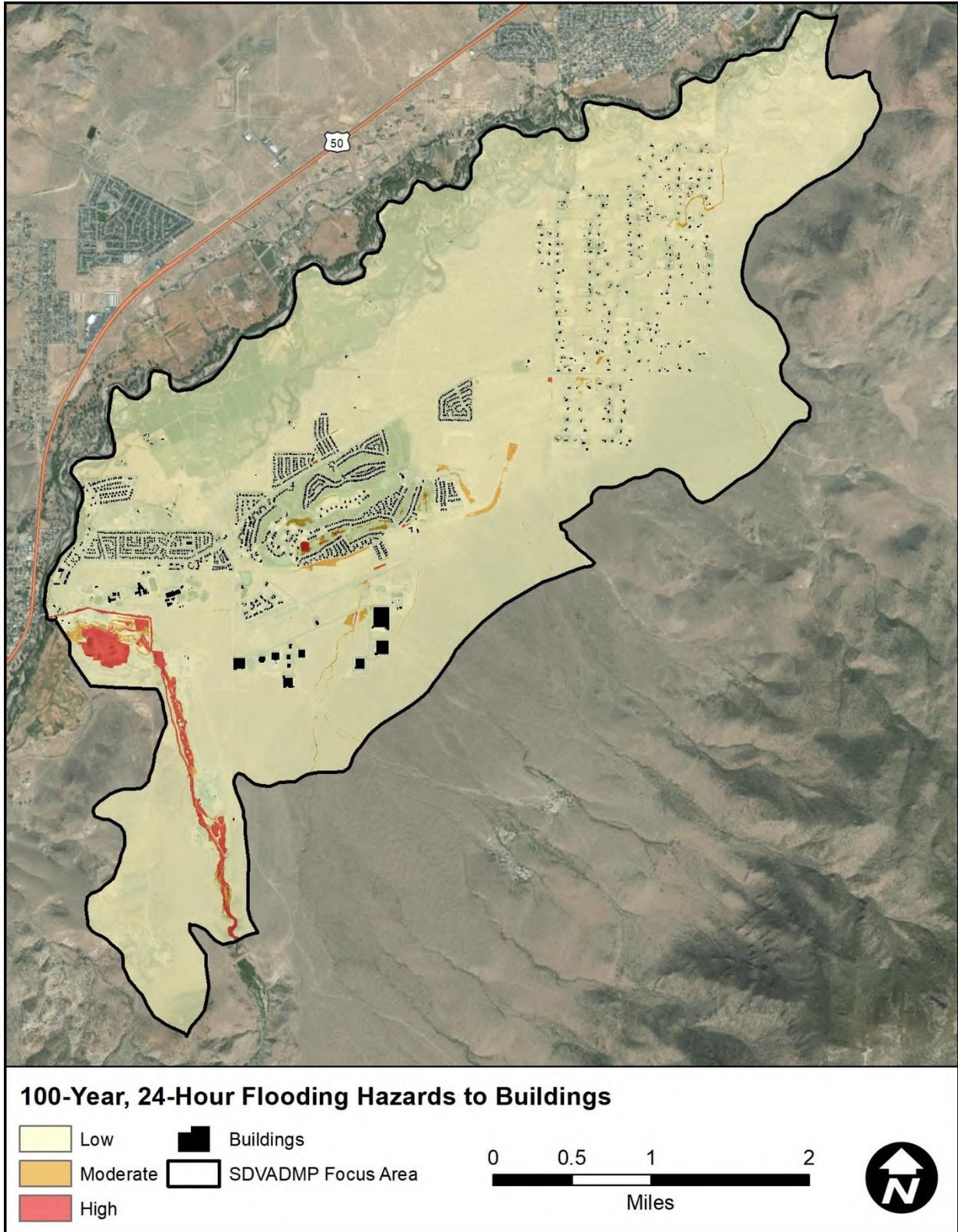


Figure 4-5. USBR criteria flooding hazards to buildings based on the 100-year, 24-hour results

