

KINGMAN AREA DRAINAGE MASTER PLAN



CONCEPT SOLUTION OVERVIEW MAP

Legend

- Areas
 - Stormdrain
 - Storage
 - Channel
 - Road Reconstruction
 - Other
- Land Ownership**
- Federal
 - State
 - County
 - City
 - All Others

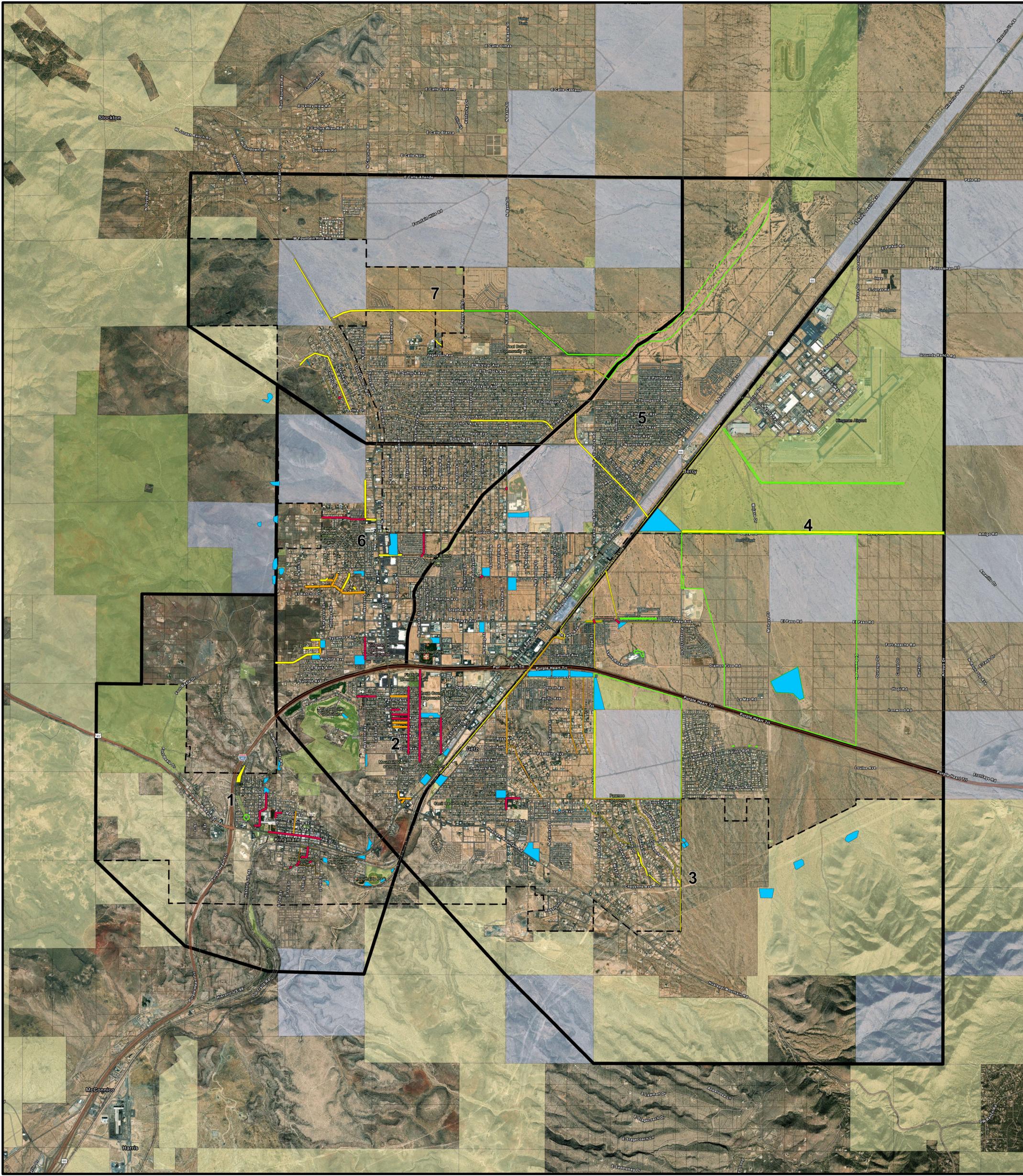
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PRELIMINARY



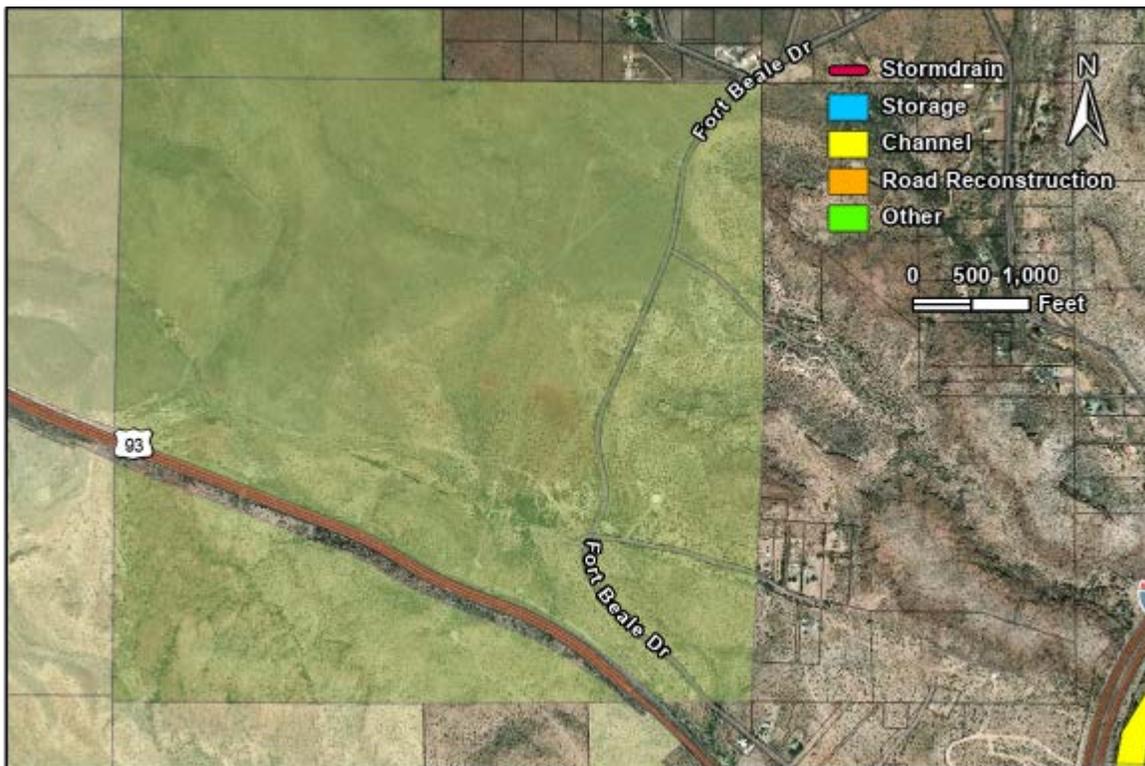
Solution Name: 1.1 City Land Basins	Location: North of Highway 93 near Fort Beale Dr.	Area: 1
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution proposes constructing one or more retention basins on City of Kingman-owned land, north of Highway 93 and west of Fort Beale Dr. Future plans for I-11 may impact the drainage of this area and areas where retention can be implemented.

There may be opportunities for in line retention, but the area is steep and most of the drainages are fairly confined. Providing sufficient volume in basins to reduce the peak flow is not likely and this solution was not developed since it would not significantly mitigate downstream flooding.

Possible solutions for this area could focus on downstream channel improvements due to the high discharge.

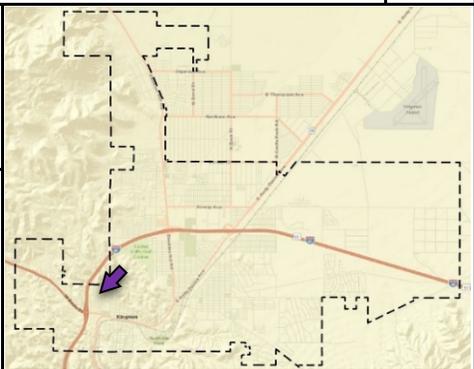


Benefits:

- Basins could reduce downstream sediment

Considerations:

- Future I-11 construction
- Focus on downstream channel improvements

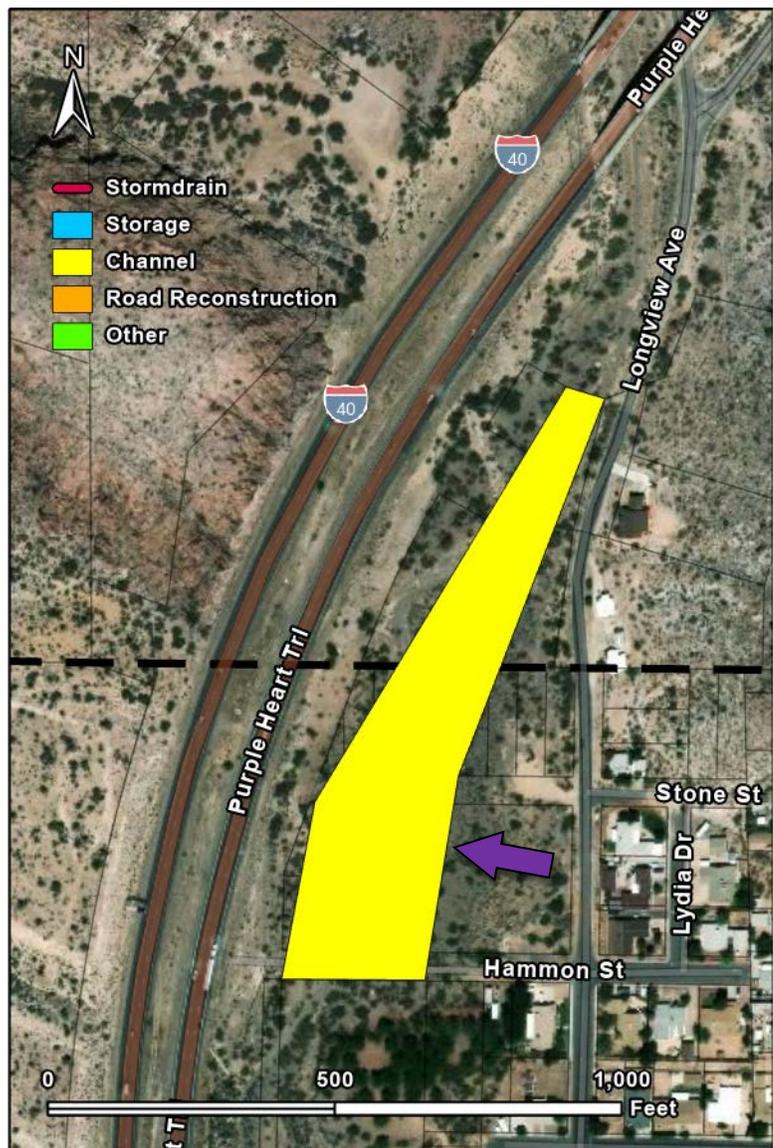
Solution Name: 1.2 Channelize Clack Canyon Channel	Location: Clack Canyon – adjacent to Longview Ave. and Hammon St.	Area: 1
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution would consist of reconstructing the Clack Canyon drainage beginning 500 ft downstream from where it crosses under I-40, to the where it would cross Hammon St.

Clack Canyon is a natural channel with an average slope of 1.7 percent through this section. The 100-year flow of 7349 cfs spreads over Longview Ave. which causes damage to the road and channel breakouts which can translate downstream.

The channel could be regraded with armored banks through this section. The reconstructed area would transition back to the existing section at or near the orchard south of Hammon St.



Benefits:

- Increased all weather access
- Reduction in maintenance

Considerations:

- Property acquisition for channel improvements
- Consider impacts to orchard

Solution Name: 1.3 White Cliffs Detention	Location: West side of White Cliffs Rd. and north of Northern Ave.	Area: 1
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

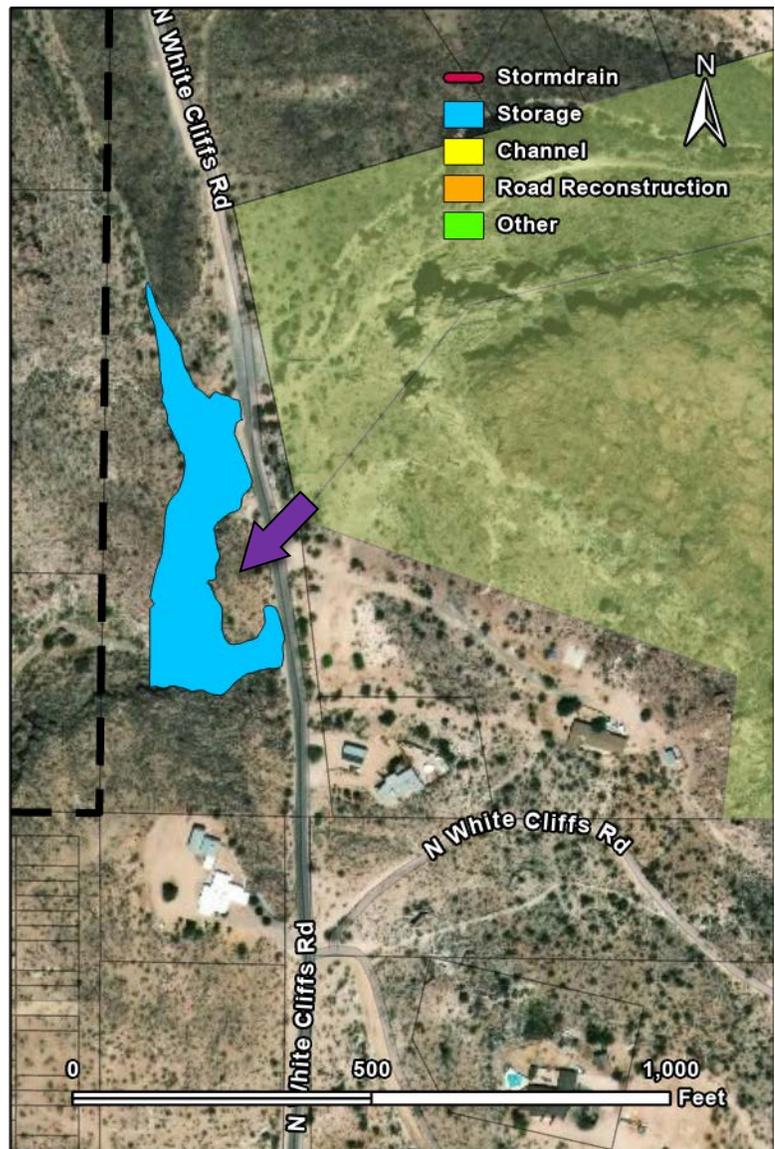
Description:

This solution would dam the drainage on the west side of White Cliffs Rd. north of Northern Ave. to provide a regional retention basin.

Construction of a 22 ft high berm in the canyon has the potential to retain approximately 8 ac-ft. If designed for detention, the basin could reduce the 100-year peak by approximately 20 percent and the 10-year by approximately 10 percent.

If designed for retention, the basin could store the full 2-year volume (0.3 ac-ft) and 2/3 of the 10-year volume (12 ac-ft). While it may not significantly reduce the 100-year flows, retention would provide a major benefit for the more frequent events.

The discharge from the basin flows south on Stockton Hill Ave. and into the high school property.



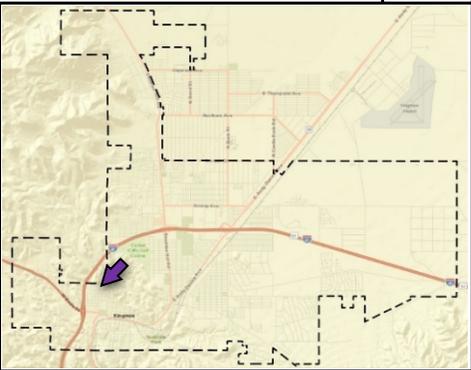
Benefits:

- Reduction in downstream flows and volumes

Considerations:

- Property acquisition
- Would be a large critical structure to maintain

Solution Name: 1.4 Stockton Hill Avenue Stormdrain (High School Stormdrain)	Location: From intersection of Stockton Hill Ave. and Silver St. to Clack Canyon Wash	Area: 1
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Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution includes the construction of a new 100-year capacity stormdrain from the Intersection of Stockton Hill Ave. and Silver St. to Clack Canyon Wash. Based on a total discharge of 1,005 cfs, a 96 in SRP pipe would be required.