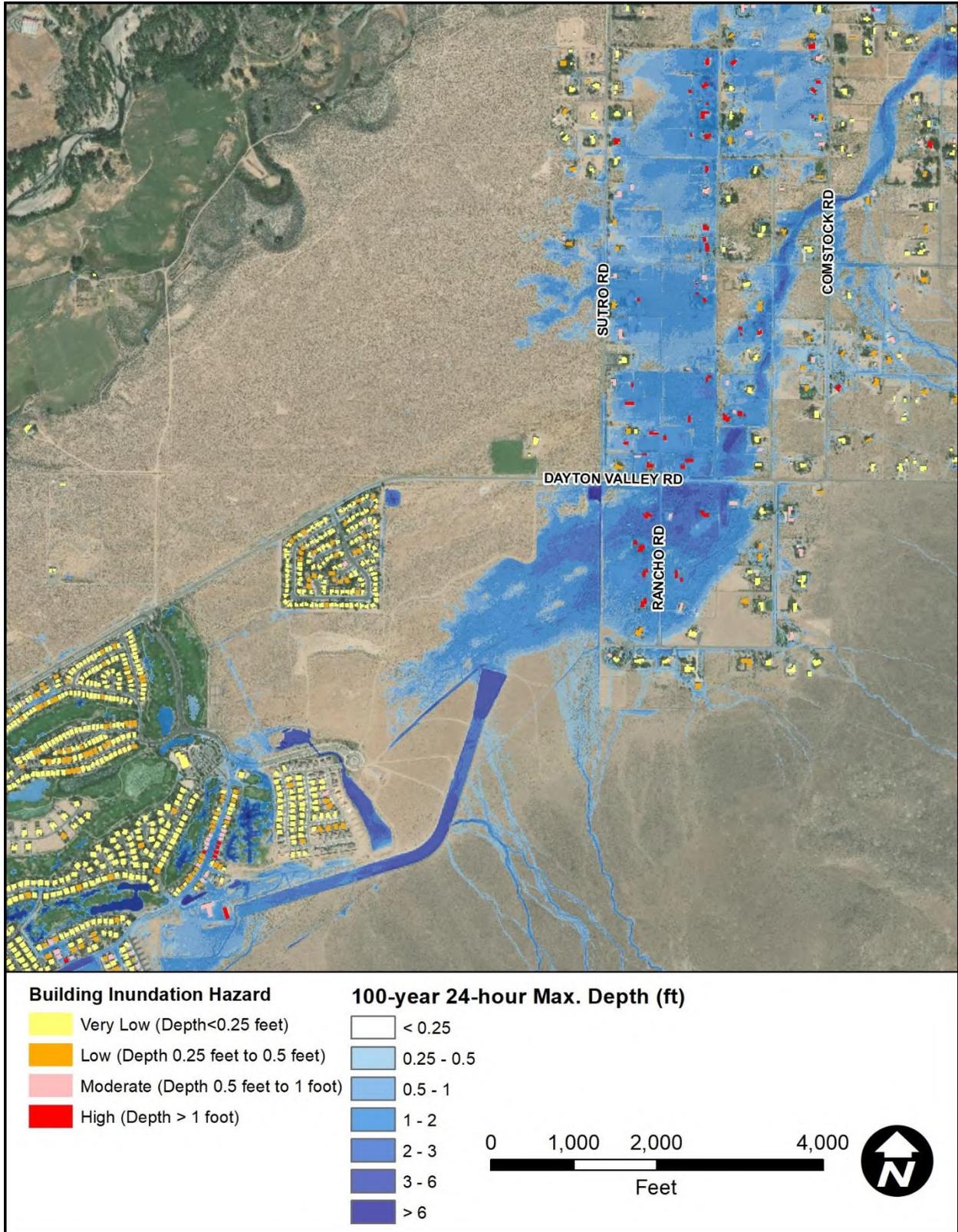


Figure 4-6. Building inundation assessment (100-Year, 24-Hour) result example

4.1.1 HAZUS Analysis Results

FEMA’s HAZUS program² is a standardized computer software package that automates FEMA’s methodology for estimating potential economic losses and human displacement due to natural disasters such as earthquakes, floods and hurricanes. For flood related losses, HAZUS has the capability to perform varying levels of analyses that are distinguished primarily on the amount of user provided data. A Level 1 analysis is primarily based on generalized data provided with the software and rudimentary estimations of hydrology and flood depths to estimate flood risk. A Level 2 analysis blends user generated data with software data. A Level 3 analysis primarily uses all user generated input data. The analysis performed in this study would be considered a simple Level 2 since more detailed flood risk data (flood depth grids from FLO-2D) has been generated external to the model and imported for use in conducting the loss analyses. A results summary is presented as Table 4-1. From these results, the 100-year 24-hour storm event causes significantly more damage than the other storms. Additionally, the 25-year 24-hour event causes more damage than the 100-year 6-hour storm, which is surprising but not unreasonable given the magnitudes of the precipitation in this region.

Table 4-1. Summary of flood damage estimates (base conditions)

Base Conditions					
Recurrence Interval	Direct Building Economic Loss				
	Residential	Commercial	Industrial	Others	Total Property¹
	\$ millions	\$ millions	\$ millions	\$ millions	\$ millions
25Y24H	2.68	0.21	0.45	0.43	3.77
100Y24H	5.93	0.36	0.69	0.67	7.65
100Y6H	0.78	0.05	0.08	0.06	0.97
1. May not be additive due to rounding in internal HAZUS calculations					

² HAZUS-MH 4.2 (<https://msc.fema.gov/portal/resources/hazus>)

5 REGIONAL FLOOD MITIGATION ALTERNATIVES

5.1 INTRODUCTION

The development of the regional alternatives comprised the following elements:

- 1) Drainage improvement assessment for the Ranchos area
- 2) Flood hazard identification
- 3) Alternative formulation/evaluation
- 4) Development of conceptual 15% design plans and cost estimates for the selected mitigation alternative

5.2 MITIGATION ALTERNATIVES

The consultant team developed three mitigation alternative systems that were presented to Lyon County. Each system was comprised of a series of sediment/detention basins and collector/conveyance channels in various configurations that would result in significant mitigation of offsite flooding to the South Dayton community.

5.2.1 Alternative 1

Alternative 1 was initially proposed as six sediment/detention basins located at the major offsite drainage channels on the lower piedmont. The basins would be connected to a collector/conveyance channel that spanned the entire length of the piedmont and drained to the Carson River east of the South Dayton community (Figure 5-1).

5.2.2 Alternative 1a

Alternative 1a is comprised of five sediment/detention basins, a series of collector/conveyance channels, and proposed improvements to existing drainage infrastructure (Figure 5-2). Three basins would be located south of the airport commercial district and would collect and pass offsite runoff to a conveyance channel that would flow to the northwest and empty into the main channel of El Dorado Canyon. A separate collector channel would be constructed southeast of the airport commercial district and would be incorporated into the existing drainage channel to the east of the commercial district. The existing channel would need to be improved to collect and convey the storm runoff. A new conveyance channel would need to extend from the existing channel to the existing regional detention basin east of the Dayton Valley Golf Course community. The existing basin would also need to be improved to safely detain and convey the storm runoff. A new conveyance channel would extend from the existing basin outlet across Dayton Valley Road and north to the Carson River.