Roadway reconstruction of Lead St. and Stockton Hill Ave. would be required to create an inverted crown and install large transverse grate inlets the width of the road. Significant utility conflicts are expected.

The proposed stormdrain would continue south on Grandview Ave. to Oak St. where it would transition into a shallow and wide box culvert to its outlet in Clack Canyon. The west end of Oak St. would need to be reconstructed and raised to allow for the stormdrain. The downstream impacts of routing the flow from Stockton Hill Ave. to Clack Canyon has not been analyzed.

There will be trench depths in excess of 20' at Gold St. An alternative alignment would be to route the stormdrain through the High School property to reduce trench depth.

FEMA coordination is expected based on changing the hydrology and potentially the hydraulics of Clack Canyon. The proposed stormdrain will cross the high school property and coordination will be required. If maintenance is to be provided by the City, then easements will be required for areas not within City ROWs.



Benefits: <ul style="list-style-type: none"> • Increased all weather access • Reduction in maintenance • Divert runoff from high school 	Considerations: <ul style="list-style-type: none"> • Outlet into Clack Canyon requires significant road reconstruction • Utility conflicts and significant trench depths • Downstream impacts to be analyzed
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Solution Name: 1.5 Maple Street Stormdrain	Location: Corner of Maple St. and 1st St.	Area: 1
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution includes replacement or upgrading of the stormdrain from the existing stormdrain inlet midblock between 1st St. and 2nd St. to the existing manhole at the intersection of 1st St. and Pine St. The inlet of the pipe on the north side of Maple St. seems to be both a low water crossing and pipe inlet. The new stormdrain would flow east in Maple St. to a newly constructed catch basin on the west side of 1st St., then south to connect to the existing stormdrain manhole southeast of the 1st St./Pine St. intersection.

The solution may require reconstruction of a section of Maple St. to direct flow into the new inlets.



Benefits:

- Reduction in flow in Maple St. and lots to the south

Considerations:

- Additional capacity of downstream stormdrain is unknown
- Potential utility conflicts
- Road improvements required

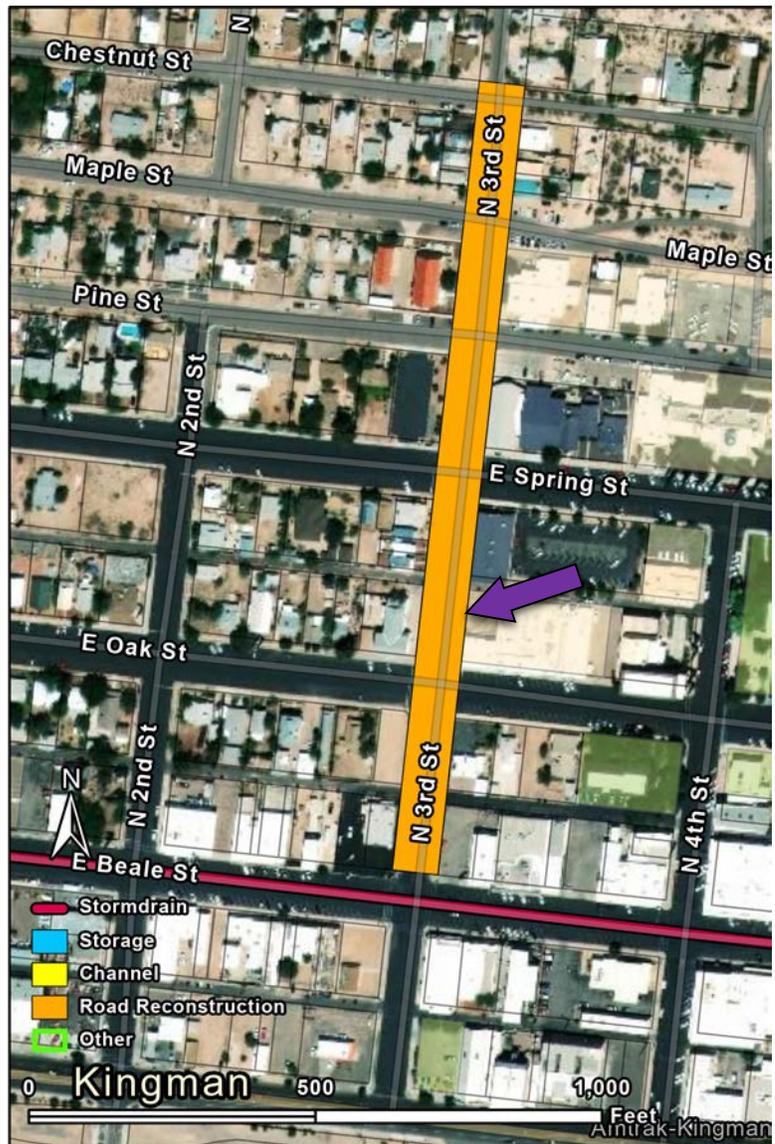
Solution Name: 1.6 3rd Street Reconstruction	Location: 3rd St. from Chestnut St. to Andy Devine Ave.	Area: 1
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal		

Description:

This solution would include surface improvements to better convey the runoff down 3rd St. to Beale St.

Currently, 3rd street is paved in what appears to be a standard crown from Spruce St. to Andy Devine Ave. It is without curb and gutter from Spruce St. south to Maple St. Maple St. to Pine St. has 6 in curbs on both sides. Pine St. south to Oak St. has approximately 8 in curb with 6 ft wide curbside valley gutters on both sides of the street. From Oak St. to Beale St., a valley gutter is on the west side only. Additionally, there are no valley gutters at any of the crossing streets. The existing roadway slope varies from 10 percent or more north of Maple St. to 2.0 percent near the intersection with Beale St.

The road has capacity for the 100-year discharge from Pine St. to Beale St. Improvements to the current condition should be limited to three different options. One, continue valley gutters through the intersections at Pine, Spring and Oak streets. Second, install transverse grate or catch basins at Beale St. with stormdrain connecting to the Beale St. stormdrain as part of Solution 1.12. Third, construct and connect curb and gutter on 3rd St. from Spruce St. to Maple St.



Benefits:

- Increased conveyance and efficiency of 3rd St. Reduction in flood risk to buildings south of Beale St.

Considerations:

- Integrate solution into Beale St. roadway improvement projects
- New grate construction should take into account the capacity of existing stormdrain in Andy Devine Ave.
- Does not address debris

Solution Name: 1.7 Stockton Hill Avenue Retention	Location: Stockton Hill Ave. north of Lead St.	Area: 1
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

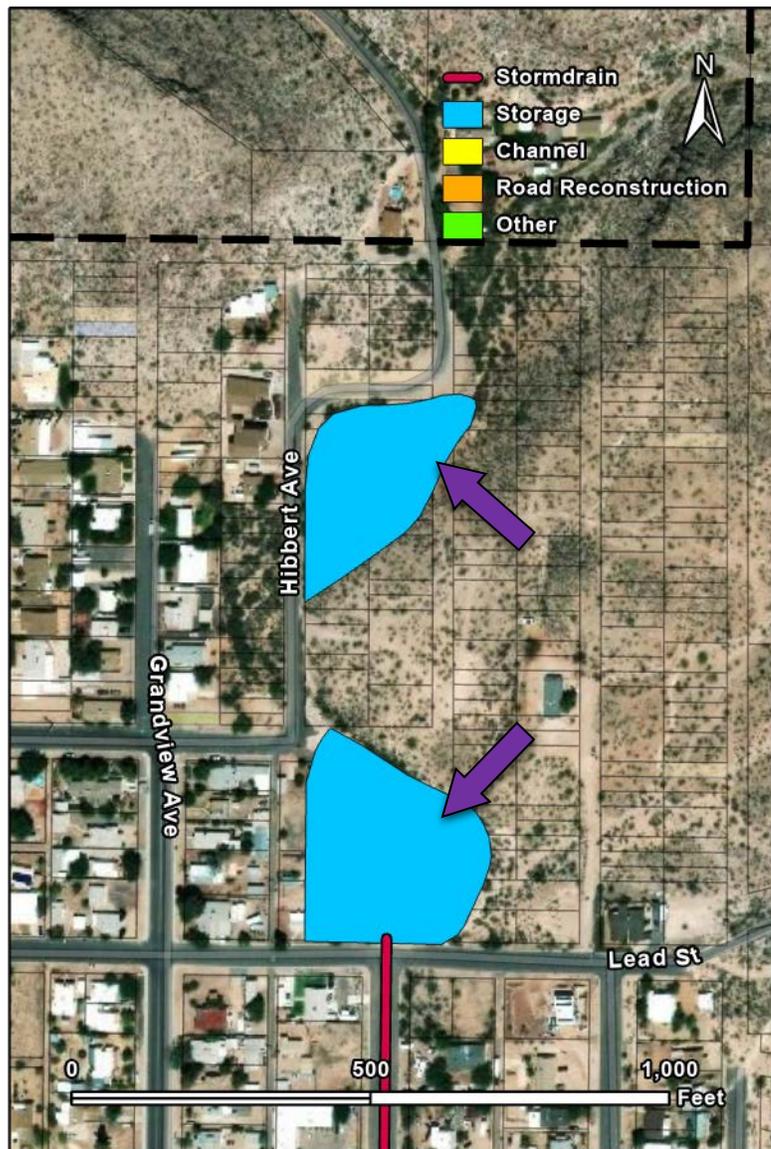
Description:

The solution potentially includes the construction of a retention basin at one or two locations upstream of Lead St. One on vacant private property north of Lead St. and one north of Turquoise St. between Hibbert Ave. and Stockton Hill Ave.

If all properties on the block were acquired, the basins could retain approximately 3.5 ac-ft at 7 ft of ponding depth. Similar to the potential White Cliffs retention, this solution would not significantly reduce the peak 100-year flows. However, if done in conjunction with the upstream retention, the basins could contain the full 10-year event and significantly reduce annual maintenance and risk downstream.

The discharge from each basin alternative flows south on Stockton Hill Ave. and into the high school property.

Neither of these options, individually or collectively, will produce the eliminate the 100-year flood risk at the high school.



Benefits:

- Reduction in downstream flows and volumes

Considerations:

- Property acquisition
- Annual maintenance considerations

Solution Name: 1.8 Detention Upstream of 8th Street	Location: Northwest corner of Andy Devine Ave. and Chadwick Dr.	Area: 1
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

The solution potentially includes the construction of a retention basin at one of two locations. Construction of a retention basin north of the BNSF ROW on the south side of Andy Devine Ave.

The footprint of the south basin is approximately 1.0 ac with a ponding depth of 3 ft. A billboard is located in the middle of the proposed basin which will need to be planned around or relocated. This provides a total runoff storage of 3 ac-ft which is approximately 1/3 of the total 10-year storm volume of 10.5 ac-ft.

Construction of an outlet headwall on the north end of the 72 in CMP under Andy Devine Ave. would create the north basin. The outlet would be optimized for the 10-year event and in doing so would have a minimal impact on the 100-year discharge.

The area north of Andy Devine Ave. currently detains approximately 1.7 ac-ft in the 10-year event and 5.9 ac-ft in the 100-year event. The proposed headwall would include a 2 ft diameter opening at the base with weir at 8.5 ft above the bottom of the basin. It will allow for approximately 14 ac-ft of detention in the 100-year storm.

This will have the effect of reducing the 100-year peak below Andy Devine Ave. from 326 cfs to 293 cfs and the 10-year peak from 115 cfs to 35 cfs.



Benefits:

- Reduction in downstream flows
- Infiltration opportunities

Considerations:

- An inundation easement is needed to preserve the ponding area associated with the detention basin.
- This option only involves detention storage. Detention will reduce the flow rate to 8th St. but will not reduce the runoff volume.

Solution Name: 1.9 South Downtown Channelization	Location: South of BNSF ROW near Old Trails Rd.	Area: 1
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	
Description: This solution involves several components/options: <u>Topeka St. Channel</u> It is recommended that a channel be constructed north of Topeka St. to collect runoff crossing the BNSF railroad tracks through culverts, road conveyance or sheet flow. The channel would outlet into the 5th St. Stormdrain. <u>5th St. Stormdrain:</u> A stormdrain is recommended to contain the 10-year event originating from the Topeka Channel. The channel will outlet south of Park Ln. near Hubbs Park. <u>5th St. and Park Ln. Reconstruction:</u> reconstruct Park Ln. and 5th St. to contain the remainder of the 100-year event within the ROW. The roadway would outlet into the channel at the 5th St. stormdrain outlet. <u>4th St. Reconstruction:</u> Reconstruct 4th St. to contain the 100-year event within the row though an inverted crown and curb and gutter. <u>Hubbs Park Channel:</u> Reconstruct the Hubbs Park Channel to contain the 100-year event. The channel would be a concrete-lined trapezoidal channel with 2 ft bottom width. <u>4th St. Culvert:</u> Reconstruct the existing culvert to be a box to convey the 100-year event to the Old Trails Channel. <u>Old Trails Culvert:</u> Reconstruct the existing culvert to be a box to convey the 100-year event to the Old Trails Channel. <u>3rd St. Culvert:</u> Reconstruct the existing culvert to be a box to convey the 100-year event to the Old Trails Channel. <u>Old Trails Channel:</u> Reconstruct the existing channel to convey the 100-year event. <u>1st Ave Channel and Road Reconstruction:</u> Reconstruct the road and associated channel to convey the 100-year event. <u>Upper and Lower Golconda Channel:</u> Reconstruct the existing channel to convey the 100-year event. Note that space constrictions may only allow the channel to be constructed for the 10-year event unless upstream retention is provided. <u>Golconda Box Culvert:</u> Install a 4 ft x 12 ft box culvert to convey 100-year flow across road. <u>1st Ave./Kier St./3rd Ave. Reconstruction:</u> Reconstruct roads with curb and inverted crown to convey 100-year event. <u>7th St. Basin:</u> Construct a basin on private and public land between 6th St. and 7th St. At 5 ft of ponding depth approximately 7 ac-ft of storage can be provided.		

Solution Name: 1.9

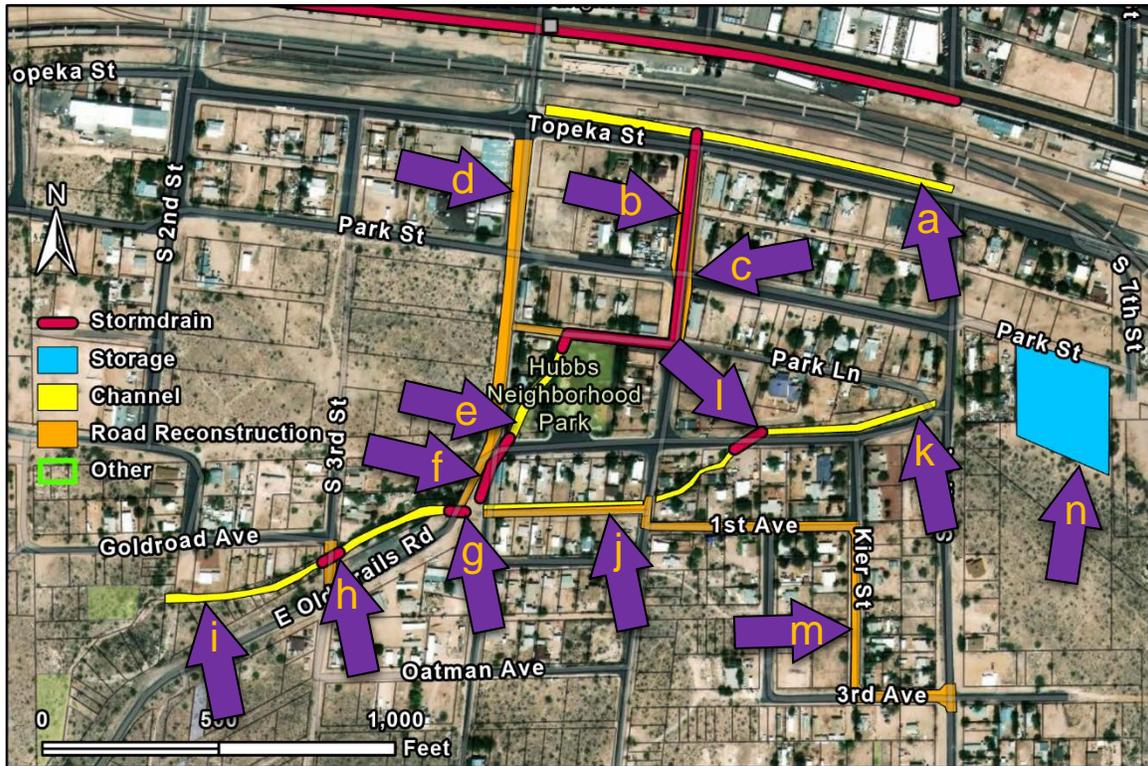
South Downtown
Channelization

Location:

South of BNSF ROW near Old Trails Rd.