To mitigate offsite flows from east of the Ranchos area, a single sediment/detention basin would be located on the main drainage corridor and would connect to a collector/conveyance channel that would extend directly north and connect to the existing channel that exists the Ranchos development. The existing channel would require improvements to convey the storm runoff directly north to the Carson River.

5.2.3 Alternative 1b

Alternative 1b incorporates all the structure elements of 1a except for the conveyance system downstream of the existing regional basin. The 1b system includes a conveyance channel from the basin

outlet to Dayton Valley Road, then extends south of the road to the existing drainage channel that flows through the Ranchos development (Figure 5-3). A new culvert at Dayton Valley Road would allow the flow to pass beneath the road to the existing channel. The ADMP hydraulic modeling results indicate a section of the existing channel does not have capacity to convey the offsite flow, thus channel improvements would be necessary. The existing channel alignment through the Ranchos intersects many individual private parcels.

5.2.4 Summary

Figure 5-1 through Figure 5-3 illustrate the conceptual layout of each alternative system. Land ownership within the alternative areas is either Private or Bureau of Land Management (BLM). The land ownership boundaries are shown in the figures.

Table 5-1 provides a summary of the alternatives and the key opportunities and constraints that were presented to Lyon County to aid in their decision in selecting a preferred alternative system to advance to the conceptual design phase of the ADMP.

Table 5-1. Alternative comparison summary

Alternative System	Structure Elements	Opportunities	Constraints	Preliminary Cost Estimates
1	<ul style="list-style-type: none"> • New Sediment/Detention Basins • New Collector/Conveyance Channel 	<ul style="list-style-type: none"> • Regional mitigation solution • Minimal private land right-of-way acquisition needed • Construction/design with regional future bypass road could result in significant cost savings 	<ul style="list-style-type: none"> • Coordination with BLM • Coordination and approval needed from 6 private parcel owners 	<p>25-yr: \$28.2 million 100-yr: \$44.0 million</p>
1a	<ul style="list-style-type: none"> • New Sediment/Detention Basins • New Collector/Conveyance Channels • Improvements to existing drainage channels • Improvements to existing regional detention basin 	<ul style="list-style-type: none"> • Regional mitigation solution • Utilizes existing drainage infrastructure 	<ul style="list-style-type: none"> • Coordination with BLM • Significant private right-of-way area needed • Coordination and approval needed from 20 private parcel owners 	<p>25-yr: \$33.5 million 100-yr: \$37.3 million</p>
1b	<ul style="list-style-type: none"> • New Sediment/Detention Basins • New Collector/Conveyance Channels • Improvements to existing drainage channels • Improvements to existing regional detention basin • Upgrade 8 existing culverts 	<ul style="list-style-type: none"> • Regional mitigation solution • Utilizes existing drainage infrastructure 	<ul style="list-style-type: none"> • Coordination with BLM • Significant private right-of-way area needed • Coordination and approval needed from 52 private parcel owners 	<p>25-yr: \$30.5 million 100-yr: \$34.9 million</p>

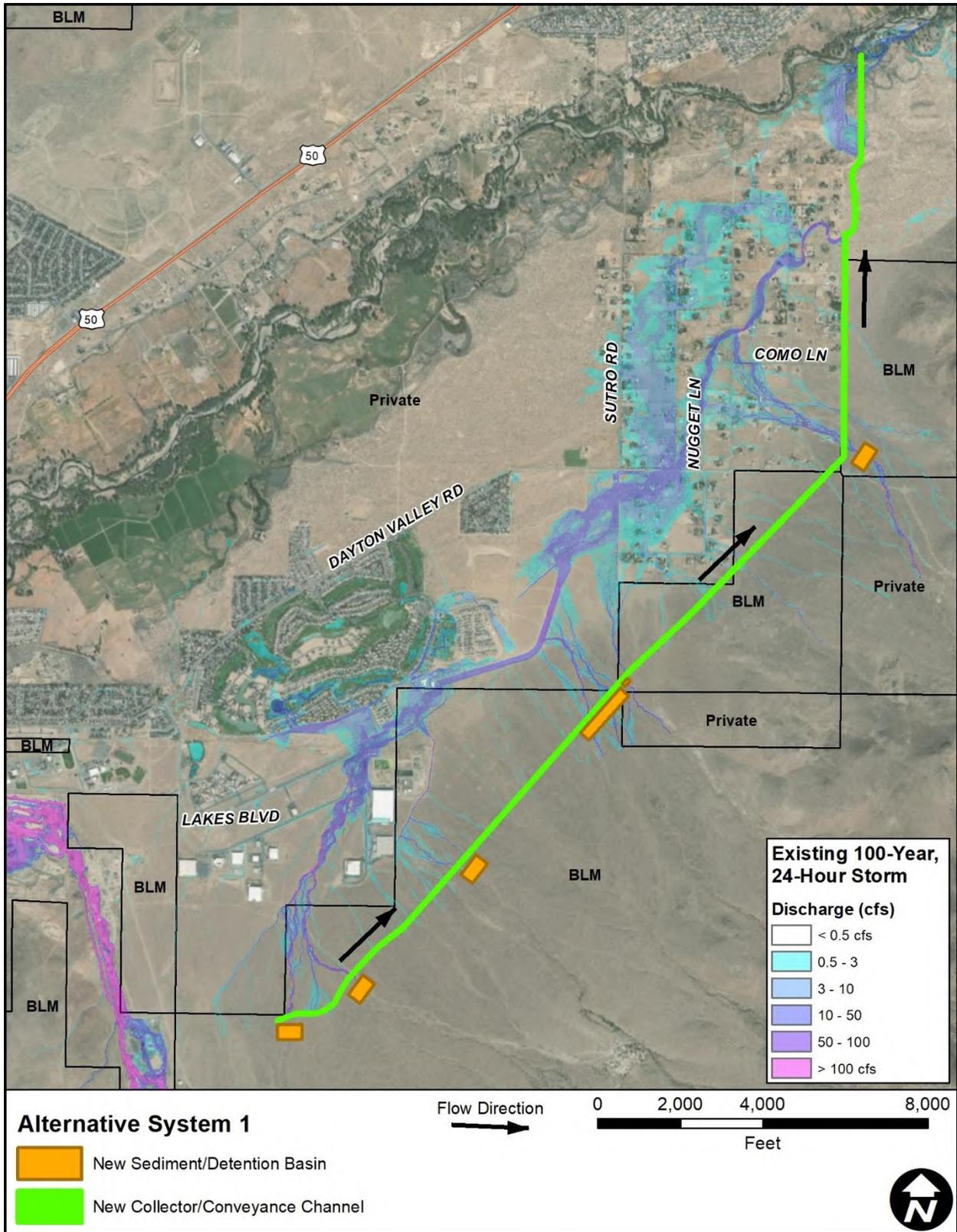


Figure 5-1. Conceptual layout of Alternative 1

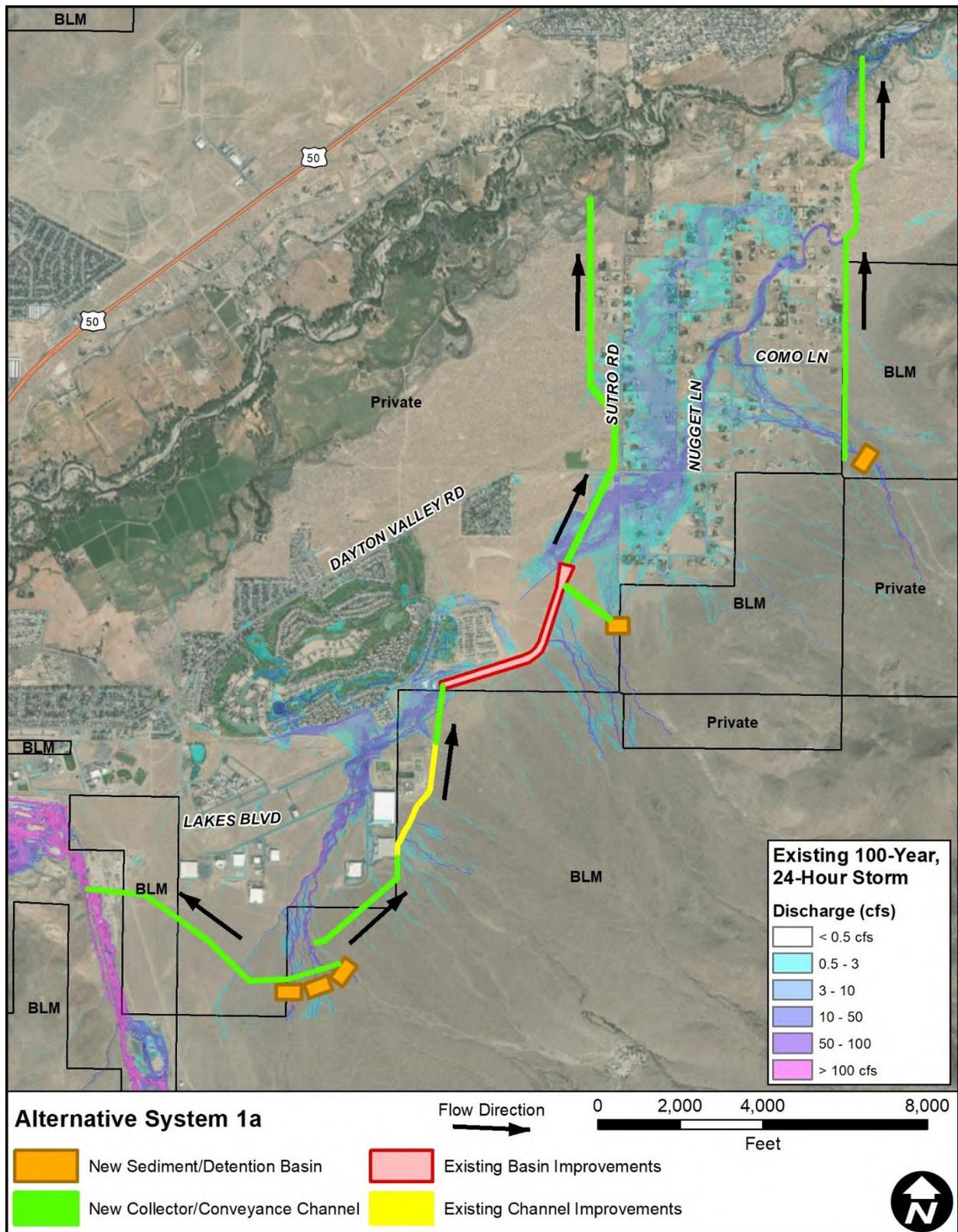


Figure 5-2. Conceptual