Area:

1



Benefits:

- Reduced flow across private property
- Reduced inundation of yards and structures

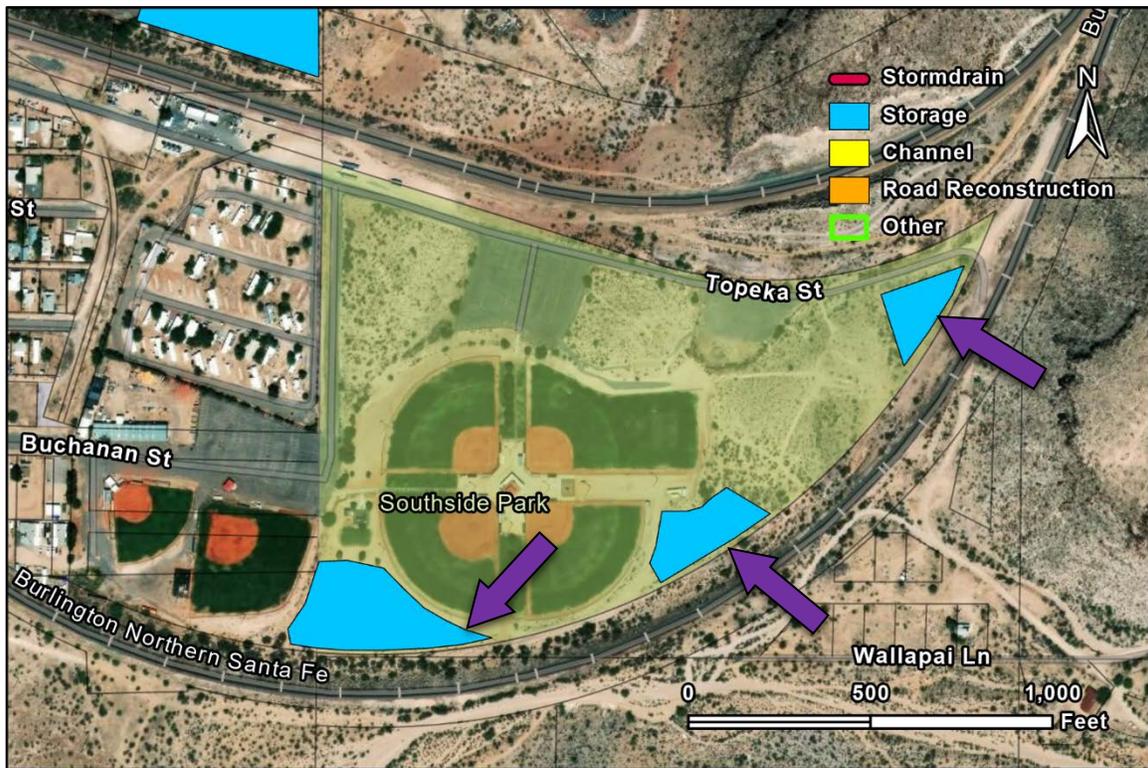
Considerations:

- Traditional neighborhood access patterns.
- Potential utility conflicts
- Effect of Southside Park Retention Detention

Solution Name: 1.10 Southside Park Retention/Detention	Location: Southside Park	Area: 1
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution involves constructing retention/detention basins at three possible locations within the Southside Park. The combination of the basins can provide up to 12 ac-ft of storage and could potentially significantly reduce the downstream flows.



Benefits:

- Reduced flow to South Downtown neighborhood

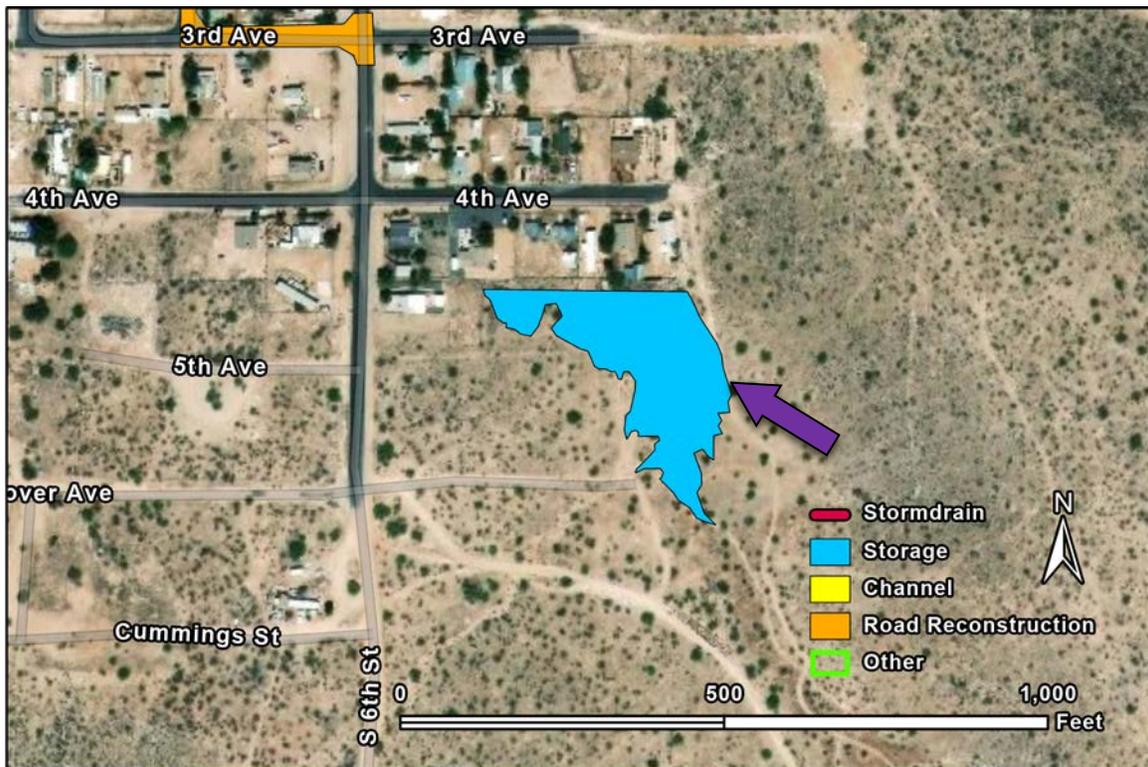
Considerations:

- Solution could positively affect South Downtown Channelization
- Potentially look at diverting runoff to Sawmill Canyon

Solution Name: 1.11 4th Avenue Basin	Location: 4th Ave. east of 6th St.	Area: 1
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution involves constructing a basin largely on City-owned parcels that lie north and south of the 5th Ave. ROW. A 6 ft deep basin with no additional excavation could store 3.5 ac-ft. This would account for more than the 2.85 ac-ft from the 10-year storm. With excavation, the basin could contain the full 100-year event.



Benefits:

- Infiltration opportunities
- Sediment control

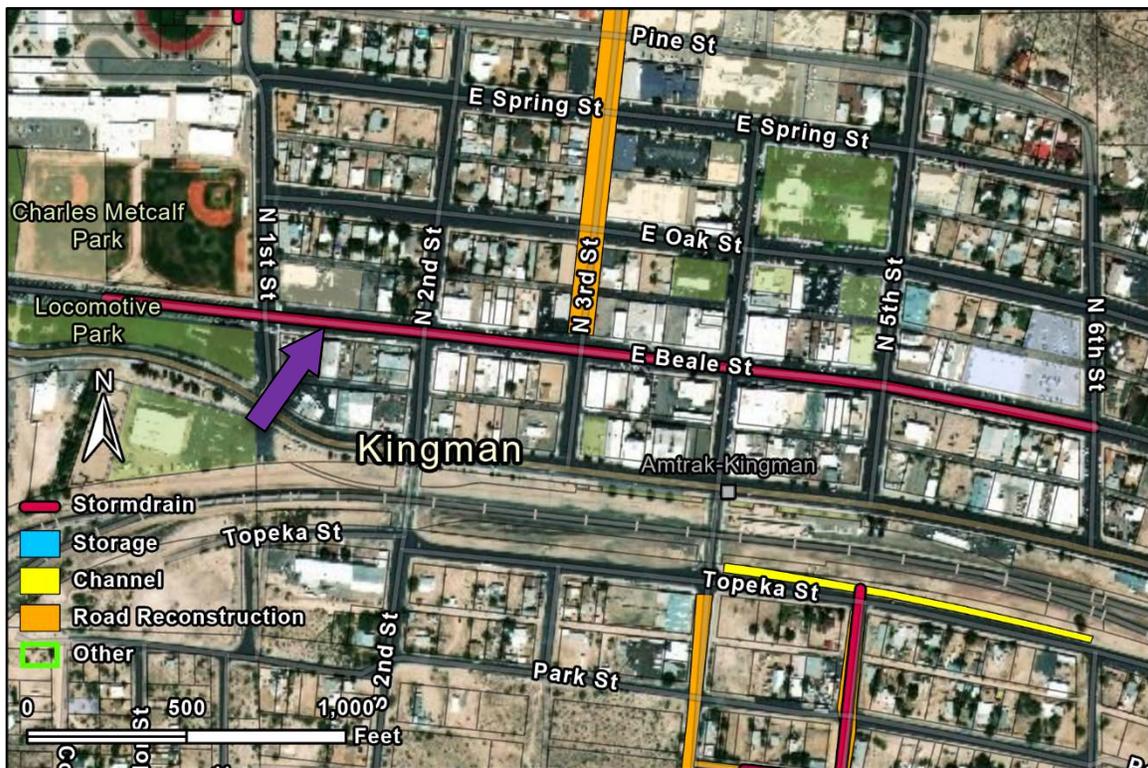
Considerations:

- Retention option more effective in debris mitigation

Solution Name: 1.12 Beale Street Stormdrain	Location: Andy Devine Ave. between 1st St. and 6th St.	Area: 1
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution would include installation of a new stormdrain system in Beale St. from 6th St., west to the wash crossing midway between 1st St. and Grandview Ave. The proposed stormdrain system is intended to capture flow from the cross streets and direct it to an ultimate outfall point south of the high school. The modeling indicates that in order to capture the 10-year event, the stormdrain would need capacity for approximately 100 cfs, which could be handled in a 48” diameter stormdrain. The capacity will be dependent on ultimate slope and inlet configurations.



Benefits:

- Reduce flows reaching Andy Devine Ave.

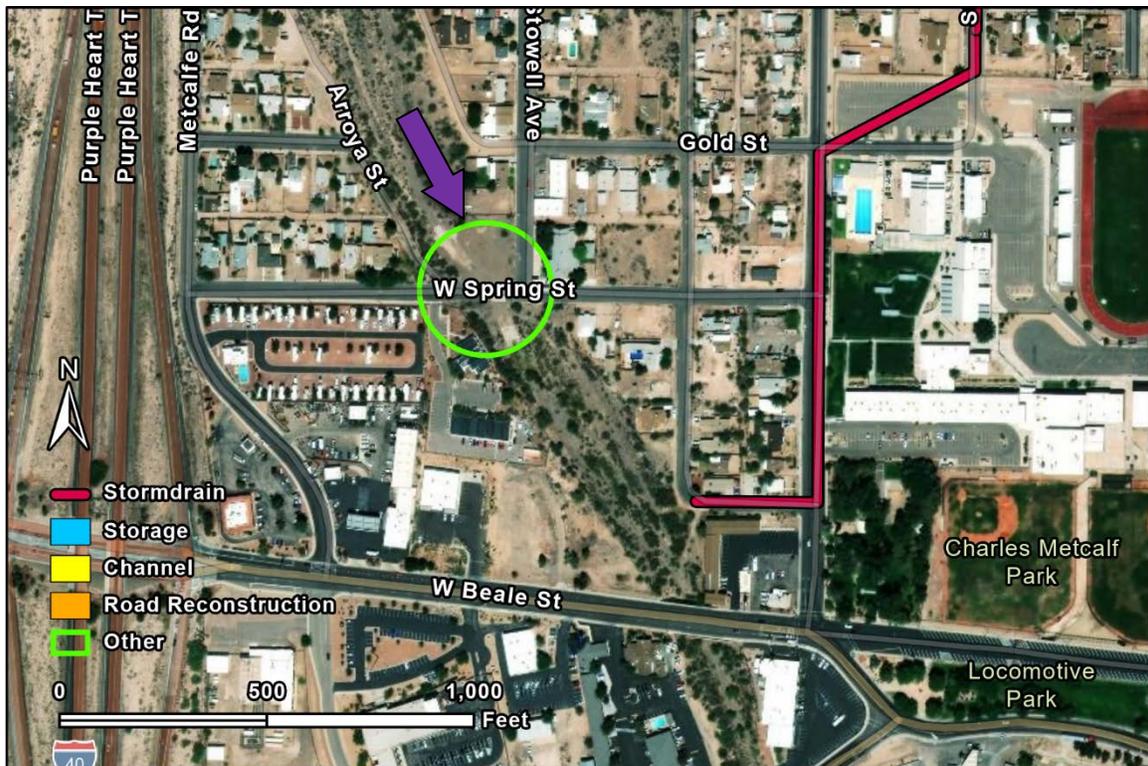
Considerations:

- Should be implemented with planned Beale St. reconstruction project.

Solution Name: 1.13 Spring Street Crossing	Location: Spring St. between Metcalfe Rd. and Stowell Ave.	Area: 1
Type of Solution: <input type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution is a maintenance issue. Channel improvements and maintenance of Clack Canyon upstream of Spring St. may mitigate much of the sedimentation problem. This solution does not directly improve existing flooding issues in the area and is not further developed with this plan.



Benefits:

- Increased emergency access

Considerations:

- Sedimentation is a regional issue that may not be solved by erosion protection upstream or downstream.

Solution Name: 2.1 Golf Course Retention	Location: Within the Cerbat Cliffs Golf Course located west of Golf Dr.	Area: 2
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution involves capturing the runoff entering the site from the west within a basin located within the Cerbat Cliffs Golf Course located west of Golf Dr. The basin would be constructed within the open space between Hole 9 and Hole 11. Assuming a maximum basin depth of 5 ft, (4 ft of storage and 1 ft of freeboard) and to retain the 100-year storm event volume of 4.86 ac-ft, the basin would need to encompass an area of 42,000 sq-ft. The basin could potentially be drained solely through evaporation and percolation, though an 18 in pipe fitted with a 6 in orifice plate could be constructed as part of the basin to assist in metering out storm water. An emergency spillway with a width of 39 ft would be used to pass a peak discharge 110 cfs.



Benefits:

- Reducing inflow leaving golf course
- Infiltration opportunities

Considerations:

- High potential for shallow rock
- Additional maintenance needed for basins

Solution Name: 2.2 Miami Avenue Stormdrain Extension	Location: Miami Ave. from Mark Dr. to La Salle Ave.	Area: 2
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution involves capturing runoff that originates from the contributing watershed to the west, entering Miami Ave./Heather Alley from Foothill Ave. The peak 100-year discharge of 233 cfs could be conveyed within a stormdrain system consisting of potentially 2-48 in diameter pipes. However, given that the logical outfall is an existing stormdrain located in the intersection of Miami Ave. and La Salle Ave., it is recommended that the stormdrain system conveys only the 10-year storm while runoff from the larger storm events is conveyed as surface flow within the street. Given this, the stormdrain system would consist of a single 36 in pipe, ($Q_{des} = 74$ cfs). Runoff would be discharged into the system via a traverse grate east of the intersection Mark Dr./Heather Alley and a second transverse grate east of the intersection of Western Ave./Miami Ave. Catch basins within Miami Ave. would serve to capture additional flow within the pavement as well as any bypass flow over the grate. In conjunction with the stormdrain improvements, Miami Ave. would also be improved. The improvements would consist of inverting the roadway and adding sidewalks. These improvements could increase the roadway conveyance capacity to as much as 159 cfs. Coupled with the runoff conveyed in the stormdrain, the total conveyance capacity for the system could potentially be 233 cfs.



Benefits:

- Capturing runoff impacting Miami Ave. and areas to the north

Considerations:

- Potential utility conflicts

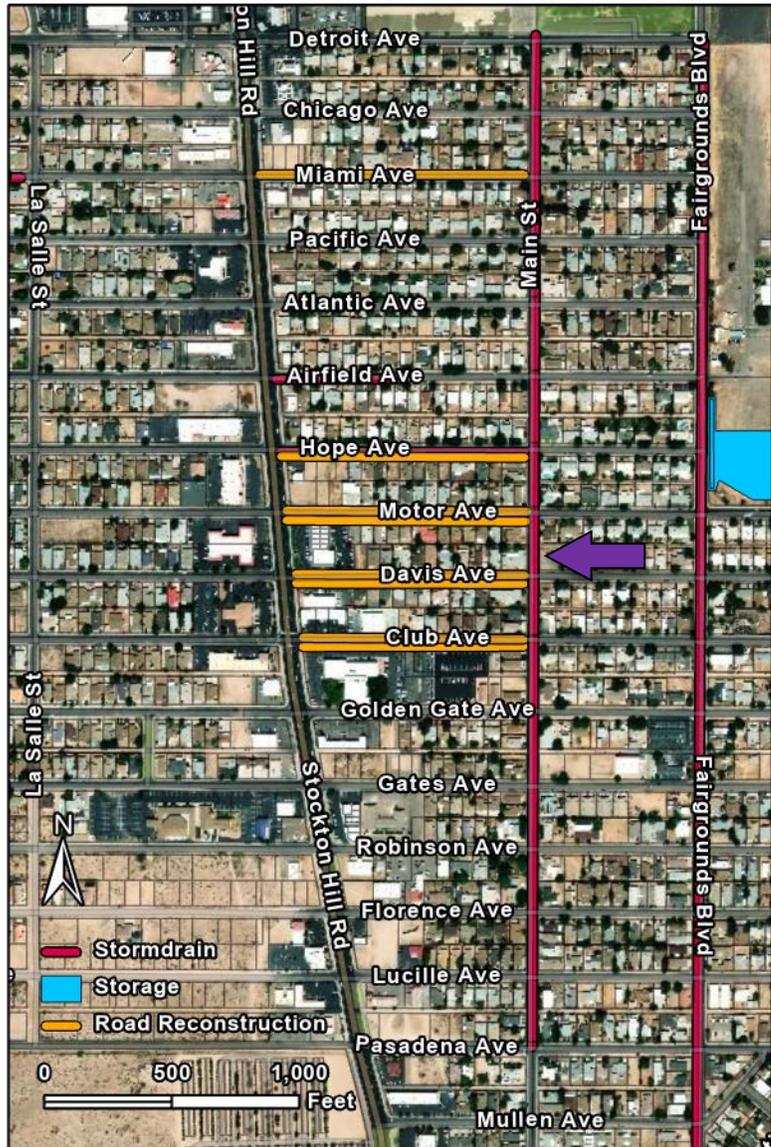
Solution Name: 2.3 Main Street Stormdrain Extension	Location: Along Main St. from Pasadena Ave. to Detroit Ave.	Area: 2
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution consists of extending the stormdrain system along Main St. The system would begin at Pasadena Ave. and tie into the existing system at Detroit Ave. The 100-yr peak discharge conveyed within Main St. is determined to be 475 cfs, which appears to be primarily conveyed within the ROW. Given that the outfall consists of 3-36 in pipes, it is recommended that the proposed extension would consist of three 36 in RCP with a conveyance capacity of 74 cfs each for a total of 222 cfs. This would reduce the runoff in the street by 48 percent, leaving about 252 cfs to be conveyed by the street section.

Transverse grates would be constructed downstream of intersections with Airfield Ave., Hope Ave., Motor Ave. Club Ave. and at Pasadena Ave. Because portions of the street appear to have an inverted crown, slotted drains with a centerline valley gutter would be used to augment the intercepting capacity of the system.

Given that portions of the street appear to be bound by curb/sidewalk and that the analysis indicates that the flow is primarily contained within the ROW, improvements to increase capacity are not being considered as part of the necessary solution.



Benefits:

- Reduction in runoff within Main St.
- Reduction of flow through cross street areas west of Main St.

Considerations:

- Potential utility conflicts
- Implement in conjunction with cross street road improvements.

Solution Name: 2.4 Fairgrounds Boulevard Stormdrain	Location: Along Fairgrounds Blvd. from Sunset Blvd. to I-40.	Area: 2
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

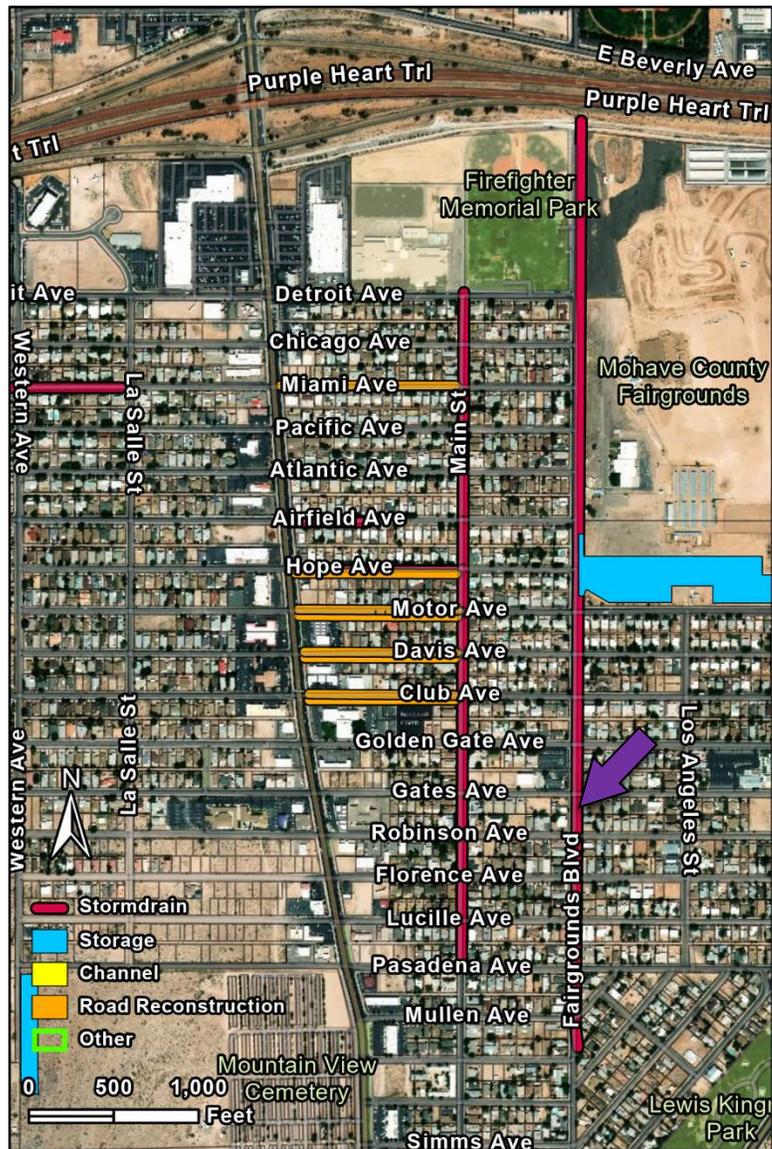
The proposed project consists of construction of a stormdrain along Fairgrounds Blvd. The intercepted storm drainage would discharge into the existing concrete lined channel to the north. The extension would be complementary to the stormdrain and roadway improvements previously designed by JE Fuller for Fairgrounds Blvd. from Detroit Ave. to the north. The proposed solution would consist of 1-48 in pipe which could potentially convey 126 cfs. This would exceed the 10-year storm event and leave 144 cfs within the street during the 100-year event.

Transverse grates would be constructed downstream of the intersections of Sunset Blvd., Wickieup Ave., Florence Ave., Club Ave., Airfield Ave., and Detroit Ave.

Given that portions of the street appear to be bound by curb/sidewalk and that the analysis indicates that the flow is primarily contained within the ROW, improvements to increase capacity are not being considered as part of the necessary solution.

Catch basins with laterals would be used to capture street runoff between the transverse grates. The stormdrain could also serve as a logical outfall to a future basin within Andy Devine Ave. (Solution 2.5).

The stormdrain has been previously designed north of Detroit Ave. by JE Fuller.



Benefits:

- Reduction in runoff within Fairgrounds Blvd.
- Reduction of flow through cross street areas west of Fairgrounds.

Considerations:

- Potential utility conflicts
- Consider design of Andy Devine retention.
- The lower portion of this stormdrain has already been designed. This project includes this section.

Solution Name: 2.5 Andy Devine Detention	Location: Within the open space north of Andy Devine Ave. and east of Fairgrounds Blvd.	Area: 2
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution would consist of constructing a basin within the open space north of Andy Devine Ave. and east of Fairgrounds Blvd. While the discharges associated with the generated runoff are not substantial, the volume of flow that it is conveyed to the area is such that complete retention of the 100-year event would not be possible in the space available. That said, a 4 ft deep basin with 1 ft of freeboard would provide 19.8 ac-ft of storage. The basin could potentially connect to a stormdrain within Fairgrounds Blvd. via a 24 in pipe, which would operate under outlet control conditions and convey the runoff from the 10-year event. To drain the 100-year event, an emergency spillway consisting of a 47 ft wide concrete weir would be constructed as part of the basin. The attenuation and discharge reduction from the basin would reduce the flow in Fairgrounds Blvd. and improve the capacity of the stormdrain proposed in Solution 2.4. The solution does not account for any attenuation from the basin being considered upstream in Area 3.



Benefits:

- Infiltration opportunities
- Reduction in flows downstream

Considerations:

- Could be developed in conjunction with ball fields or other amenities
- Potentially completed in phases or smaller footprint

Solution Name: 2.6 Harrison Street Stormdrain Extension	Location: Pasadena Ave. north to Motor Ave. along Harrison St.	Area: 2
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure <input type="checkbox"/> Masterplan	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution consists of extending a stormdrain from Pasadena Ave. north to Motor Ave. along Harrison St. The stormdrain would consist of a 36 in pipe in order to convey the 100-year event, though a smaller pipe could be considered. The stormdrain could outlet into the stormdrain located in Fairgrounds Blvd. at Detroit Ave. Runoff would be captured within and diverted into the stormdrain via transverses grates constructed downstream of the intersection with Pasadena Ave. and upstream of the intersection with Lucille Ave.

Should a pipe that did not convey the enter 100-year storm event be selected, street improvements (i.e. curb/sidewalk) should be added to the design to convey the 100-year flow within the roadway. Additional improvements to Lucille Ave. would be warranted though they were not considered as part of this solution.



Benefits:

- Reduction in runoff within Harrison St.
- Reduction of flow through cross street areas west of Harrison St.

Considerations:

- Potential utility conflicts
- Consider design of Harrison St. retention.

Solution Name: 2.7 Fairgrounds Detention	Location: Within the open space at the south end of the fairgrounds	Area: 2
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution would consist of constructing a basin within the open space at the south end of the fairgrounds. While the discharges associated with the generated runoff are not substantial, the volume of flow that it is conveyed to the area is such that complete retention of the 100-year event would not be possible in the space available. Based on a predetermined configuration of a 4 ft deep basin with 1 ft of freeboard, the available storage equates to 23.7 ac-ft of storage. The proposed design will not accommodate the 100-year event and the fairgrounds will need to continue to use the space for parking during events. As such, it is recommended that the area be solely used for infiltration opportunities with a small basin located along the western side of the site to allow for the basin to outfall into a future stormdrain within Fairgrounds Blvd.

This basin would provide 7.3 ac-ft of storage which is enough to capture runoff in excess of the 2-year event. An emergency spillway of 75 ft would be used to drain runoff from the basin during larger storm events. As stated, the basin, which has a maximum depth of 3 ft would have the ability to tie into a future stormdrain system such that it could drain in accordance with Mohave County requirements.



Benefits:

- Infiltration opportunities
- Connectivity to proposed stormdrain systems

Considerations:

- This would utilize a large portion of the fairgrounds property

Solution Name: 2.8 Post Office Area Curb and Gutter	Location: Multiple – see descriptions a) through c) below	Area: 2
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input checked="" type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

a) Stockton Hill Rd. along the west side of the Post Office from Johnson Ave. to Jefferson St.

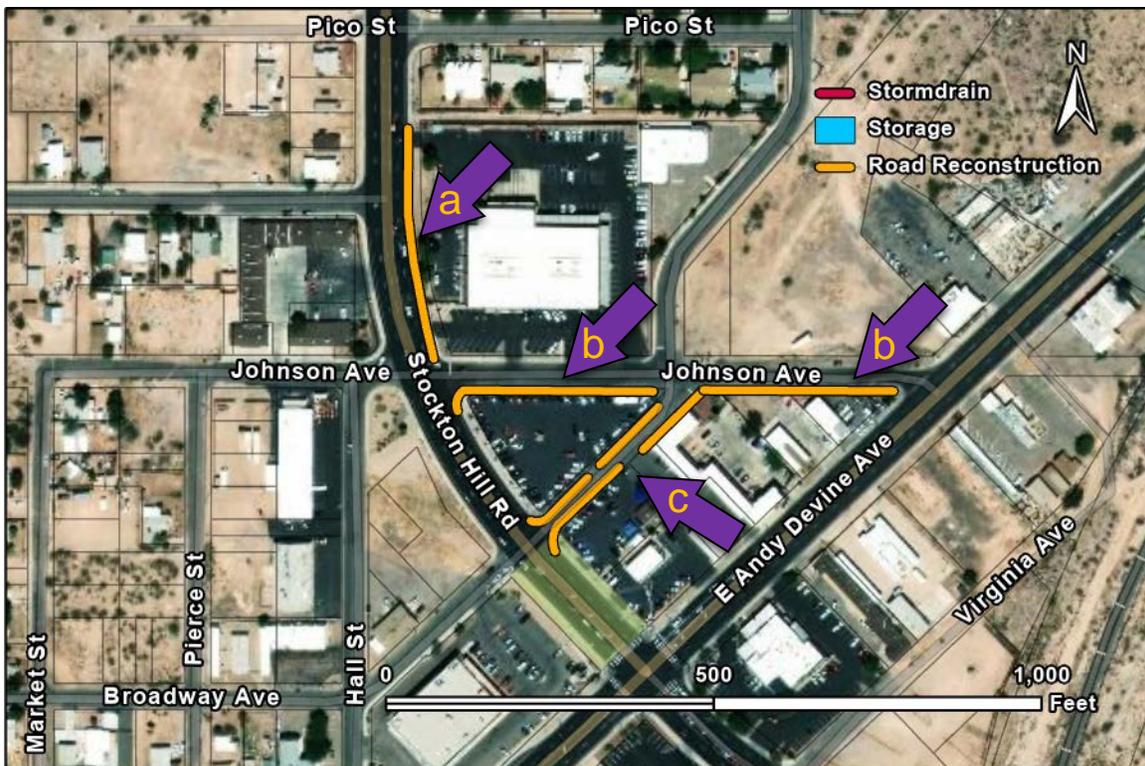
It is recommended that a 2 in depressed gutter with new 8 in curb be constructed along this roadway segment. In addition, a high point should be constructed at the northern entrance of the Post Office building. Should an 8 in curb be undesirable, a landscape berm could be constructed within the area between the sidewalk and the patio wall to divert flow from entering the building.

b) Johnson Ave. from Stockton Hill Rd. to Andy Devine Ave.

It is recommended that along the southern side of Johnson Ave., the sidewalk be extended with new 8 in curb or inverted crown added. The resulting configuration would reduce the travel lanes such that the pavement width would consist of two 15 ft travel lanes. This would be a 100-year solution.

c) Broadway Ave. from Stockton Hill Rd. to Johnson Ave.

It is recommended that sidewalk and curb be constructed along the roadway and the roadway crown be inverted. This would be a 100-year solution assuming that a high point is constructed within the car dealership entrance.