layout of Alternative 1a

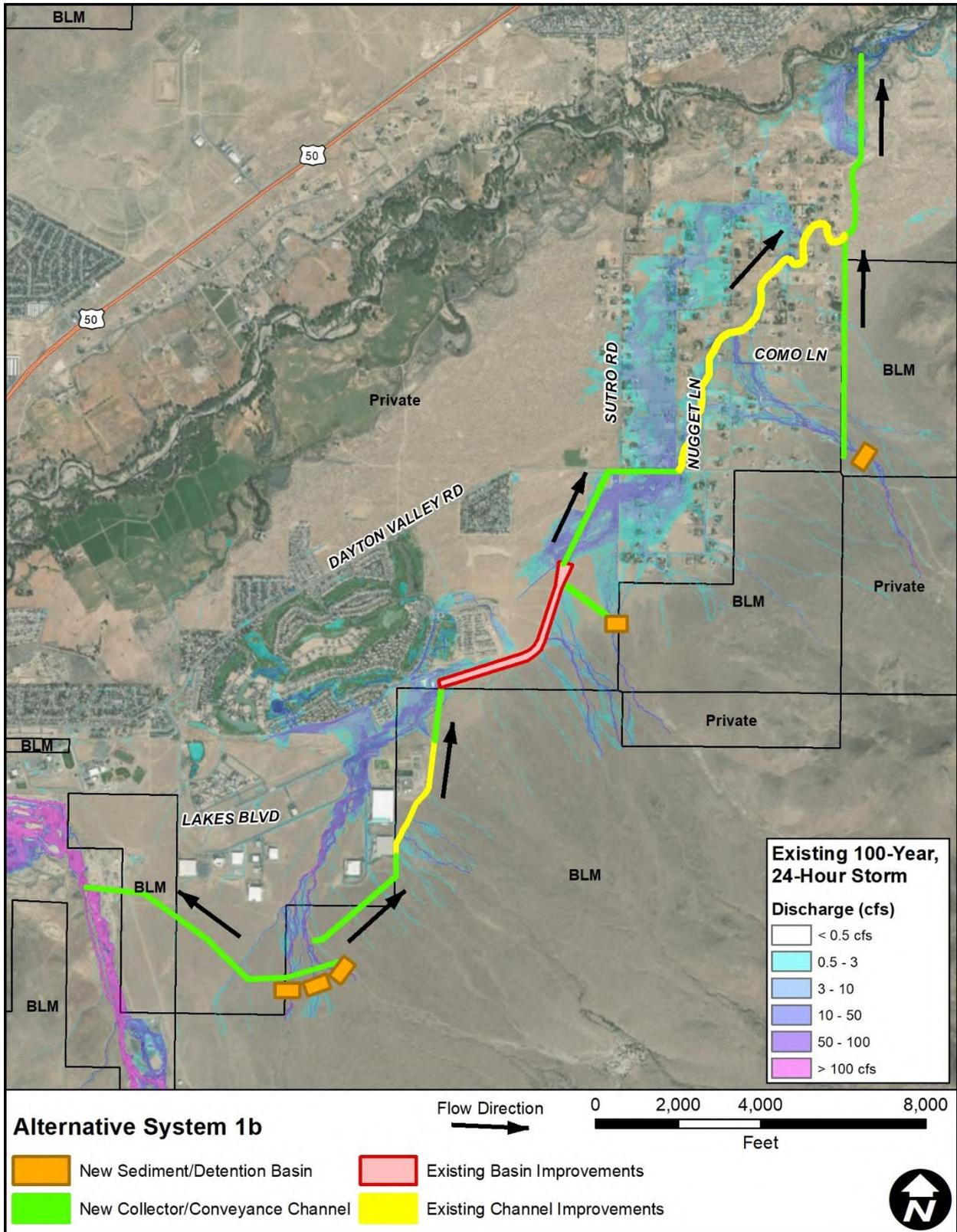


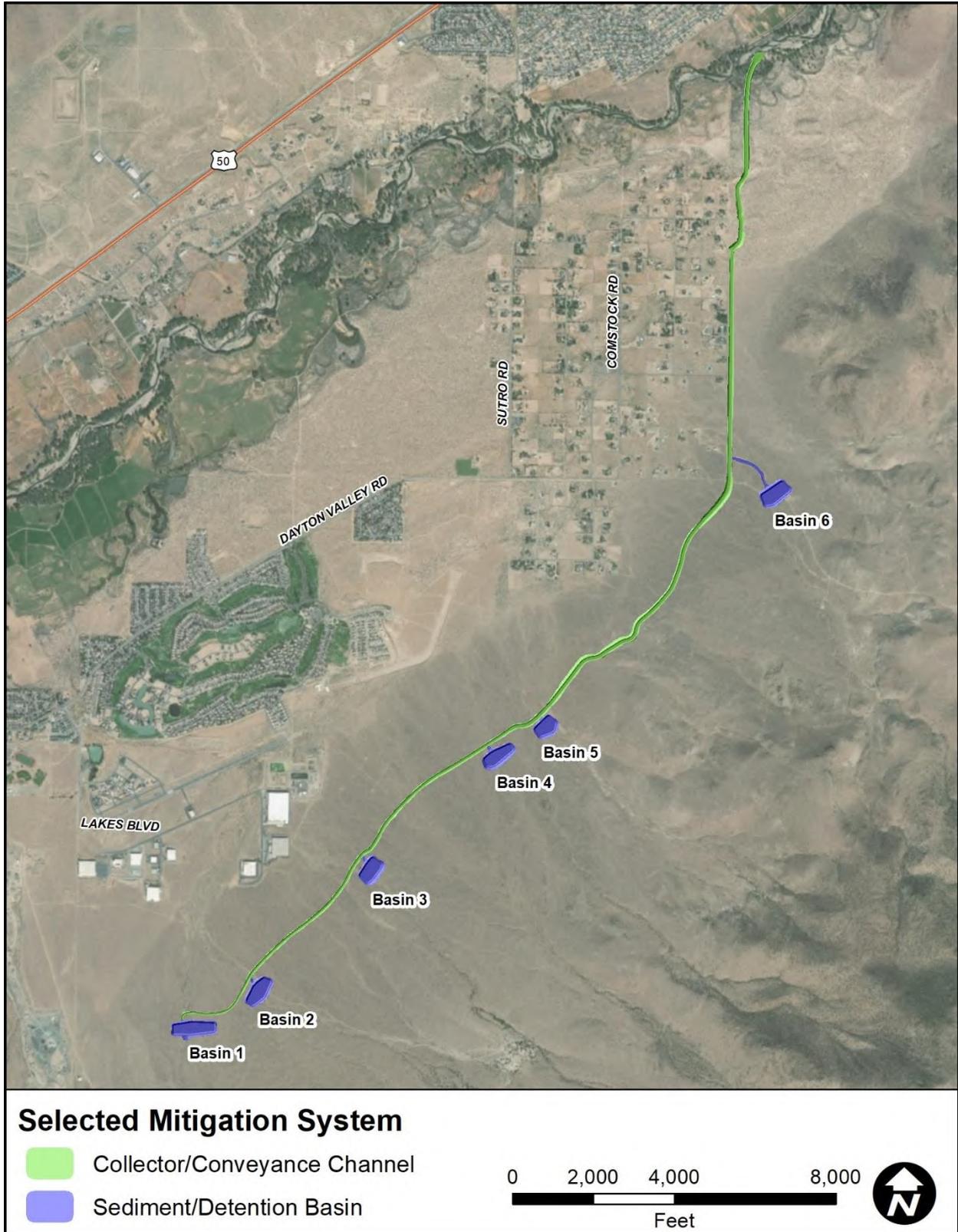
Figure 5-3. Conceptual layout of Alternative 1b