Benefits:

- Improved roadway conveyance
- Protection of the Post Office

Considerations:

- Downstream impacts need to be considered

Solution Name: 2.9 Harrison Street Detention	Location: Within the open space north of Andy Devine Ave. and east of Harrison St.	Area: 2
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution would consist of constructing a basin within the open space north of Andy Devine Ave. and east of Harrison St. While the discharges associated with the generated runoff are not substantial, the volume of flow that it is conveyed to the area is such that complete retention of the 100-year event would not be possible in the space available. That said, a 4 ft deep basin with 1 ft of freeboard would provide 9.65 ac-ft of storage. This would fully retain runoff from storm events greater than the 10-year storm, while detaining runoff from the 100-year event.

The basin outfall could potentially connect to a stormdrain within Harrison St., which would operate under outlet control conditions and drain the basin. Runoff from the 100-year event would be discharged out of the basin via an emergency spillway consisting of a 40 ft wide concrete weir. The attenuation and discharge reduction from the basin would reduce the flow in Lucille Ave. and Harrison St.



Benefits:

- Infiltration opportunities
- Reduction in flows downstream

Considerations:

- Land acquisition required

Solution Name: 2.10 Cemetery Detention	Location: Along western edge of Mountain View Cemetery and parallel to the Western Ave. alignment	Area: 2
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution would consist of constructing a basin along the western edge of the Mountain View Cemetery running parallel to the alignment of Western Ave.

While the discharges associated with the generated runoff are substantial, the volume of flow that it is conveyed to the area is such that complete retention of the 100-year event would be possible in the space available. A 4 ft deep basin with 1 ft of freeboard would provide 5.0 ac-ft of storage which would fully retain runoff from the 100-year event.



Benefits:

- Reduction in flow crossing Pasadena Ave, and continuing towards Stockton Hill Rd.
- Sediment catchment

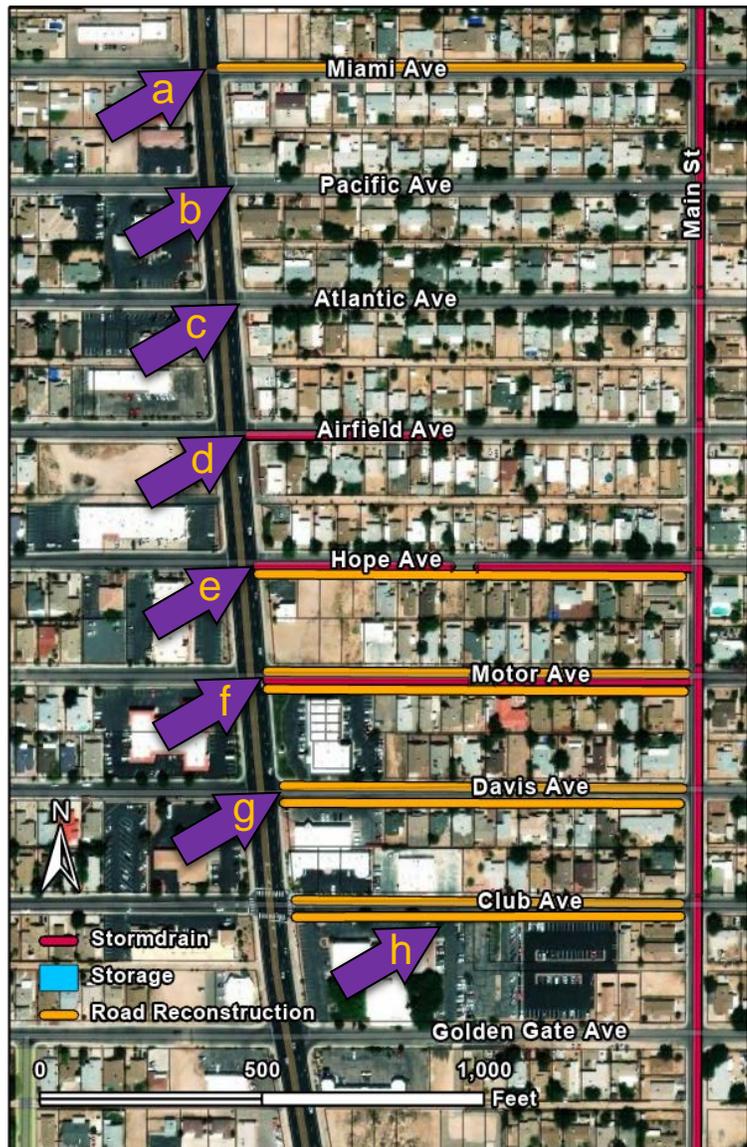
Considerations:

- Property acquisition from Mountain View Cemetery

Solution Name: 2.11 Neighborhood Road Reconstruction	Locations: Multiple – see descriptions a) through h) below	Area: 2
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

- a) Miami Ave. from Stockton Hill Rd. to Main St.
It is recommended that a 6 in wedge curb be added along the northern side of Miami St. and the attaching driveways be reconfigured to slope up to the new curb line. Sidewalk could be incorporated into the project, though given that it is not contiguous along the southern side, it could be omitted as a cost saving measure. This would be a 100-year solution. In the event that the Main St. stormdrain is constructed, the roadway flow could be in part directed to stormdrain via an 18 in lateral pipe and curb inlets.
- b) Pacific Ave. from Stockton Hill Rd. to Main St.
In the event that the Main St. stormdrain is constructed, the roadway flow could be in part directed to the stormdrain via an 18 in lateral pipe and curb inlets or, if possible, to the stormdrain in Stockton Hill Rd.
- c) Atlantic Ave. from Stockton Hill Rd. to Main St.
It is recommended that no improvements be made at this time.
- d) Airfield Ave. from Stockton Hill Rd. to Main St.
It is recommended that a 24 in lateral pipe with curb inlets be constructed within Airfield Ave. to capture runoff ahead of the areas where it breaks out of the road.
- e) Hope Ave. from Stockton Hill Rd. to Main St.



e) Hope Ave. from Stockton Hill Rd. to Main St.
To better convey runoff, the roadway could be reconfigured to an inverted crown cross-section, with curbs on each side. This section would convey roughly 50 cfs. Adding a 36 in stormdrain that connects to the stormdrain in Stockton Hill Rd. and a future stormdrain in Main St., would provide a 100-year solution. Runoff would be discharged into the system via transverse grates or by slotted drain.

Solution Name: 2.11 Neighborhood Road Reconstruction	Locations: Multiple – see descriptions a) through h) below	Area: 2
<p>f) <u>Motor Ave. from Stockton Hill Rd. to Main St.</u> To convey runoff, the roadway could be reconfigured to an inverted crown cross-section, with curbs on each side. This section would convey roughly 50 cfs. Adding a 36 in stormdrain that connects to the stormdrain in Stockton Hill Rd. and a future stormdrain in Main St., would provide a 100-year solution. Runoff would be discharged into the system via transverse grates or by slotted drain. The installation of the improvements recommended to Motor Ave. would decrease the runoff within Hope Ave. and could reduce the size of the measures recommended in Solution 2.11(e).</p> <p>g) <u>Davis Ave. from Stockton Hill Rd. to Main St.</u> By adding curb and sidewalk to both sides of the roadway, runoff flow could be contained within the street section.</p> <p>h) <u>Club Ave. from Stockton Hill Rd. to Main St.</u> By adding curb and sidewalk to both sides of the roadway, runoff flow could be contained within the street section.</p>		
Benefits: <ul style="list-style-type: none"> • Improvements to the roadway capacity in a large neighborhood • Reduction in street, yard, and structure flooding potential 	Considerations: <ul style="list-style-type: none"> • Should be considered as a neighborhood Improvement district type project • Additional detailed modeling should be completed to determine the individual and collective benefits of each sub-solution • Must be considered with other capital improvements slated for the area 	

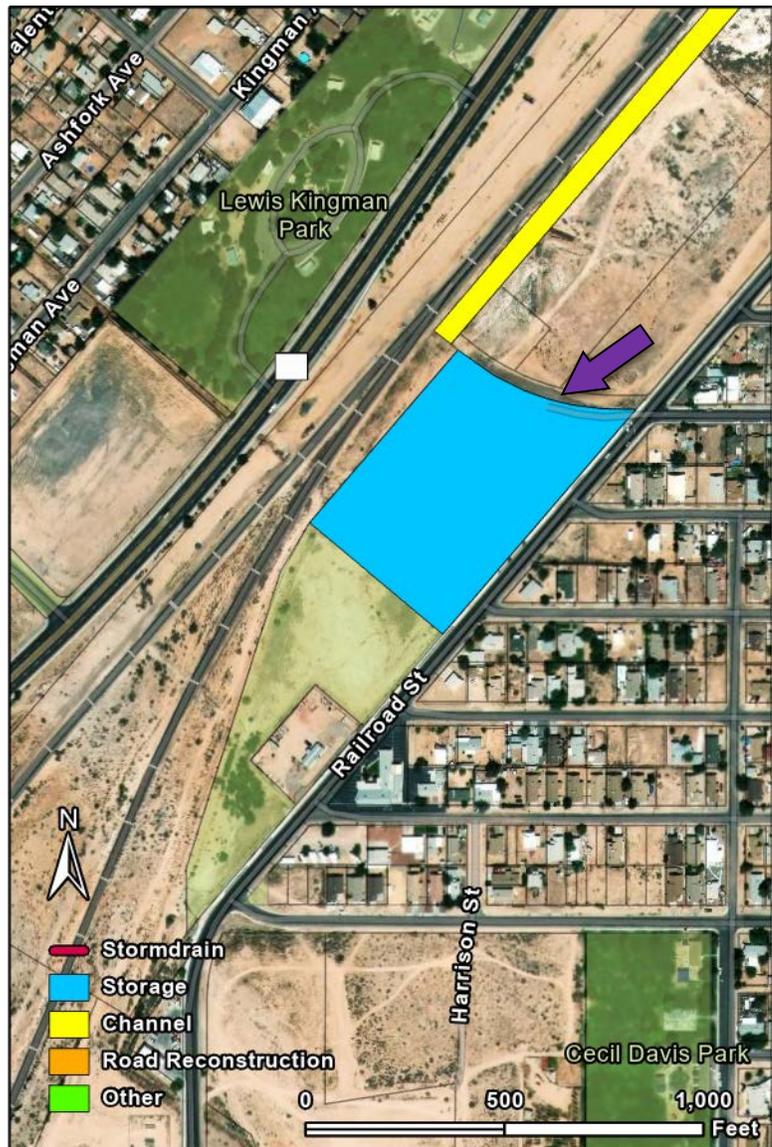
Solution Name: 3.1 Harrod Avenue Basin Upgrades	Location: West end of Harrod Ave.	Area: 3
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This basin is at the downstream end of Area 3 with the railroad forming the downstream outlet embankment. The FLO-2D modeling and personal accounts suggest that the west basin does the bulk of the work while the east basin is not fully utilized. The outlet configuration has a single 24 in pipe draining the west basin with a single 18 in pipe draining the east basin. A small weir connects the basin with the weir elevation approximately 4 ft above the west outlet culvert.

The proposed solution would construct a weir structure upstream of the west outlet to restrict flow entering the culvert. This structure would be elevated 2 ft above the interconnecting weir so that flow goes into the east basin before it goes into the culvert.

The interconnecting weir would be reconstructed to be 25 ft long and 1 ft lower than it currently is. This configuration would allow for approximately 200 cfs to flow into the east basin before flow exits the west basin. This configuration should not increase the west basin water surface elevation while potentially increasing the storage volume in the east basin by 8 ac-ft and reducing the potential for the west basin to overtop its embankment.



Benefits:

- Increases the total detention capacity and adds about 3 ft of full retention to the west basin

Considerations:

- Would reduce the discharge downstream

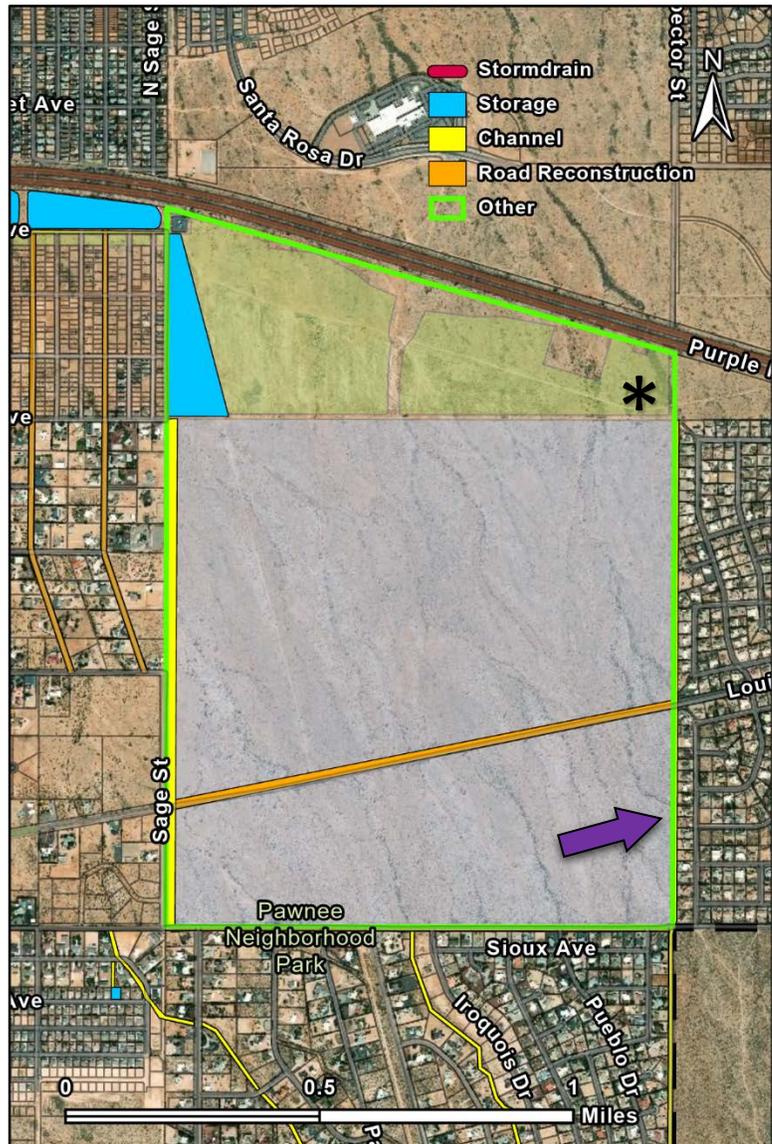
Solution Name: 3.2 Cherokee Street Regional Channel	Location: Cherokee St. and areas to northwest	Area: 3
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input checked="" type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

Multiple flow paths cross Cherokee St. in a northwesterly direction. These flows impact both developed and undeveloped areas near Cherokee St. and downstream. This solution proposes to channelize this flow and convey it north to some logical outlet while avoiding rerouting flows and increasing flooding elsewhere.

If all flow is taken directly to the ADOT ROW, there may be unintended consequences of concentrating the runoff. In order to make this solution work, the channel should outlet into a retention basin, which could be located in several places. Depending on the basin locations, proposed development in the area and land ownership, the solutions could vary significantly. Two options to consider are:

1. Capture flow and route into the State Land north of Southern Ave. and west of Cheyenne St., Construct basins on State Land to outlet into existing flow paths.
2. Capture flow and route flows north to city land adjacent to I-40. Construct a variety of basins or channels that limit impacts to I-40.



Benefits:

- Flood protection for the Hualapai Foothills neighborhood and undeveloped State Land area
- Would reduce flow along Cherokee St. and may provide emergency access

Considerations:

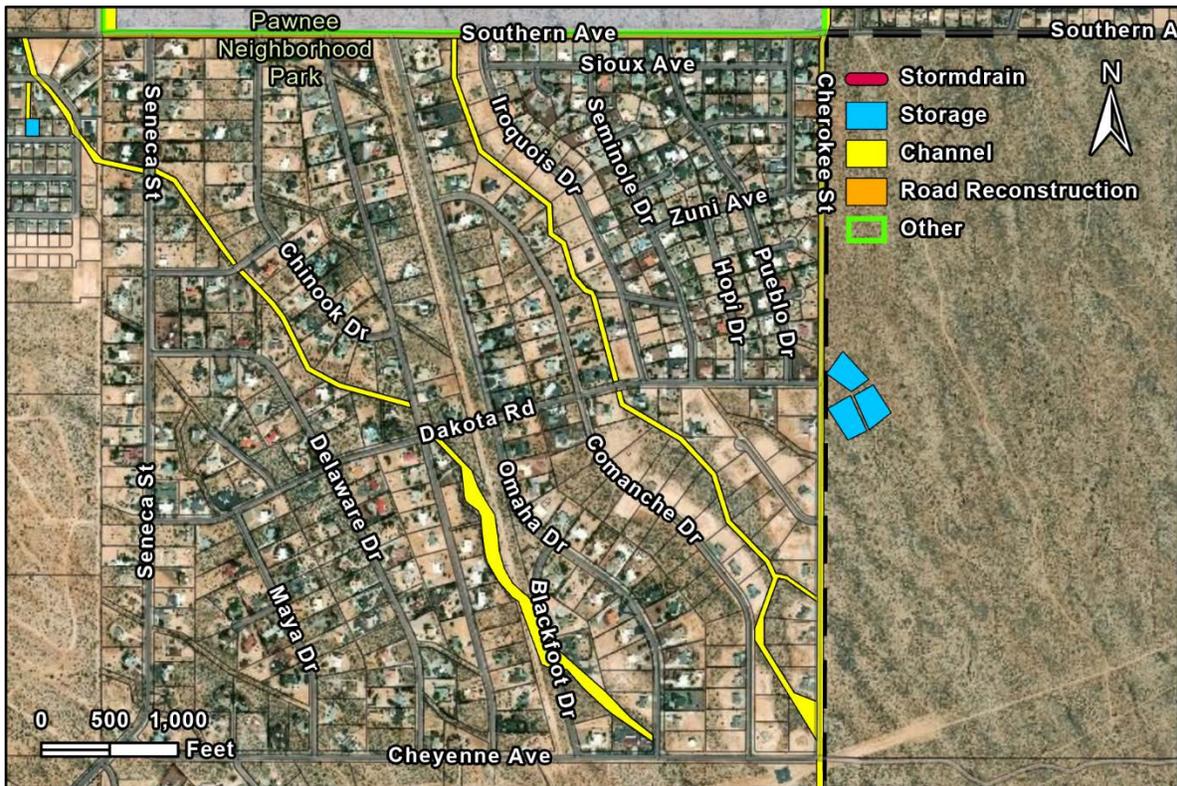
- State land coordination
- Dependent on future development
- This solution could produce adverse impacts or have unintended consequences to the state land, city land and ADOT ROW if not appropriately handled.

Solution Name: 3.3 Hualapai Neighborhood Improvements	Location: Hualapai Neighborhood	Area: 3
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

The Hualapai Neighborhood is transected by several flow paths which impact residential lots and streets. This project would add drainage improvements to the two primary drainage corridors. The first of these corridors is situated between Comanche Dr. and Iroquois Dr. The 100-year discharge is 330 cfs south of Dakota Road and increases to nearly 600 cfs before crossing Southern Ave. The second corridor is situated between Delaware Dr. and Chinook Dr./Omaha Dr. The 100-year discharge in this corridor is 420 cfs at Dakota Rd. and nearly 540 cfs at Seneca Ave.

Both drainage corridors lie within 40-foot-wide drainage easements and are currently unlined channels. This project would reconstruct these channels with hardened banks to convey greater flow. A rip-rap channel with an 8-foot bottom width could convey most, if not all, of the 100-year discharge in each of these corridors at a depth of 3 feet. Culverts would also be added at road crossings.



Benefits:

- Would reduce sediment within streets.
- Would reduce flooding of lots.

Considerations:

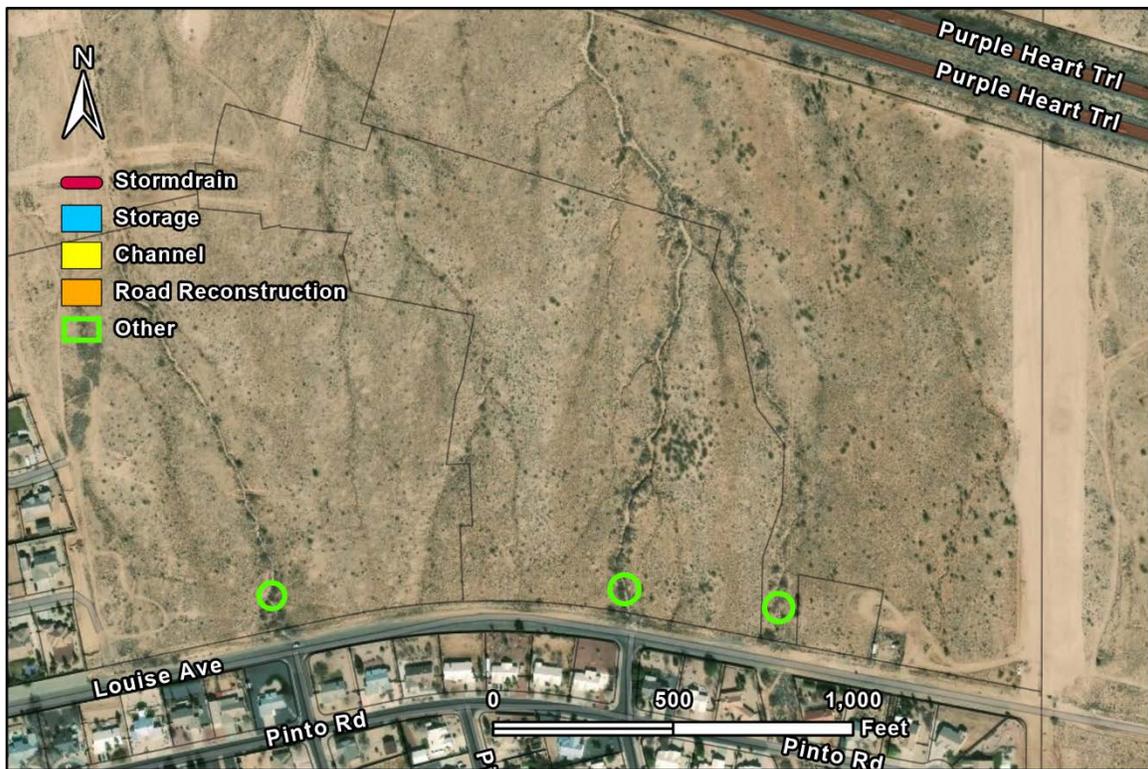
- If the Cherokee Street Channel (Solution 3.2) is installed east of Cherokee St., then the offsite drainage to this street is significantly reduced or eliminated.

Solution Name: 3.4 Louise Avenue Zuni Bowls	Location: Immediately north of Louise Ave. in three locations	Area: 3
Type of Solution: <input type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input checked="" type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input type="checkbox"/> Local <input checked="" type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

There are three incised washes that are north of Louise Ave. that could benefit from Zuni Bowls. Two of these washes are downstream of flow-conveying roads (Triangle St. and Running Iron St.) while the third is downstream of a wash that crosses Louise Ave.

This would be a good area to test some Zuni Bowls, except for the fact the land is privately owned. One Zuni Bowl could be placed on each of the three washes with the goal of protecting the road from future damage due to headcutting.

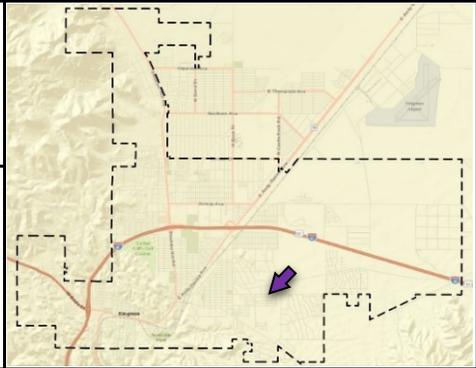


Benefits:

- Might reduce scour risk on Louise Ave. due to headward erosion

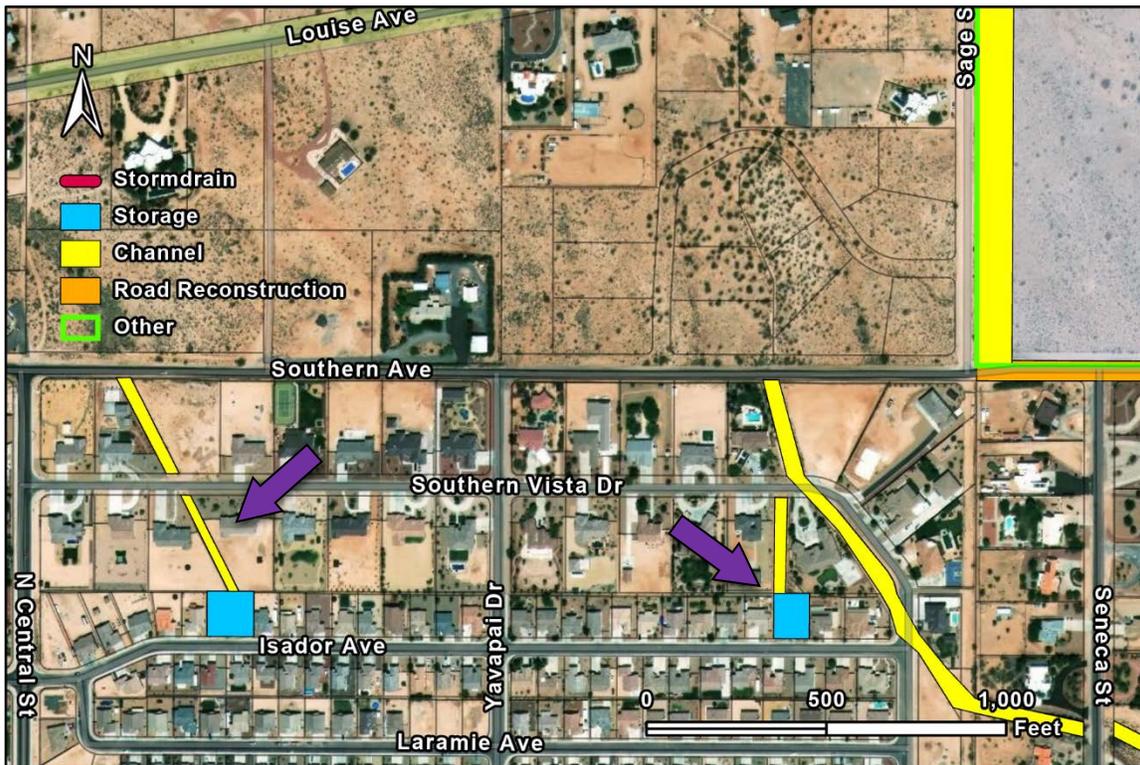
Considerations:

- Placement would be on private land

Solution Name: 3.5 Southern Vista Drainage Improvements	Location: Southern Vista Dr.	Area: 3
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

The Southern Vista neighborhood has been the subject of previous studies to resolve flooding problems. This neighborhood is impacted by flows with 100-year discharges exceeding 500 cfs. These flows are poorly conveyed through limited internal infrastructure and drainage easement areas. This project would improve the flow conveyance within the established drainage corridors as shown on already prepared plans by the City of Kingman and Bull Mountain Engineering. This would include improving two existing drainage easements and two existing basins. Culverts may also be added across Southern Vista Drive and upsized along Southern Ave. Adding these improvements would limit flooding within lots and would improve all-weather access. With the last 5 years of development along Isador Ave, the flow conditions have changed although there still appears to be drainage conveyance issues. Any design will need to be updated to reflect the current development and coordinate with the surrounding development.



Benefits:

- Would reduce on-lot flooding
- Could reduce sediment in roads

Considerations:

- If the Cherokee Street Channel (Solution 3.2) is installed east of Cherokee St., then the offsite drainage to this location is reduced.

Solution Name: 3.6 Franklin Drive/Eastern Street Reconstruction	Location: Franklin Dr. and Eastern St.	Area: 3
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure <input type="checkbox"/> Masterplan	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

Franklin Dr. is an uncurbed street and is a primary conveyance corridor for flow between Southern Ave. and Eastern St. The 100-year flow rate in this road is 20 cfs at Southern Ave. and as much as 175 cfs at Pasadena Ave. The flow within Franklin Dr. continues on in Eastern St. to flow north and combine with additional flow from Broudy Dr.

The proposed project would add curbs to both Franklin Dr. and Eastern St. The road would be rebuilt with 2-11 ft lanes and 4 in roll curb. From Southern Ave. to Pasadena Ave. the road could convey 18 cfs within the curbs and 58 cfs within the ROW.

The project is not quite clear from Pasadena Ave. to Eastern St. due to flow exiting the road at a dip into what appears to be a 20 ft drainage easement. This easement has a slope of less than 0.3 percent towards Eastern St., however there is a slope of over 0.7 percent to an open lot. This project might improve this easement or simply ignore it and pick the flow back up on Eastern St. with a similar design and capacity as mentioned for Franklin Dr.



Benefits:

- Keeps flow to the pavement which could reduce sedimentation issues
- Might reduce on-lot flooding

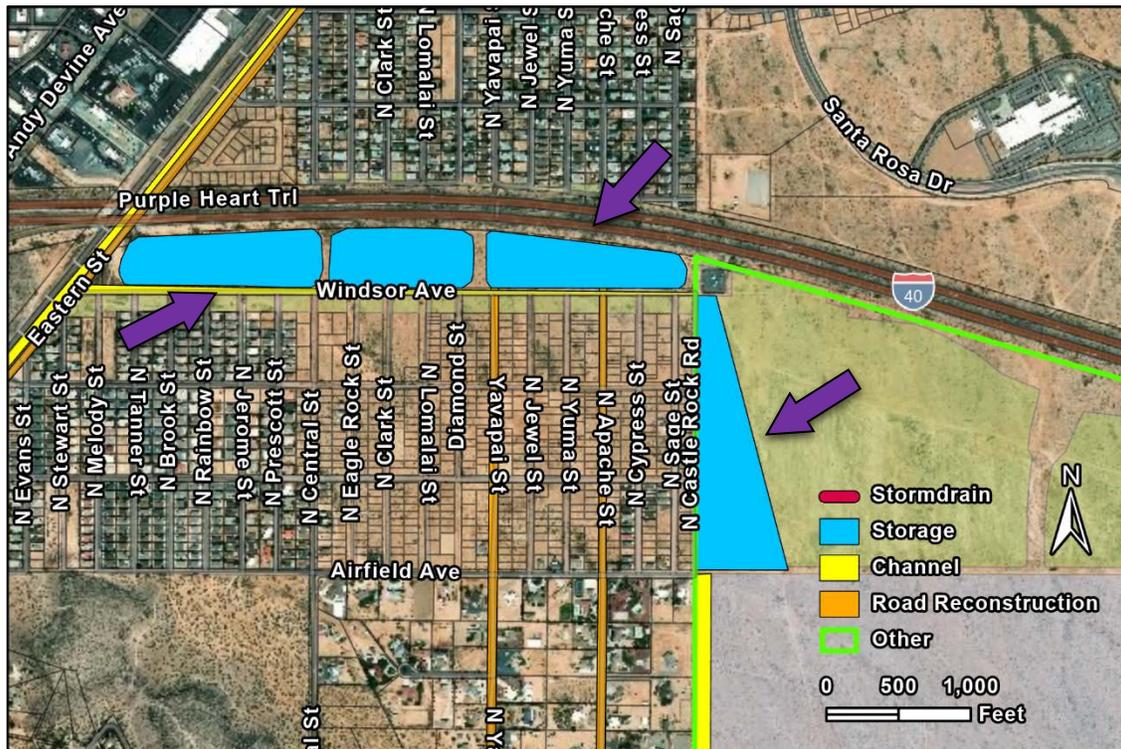
Considerations:

- The Eastern Street Improvements (Solution 3.12) would separately improve Eastern St.

Solution Name: 3.7 I-40 Regional Retention	Location: North of Airfield Ave. and east of Sage St.	Area: 3
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This project consists of constructing one or more detention/retention basins along Windsor Ave. and east of Sage St. The basins along Windsor Ave. have been previously considered as a part of the Railroad Diversion Channel and could be constructed independent of that project to reduce flooding downstream. The basin to the east of Sage Street could be constructed in various locations and might provide a place to drain the State Land Channel and/or the Cherokee Street Channel into. Depending upon the size of this basin it could significantly reduce flooding downstream.