5.3 SELECTED REGIONAL MITIGATION ALTERNATIVE

Lyon County selected Alternative System 1 to advance to the concept phase of the ADMP. The final system concept is comprised of six sediment/detention basins and one collector/conveyance channel that spans the length of most of the Pine Nut Mountain piedmont that drains to South Dayton (Figure 5-4). The consultant team developed proposed mitigation structures for both the 100-year and 25-year storms to assess which would provide the most overall benefit. There were many considerations that led to the selection of the alternative system. A few of the most significant are:

- Provides a regional solution that mitigates most of the offsite flood risk to the South Dayton community.
- The Lyon County Comprehensive Master Plan³ includes a proposed South Dayton Bypass Road that could parallel the proposed conveyance channel, resulting in significant cost savings if constructed concurrently with mitigation system; or at least each project is designed and constructed with the other project in mind.
- The basins and channel are located primarily on public land which would minimize the number of private landowners involved in acquiring property right-of-way to construct and maintain the system.

³ <https://www.lyon-county.org/773/Comprehensive-Master-Plan>



5.3.1.1 Sediment Considerations for Proposed Alternatives

The Yang sediment transport estimates were used in the development of the 15% design alternatives. Three times the annual sediment transport volume plus one design event (100-year or 25-year) sediment transport volume was used as the total sediment volume for each basin. The total sediment design volumes for the proposed flood mitigation basins are summarized in Table 5-2.

It should be noted that sediment throughput calculations exhibit wide variability based on the transport equation used, grain size of the sediment, watershed slope, and many other variables. Similarly, since the hydraulic calculations are the backbone of any sediment calculation, infiltration volumes and Manning's n values also affect total sediment volumes. Therefore, most analyses in this study were taken on a relative basis – that is the absolute values are not precise. However, the sediment basins need a calculated design volume; and, in this case, appropriate safety factors were incorporated in the analyses. Nonetheless, detailed analysis of a basin's specific watershed is recommended to refine the expected sediment volumes for final design.

Table 5-2. Sediment design volumes

Basin Name*	25-Year Sediment Storage Volume (ac-ft)	100-Year Sediment Storage Volume (ac-ft)
Basin 1	0.8	1.2
Basin 2	0.6	1.0
Basin 3	0.7	0.8
Basin 4	0.5	0.9
Basin 5	0.2	0.3
Basin 6	1.8	2.5
*The basins listed in this table represent proposed mitigation structures that are part of the selected mitigation alternative		

5.4 RANCHOS DRAINAGE IMPROVEMENT ASSESSMENT

The purpose of this task was to provide a concept drainage improvement assessment specific to the Ranchos area. This analysis included major roadway crossing improvements (excluding driveway culverts) within the Ranchos area that could potentially reduce offsite flood risk to the community even if the regional mitigation alternatives were not implemented.

As part of the ADMP, the consultant team prepared a concept that would improve drainage through the Ranchos community, exclusive of the regional mitigation structures in the selected alternative. The concept elements included:

- Conveyance Channel
- Existing Channel Improvements
- Culvert Improvements

5.4.1 Cost Estimates

Approximate cost estimates for each of the concept elements are listed in Table 5-3. These costs were developed based on the cost per lineal foot basis that Lumos developed for use on the regional alternatives (see Appendix B of the main report). Therefore, this estimate does not consider the cost of right-of-way (ROW) acquisition or drainage easements.

Table 5-3. Drainage improvement concept cost estimates

Mitigation Concept	100-Year Storm Cost Estimate
New Conveyance Channel & Existing Channel Improvements	\$6,100,000
New Culverts (9 total)	\$1,300,000
Total	\$7,400,000

5.5 SELECTED REGIONAL ALTERNATIVE CONCEPTUAL 15% DESIGN PLANS

Lumos was tasked with developing conceptual, 15% design plans for the mitigation alternative for the 25-year and 100-year storms. The Lumos plan sets and accompanying technical report are included in Appendix B of the main report. An example design plan excerpt is shown in Figure 5-5. These concept designs are meant to outline costs and general characteristics of the proposed structures to allow for recommendation and prioritization. The design volumes, structure alignments, and other characteristics should be refined during final design. There may be constraints such as utility conflicts uncovered during Final Design that are outside the scope of this study.