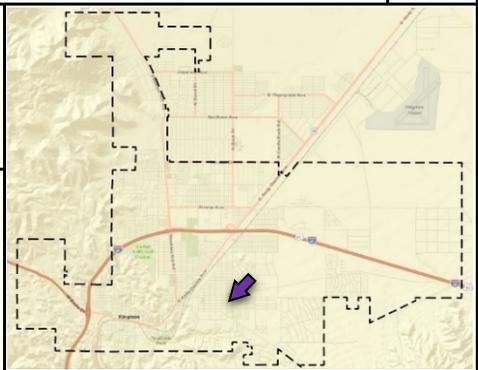


Benefits:

- Allows for other projects
- Reduces discharges downstream

Considerations:

- The State Land Channel (Solution 3.15) would drain into here.
- This basin needs to be coordinated with development of adjacent land.
- Basin outlet and downstream impacts need to be analyzed
- This basin needs to be coordinated with development of adjacent land.

Solution Name: 3.8 Dry Wells – Green Hole and School basins	Location: Green Hole basin near Southern Ave. and Eastern St.	Area: 3
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input checked="" type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This is an existing basin which holds some 37 ac-ft of the 100-year storm with a depth of over 7 ft. Flow enters this basin from curbed streets and exits the basin via a single 30 in outlet. Assuming a 36-hour drain time, the average flow rate needs to be 13 cfs out of this pipe. A HEC-1 model suggests this basin can drain in less than a day.

Two design options are proposed. The first is to restrict the outlet to reduce flow downstream while adding in dry wells to drain the basin into the ground. If we assume 37 ac-ft is drained in 36 hours by dry wells alone, and each has a 0.05 cfs capacity, then we would need 50 dry wells to fully drain the basin without an outlet. 10 dry wells may instead be added in conjunction with reducing outlet flow.

Secondly, this basin might be modified to increase storage by adding internal berms to divide the basin into a complex of basins. The southeast corner of the basin is about 14 ft deep, but the maximum depth is about 4.5 ft deep. The basin could have internal berms added with overflow weirs and outlet pipes to detain and retain more water.



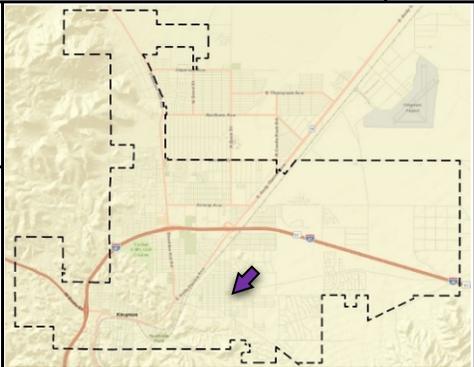
Benefits:

- Increase ground water recharge through dry wells
- Reduce peak discharges downstream

Considerations:

- If stormdrain is added to Southern Ave. and/or Eastern St., added retention might be appreciated.

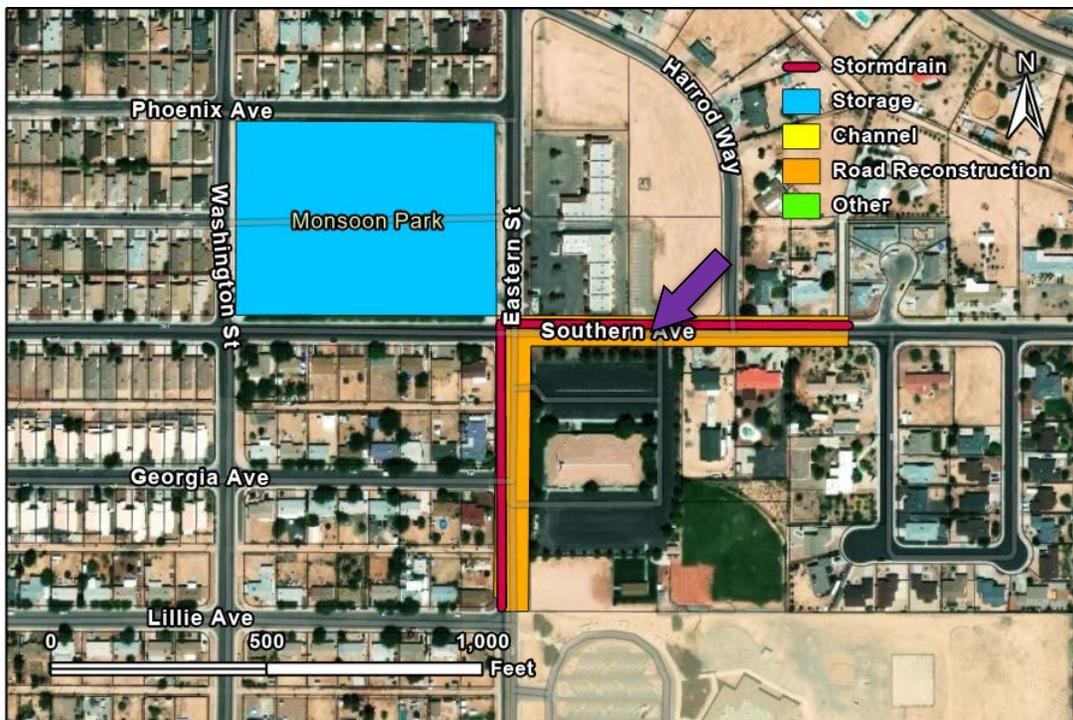
Solution Name: 3.9 Southern Avenue/Eastern Street Reconstruction and Stormdrain	Location: Southern Ave./Eastern St.	Area: 3
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Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal		

Description:

Southern Ave. and Eastern St. are currently paved and have curb and gutter. Flows in the streets are significant with 100-year discharges approaching 200 cfs in each street and flow depths exceeding 12 inches near their intersection adjacent to the Green Hole/School Basin. This project would add stormdrain to both streets with a drain into the existing basin. Assuming full flow and an RCP stormdrain, the table below lists the capacity of a stormdrain in these streets for various sizes.

Size	Q-max	Comment
36	23	~ Q2
48	49	~ Q5
60	89	~ Q10

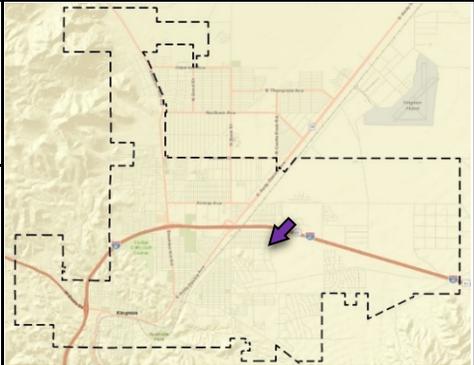


Benefits:

- Reduces depth in street
- Could improve emergency access

Considerations:

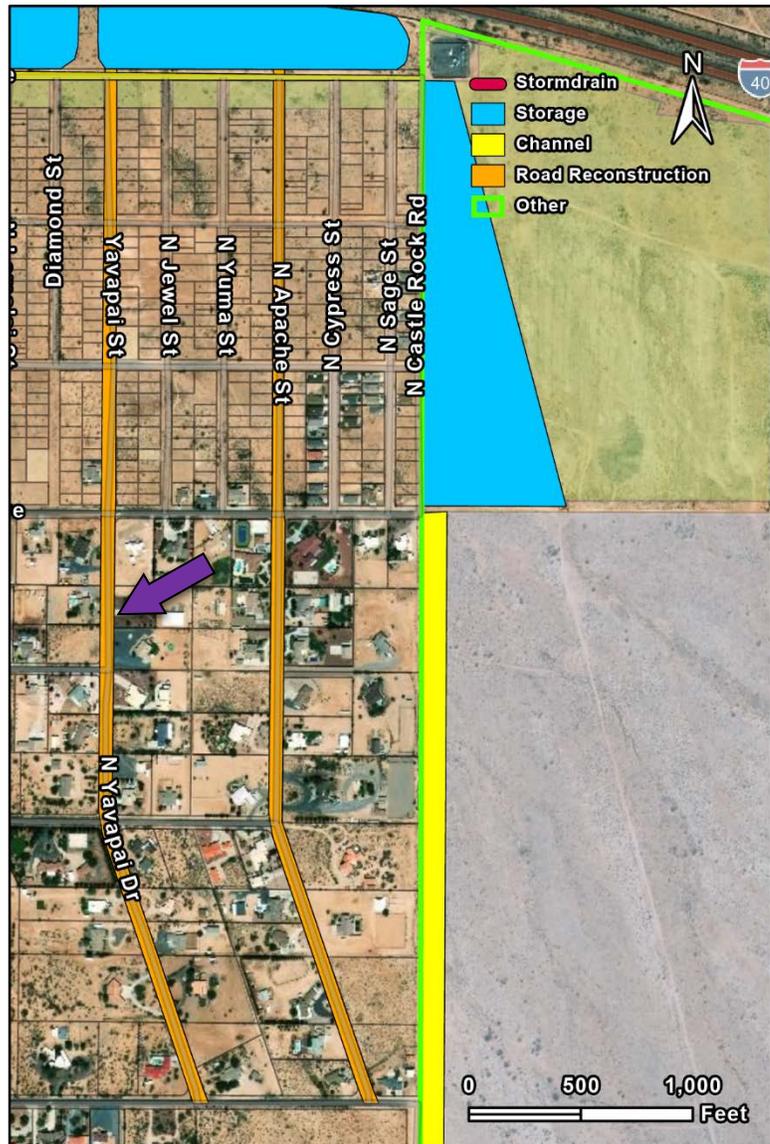
- Might warrant reconfiguration of the Monsoon Park Basin

Solution Name: 3.10 Yavapai Drive Improvements	Location: Yavapai Dr.	Area: 3
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

The 100-year flow in Yavapai Dr. is over 300 cfs between Pasadena Ave. and Berry Ave. This road has a 60 ft ROW and slopes at 2.2 percent. Flow increases to 400 cfs between Berry Ave. and Airfield Ave. and the slope here is 2.1 percent while the ROW is 60 ft. North of Airfield Ave. the ROW is reduced to 55 ft, the slope is 1.5 percent, and the discharge remains at 400 cfs.

This project would construct 2-11 ft lanes with 4 in roll curb to convey 19 cfs in the street and 60 cfs in the ROW. Driveways may need to be reconstructed.

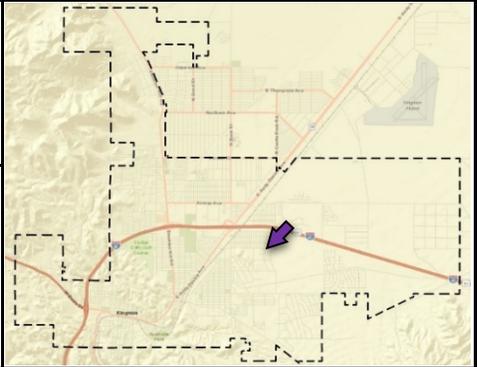


Benefits:

- Could reduce on-lot flooding
- Could reduce sediment in roads

Considerations:

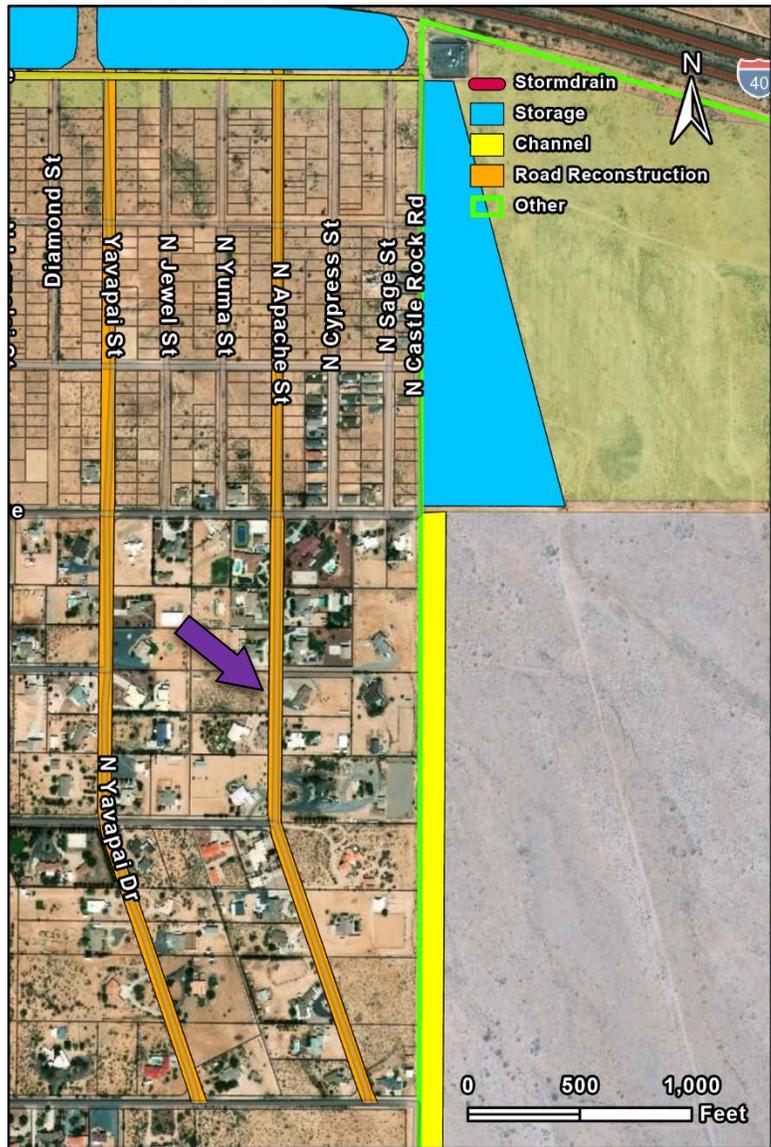
- Widened road section with inverted crown may improve conveyance

Solution Name: 3.11 Apache Drive Improvements	Location: Apache Dr.	Area: 3
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

The flow in Apache Dr. is relatively minor but presents a nuisance and sedimentation issue.

This project would construct 2-11 ft lanes with 4-inch roll curb to convey 19 cfs in the street and 60 cfs in the ROW. Driveways may need to be reconstructed.



Benefits:

- Could reduce on-lot flooding
- Could reduce sediment in roads

Considerations:

- This project may not be needed if the State Land Channel is constructed upstream

Solution Name: 3.12 Eastern Street Improvements	Location: Pasadena Ave. to Airway Ave.	Area: 3
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This project would improve Eastern St. to a three-lane road from Pasadena Ave. to Airway Ave as shown on 2017 plans by RPA. This project would also include storm drain, catch basins, scuppers, box culverts, pipe culverts, and erosion protection.



Benefits:

- Improves all-weather access of Eastern St.

Considerations:

- This project would complement the Franklin Drive improvements.

Solution Name: 3.13 Railroad Diversion Channel	Location: Louise Ave. to Rattlesnake Wash.	Area: 3
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Type of Solution: <input checked="" type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	
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Description:

This solution has been studied by URS. Some current observations are:

The railroad embankment impounds flows at the downstream end of Area 3. There are openings in the embankment to drain flow, but the openings are not large enough and are not located on all flow paths. It has been proposed to construct a channel along the southeast side of the railroad to convey flow northeast to a logical outfall.

This project proposes to build a channel to reduce the impounded flooding along the railroad embankment and to convey flow to logical locations while not increasing flooding elsewhere. To prevent the increase of flooding due to this project, series of 3 detention basins is proposed along Windsor Ave. to reduce flood flows that currently come from the east.

This project would construct a channel from Louise Ave. to the Diagonal Wash where some flow is drained to the Diagonal Wash. The railroad channel would then continue to the Rattlesnake Wash as the ultimate outfall. The slopes in portions of this reach are steep leading to supercritical flow conditions.