Figure 5-5. Example 15% design plan sheet for Basin #2

5.6 BENEFITS SUMMARY

5.6.1 Buildings Benefit

The depth and HAZUS analyses that were performed for existing conditions (Section 4) were repeated for the proposed conditions model results. The analyses were run using two scenarios for each of the three storm events for a total of six proposed conditions models. The scenarios were:

- 1) All 25-year proposed structures in place, and
- 2) All 100-year proposed structures in place

The proposed conditions building flood risk and HAZUS analyses are summarized in Table 5-4 and Table 5-5. The last column in the tables show the estimated benefit for each storm event when compared to existing base conditions for that same storm event.

Table 5-4. Summary of buildings removed from potential inundation

Recurrence Interval Storm	Proposed Conditions Building Counts				Existing Conditions Building Count	Buildings Removed (Benefit)
	Building Count Flow Depth	Building Count Flow Depth	Building Count Flow Depth	Total Building Count		
	0.25' < h ≤ 0.5'	0.5' < h ≤ 1'	1' < h			
Proposed Conditions (25-year System)						
25Y24H	314	47	12	373	445	72
100Y24H	351	80	27	458	580	122
100Y6H	432	53	7	492	499	7
Proposed Conditions (100-year System)						
25Y24H	314	47	12	373	445	72
100Y24H	345	62	15	422	580	158
100Y6H	432	53	7	492	499	7

Table 5-5. Summary of flood damage estimates and potential benefits

Recurrence Interval Storm	Direct Building Economic Loss					
	Residential	Commercial	Industrial	Others	Total Property ¹	Total Benefit
	\$ millions	\$ millions	\$ millions	\$ millions	\$ millions	\$ millions
Base Conditions						
25Y24H	2.68	0.21	0.45	0.43	3.77	-
100Y24H	5.93	0.36	0.69	0.67	7.65	-
100Y6H	0.78	0.05	0.08	0.06	0.97	-
Proposed Conditions (25-year System)						
25Y24H	1.19	0.07	0.09	0.01	1.36	2.41
100Y24H	2.53	0.22	0.39	0.35	3.49	4.16
100Y6H	0.56	0.04	0.03	0	0.63	0.34
Proposed Conditions (100-year System)						
25Y24H	1.16	0.07	0.07	0.01	1.32	2.45
100Y24H	1.76	0.13	0.13	0.08	2.11	5.54
100Y6H	0.56	0.04	0.03	0	0.63	0.34

1. May not be additive due to rounding in internal HAZUS calculations

5.6.2 Flood Risk Area and Flood Depth Reduction Benefit

The selected alternative would result in a significant reduction in flood risk area throughout South Dayton. To quantify this benefit, the total flood risk area for depths of 0.25 feet and greater was computed from the existing conditions FLO-2D model results for both the 25-year and 100-year storms and subtracted from the inundation area resulting from the selected alternative models. The results are listed in Table 5-6.

Table 5-6. Potential flood risk area reduction benefit

Recurrence Interval Storm	Flood Risk Inundation Area	Total Benefit
	Acres	Acres Removed from Flood Risk (depth < 0.25 feet)
Base Conditions		
25Y24H	770	-
100Y24H	1,165	-
Proposed Conditions (25-year System)		
25Y24H	347	423
100Y24H	751	414
Proposed Conditions (100-year System)		
25Y24H	337	433
100Y24H	501	664

5.7 FUTURE DESIGN CONSIDERATIONS

Preliminary FLO-2D modeling of the 15% design alternatives yielded items to be considered during final design:

- The dynamic nature of the upstream topography. Channels may shift, and new inlet locations may be needed.
- The overall sediment delivery to the Carson River should be analyzed in detail to ensure that the point source sediment delivery from the conveyance channel does not cause any adverse impacts.
- The sediment calculations used in this study were regional in nature and are generally applicable to channels with sandy bedload sediment. Some channels in the watershed were observed with coarser bedload sediment. A more site-specific sediment analysis is recommended for each structure during the final design process.
- If any mitigation system is implemented, the emergency spillways need to be carefully evaluated and designed to ensure that adverse impacts do not occur during larger events.

6 ADMP MITIGATION PRIORITIZATION

The regional alternative structures presented in this report can be designed and constructed in phases as funding sources are identified and/or become available. Construction should occur beginning furthest downstream so as not to cause adverse flooding conditions due to point-source releases of stormwater. Other phasing strategies could be considered, but interim spillways and/or basins should be implemented to avoid adverse impacts until the full project is built.

Figure 6-1 shows a potential construction phasing strategy that could be implemented by Lyon County, while Table 6-1 lists a possible phasing schedule with associated costs. Note that the phasing cost for the conveyance channel was computed by dividing the total channel cost by the number of phases. The actual costs of each phase of channel construction may vary from those in Table 6-1 due to variability in channel geometry and erosion protection and that if phased into multiple construction contracts, certain bid items such as mobilization will be increased

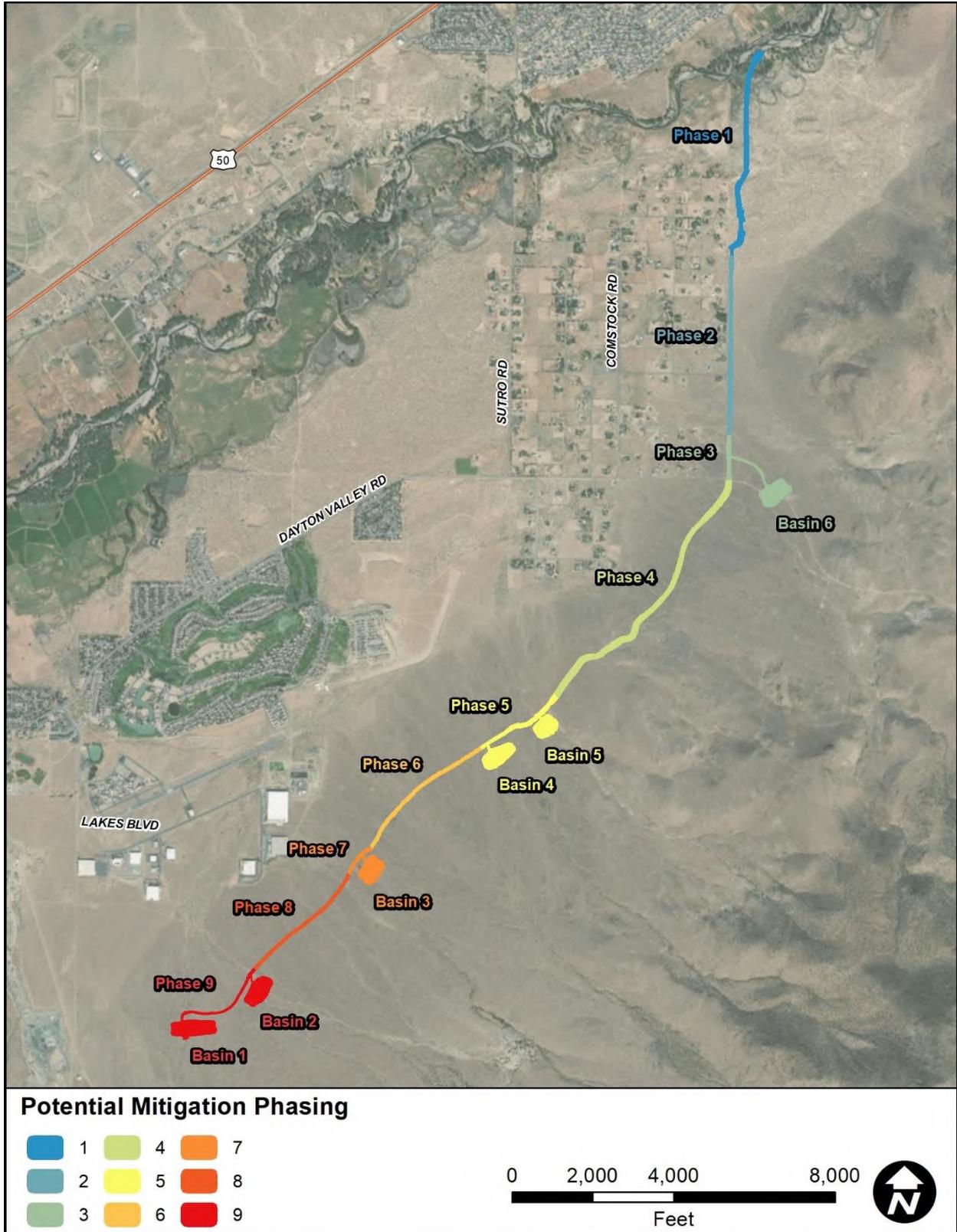


Figure 6-1. Potential mitigation construction phasing

Table 6-1. Potential mitigation construction phasing cost

Phase	Structure Elements	25-Year Structure Cost Estimate ²	100-Year Structure Cost Estimate ²
Phase 1	Conveyance Channel (5,200 LF ¹)	\$3,030,000	\$4,500,000
Phase 2	Conveyance Channel (4,500 LF)	\$2,600,000	\$3,800,000
Phase 3	Conveyance Channel (1,100 LF) Basin #6	\$700,000 \$2,400,000	\$970,000 \$2,800,000
Phase 4	Conveyance Channel (7,200 LF)	\$4,200,000	\$6,100,000
Phase 5	Conveyance Channel (2,300 LF) Basin #5 Basin #4	\$1,350,000 \$1,100,000 \$3,100,000	\$2,000,000 \$2,200,000 \$4,400,000
Phase 6	Conveyance Channel (3,700 LF)	\$2,200,000	\$3,200,000
Phase 7	Conveyance Channel (900 LF) Basin #3	\$515,000 \$2,000,000	\$760,000 \$3,200,000
Phase 8	Conveyance Channel (3,300 LF)	\$1,950,000	\$3,000,000
Phase 9	Conveyance Channel (2,500 LF) Basin #2 Basin #1	\$1,500,000 \$2,000,000 \$2,600,000	\$2,200,000 \$2,200,000 \$3,000,000
<ol style="list-style-type: none"> 1. LF = linear feet (approximate) 2. Construction costs have been rounded for simplification. See Appendix B for a detailed breakdown of cost estimates. 			

6.1 ADMP LIMITATIONS

While the results are based on detailed topography, hydrology, and hydraulic modeling, they represent the existing conditions as of the date of the LiDAR mapping. Because of the unique landform and sediment characteristics of the watershed, the topography and distribution of flow can be very dynamic (i.e., small culverts or drainage channels can quickly fill with sediment causing water to change course from what it was previously). Therefore, during final design of any of the alternatives, or prior to any future development within the project area, a detailed assessment of upstream flow distribution should be undertaken.

Furthermore, this study did not analyze rain on snow events, flooding recurrence intervals greater than 100-year, or post-wildfire flooding events. These types of events are considered outside the scope of the typical area drainage master plan process. The hydrology used in this study was state of the art, engineering design storms based on recent NDOT research. These atypical events could create hydraulic conditions that exceed these design storms.

7 REFERENCES

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