Reach	R16	R15	R14	R13	R12	R11	R10	R9	R8	R7	R6	R5	R4	R3	R2	R1
Slope	0.20%	0.43%	0.33%	0.35%	0.35%	0.65%	0.50%	0.25%	0.25%	Subcritical	0.20%	0.50%	0.30%	0.55%	0.20%	0.20%
Flow Condition	Subcritical	Subcritical	Supercritical	Supercritical	Supercritical	Supercritical	Supercritical	Subcritical								

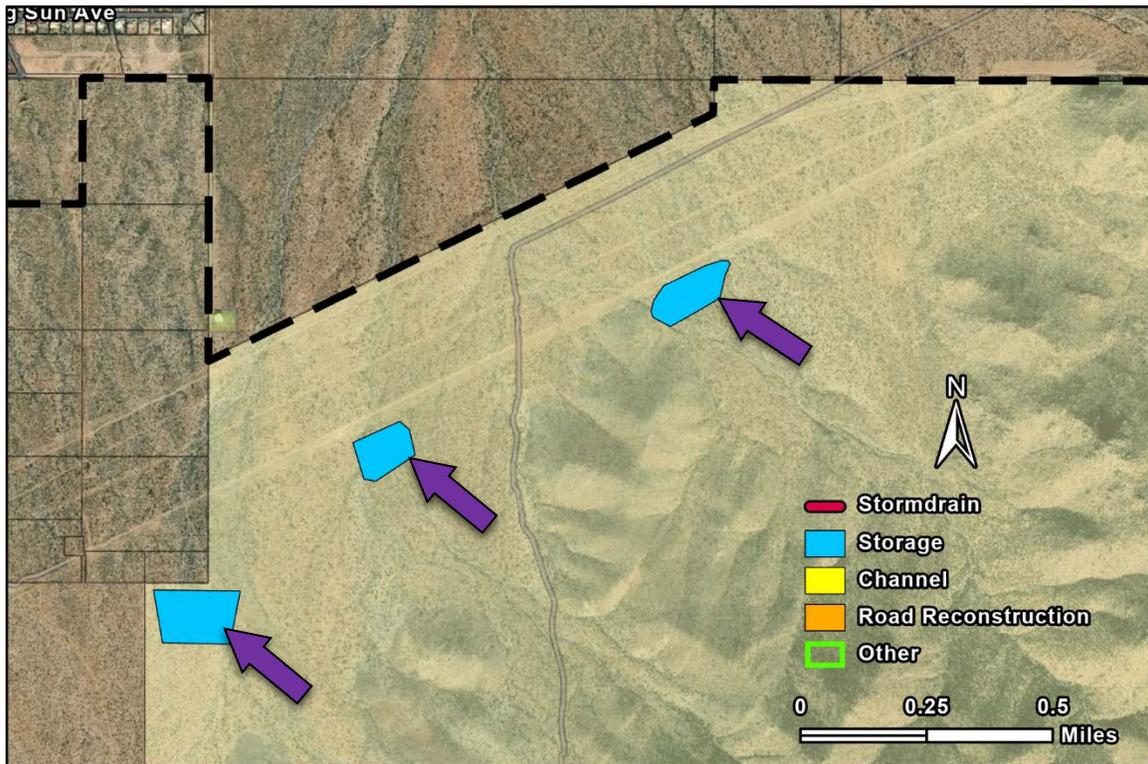
Benefits: <ul style="list-style-type: none"> This channel could reduce flooding on Andy Devine Ave. The basins could reduce flooding downstream within Andy Devine Ave. 	Considerations: <ul style="list-style-type: none"> Note that the area to the southwest of the Ross Ave. alignment may not be feasible for building a channel due to conflicts and topography. This channel may not reduce flooding in adjacent areas (near the channel). HAZUS analyses already performed have indicated the cost of this project far exceeds the likely benefit.
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Solution Name: 3.14 BLM Basins	Location: West of neighborhoods on BLM land	Area: 3
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input checked="" type="checkbox"/> Federal	

Description:

Significant flow paths could be detained on BLM land through either online or offline basin arrangements. In an offline scenario, a series of basins would be constructed with a flow diversion structure placed upstream in the main flow path. Lower flows would continue downstream while higher flows would enter into the basins. These basins would have retention below their weir outlets. Preliminary calculations suggest one of these complexes could reduce the 100-year discharge of 3,450 cfs down to 2,300 cfs.

In an online scenario, the basins are excavated to a significant depth to provide the maximum retention volume possible. This scenario might completely hold the 10-year event volume. The 100-year event in one of the watercourses is estimated to be reduced from 3,450 cfs to 1,050 cfs while retaining 84 ac-ft.



Benefits:

- Would reduce discharges
- An online basin would reduce sediment downstream which may be perceived as a benefit.
- Benefits are primarily found in undeveloped areas.

Considerations:

- The depth to rock is unknown, but if shallow would greatly impact this project.
- Existing utilities exist (gas line) and must be avoided.
- Downstream berms heights should be limited.

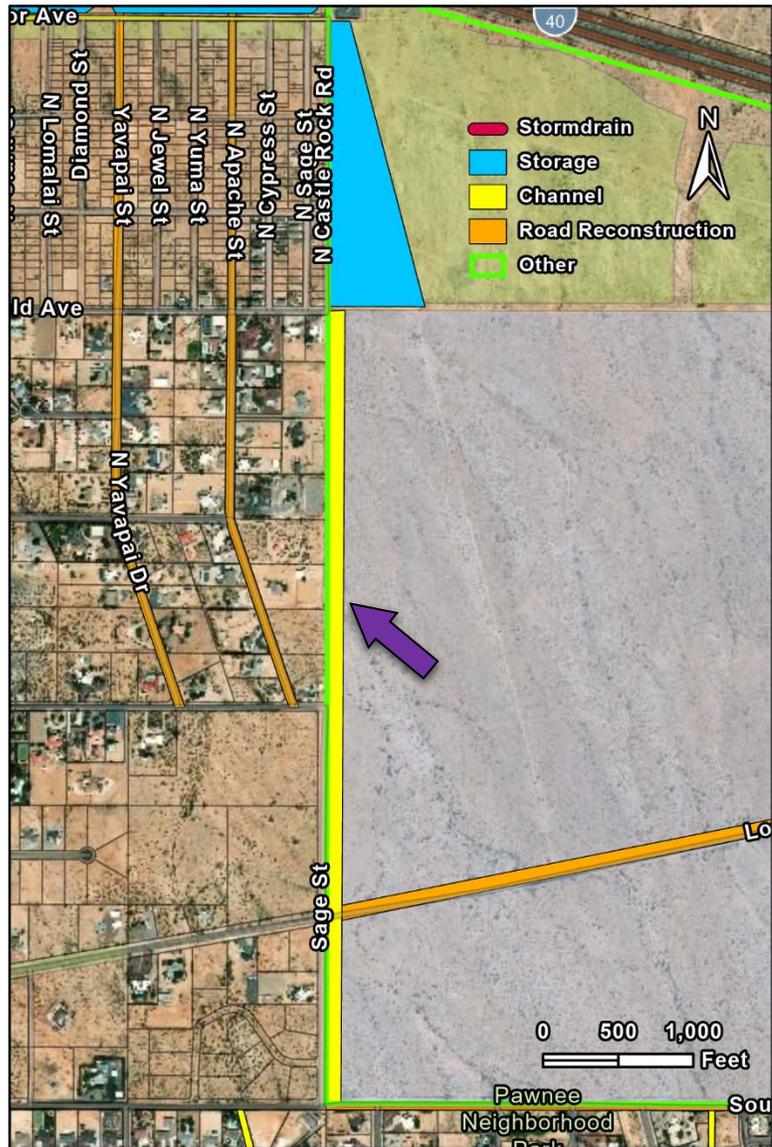
Solution Name: 3.15 State Land Channel	Location: From Southern Ave. to Airfield Ave. along Sage St.	Area: 3
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input type="checkbox"/> City / County <input checked="" type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This project is located along/near the Sage St. alignment which is impacted by several large flow corridors. The discharge in this area to the south of Louise Ave. is 50 cfs and increases to 360 cfs halfway between Louise Ave. and Airfield Ave.

This project would utilize the State Land east of Sage St., which slopes at 1.5-2.1 percent to the north, to construct a trapezoidal channel. A 6 ft bottom width, riprap channel could convey 440 cfs at a depth of 3 ft.

This channel needs a place to outlet and should be constructed along with the I-40 basin. Without this downstream basin, the channel would increase flooding wherever it releases flood flow.



Benefits:

- Would reduce flooding to the west of Sage St. and would reduce flooding along Sage St.

Considerations:

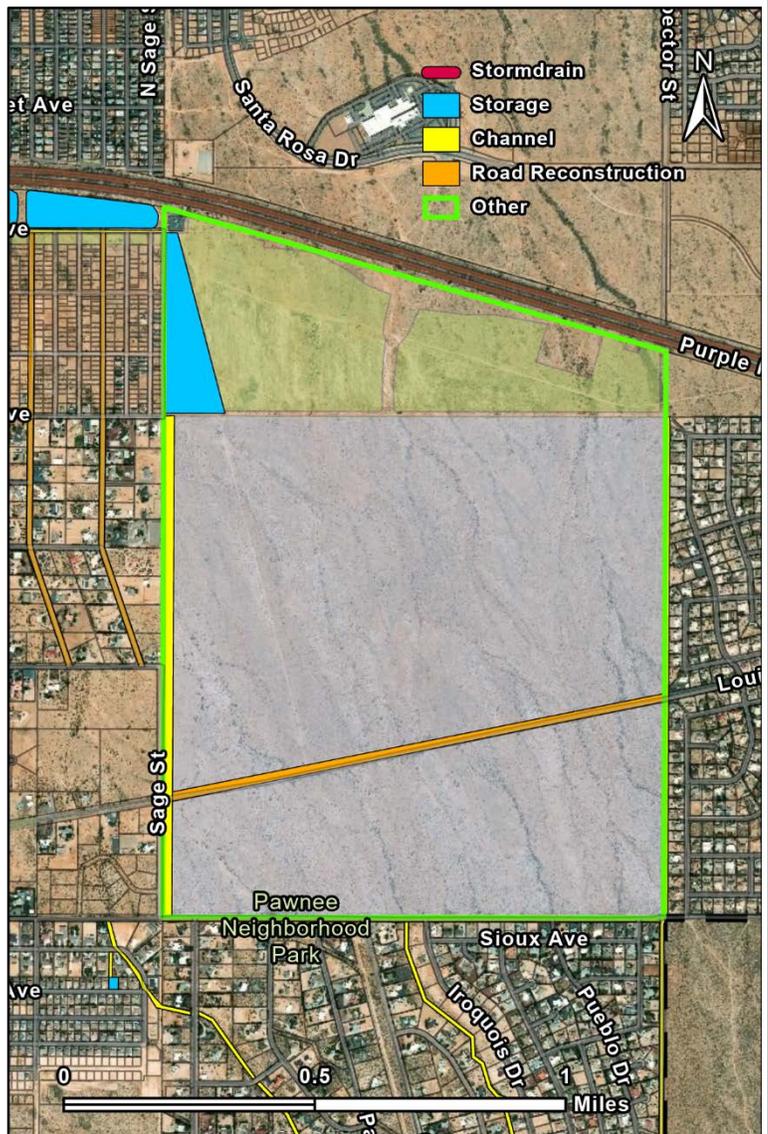
- This channel could drain into the I-40 regional basin and would only work with the basin to accept this flow (otherwise flow would be diverted).
- Discharges would change if Louise Avenue basin goes in.

Solution Name: 3.16 State/City Land Master Plan	Location: Area bounded by Southern Ave., Cherokee St., I-40, and Sage St.	Area: 3
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input checked="" type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

There is a large area of State Land and City Owned Land in the vicinity of a proposed traffic interchange on I-40. This area includes many moving pieces including various land ownership and development potential. The area also has significant flood risk due to the many flowpaths that cross the property. When development occurs, it is critical that a drainage masterplan for the area be developed. This plan should take into account potential changes in the drainage patterns due to other drainage related projects in the vicinity. In addition, road improvements should take into account all weather access to surrounding neighborhoods on Southern and Louise Avenues. Since the runoff that crosses this section ultimately ends up in Unnamed Washes 6 and 10, each development project should consider providing significant retention volumes to mitigate both discharge and volumetric increases to the flow translating downstream.

Due to the high variability of the development, the masterplan has not been developed as a part of this plan.



Benefits:

- Planning for development while considering current drainage patterns and impacts.

Considerations:

- Analyze volumetric increases to downstream flow with development.
- Integrate groundwater recharge and adequately sized drainage facilities.

Solution Name: 3.17 Southern Avenue Erosion Protection	Location: Between Sage St. and Cherokee St.	Area: 3
Type of Solution: <input type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

There are four main threads and some other minor threads that cross Southern Ave. between Sage St. and Cherokee St. These flows produce a sedimentation issue requiring maintenance.

This project would reconstruct Southern Ave. to drain from south to north. Curbs may be added on the south side to control flow entering the road and a v-ditch could be constructed to direct flow towards low points.



Benefits:

- Reduced sedimentation along the road

Considerations:

- If the Cherokee Street Regional Channel is constructed, some of these problems would be reduced.

Solution Name: 3.18 Hualapai Mountain Road Retention	Location: Hualapai Mountain Road	Area: 3
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Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

There is a 100-year discharge of 150 cfs flowing along the north side of Hualapai Mountain Road, just west of Central St. This flow ends up in Hualapai Mountain Rd. and enters residential lots downstream.

This solution would build a basin 200 ft wide basin by 300 ft long with a slope of 0.5 percent. The basin outlet would be a pair of 36 in pipes set 18 in above the floor to provide retention and sediment storage. A weir would be constructed 4 ft above the floor with a maximum basin storage depth of 5 ft. Preliminary modeling suggests this basin would reduce the 100-year discharge from 150 cfs down to 95 cfs.

Benefits: <ul style="list-style-type: none"> Reduced flooding in Hualapai Mountain Rd. and residential lots 	Considerations: <ul style="list-style-type: none"> Required property acquisition
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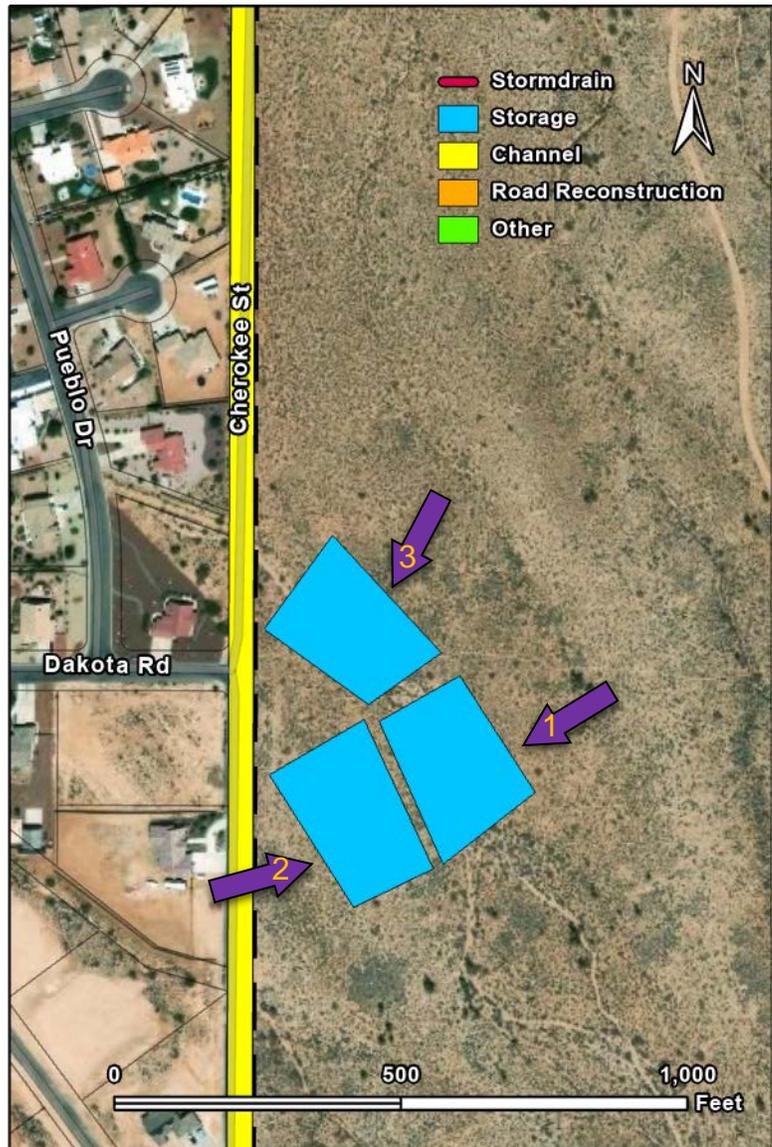
Solution Name: 3.19 Cherokee Street Basin	Location: East of Cherokee St.	Area: 3
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

A discharge of 588 cfs impacts Cherokee St. north of Dakota Rd. This flow is conveyed down Pueblo Dr. and floods residential lots.

This project would construct a basin to detain part of the flow. This basin might be a series of basins located east of Cherokee St. on private land.

The upstream basin would split the flow to Basins 2 and 3 at different rates. Basin 2 would not have flow directed into it until around the 20-year event while Basin 3 (to the north) would have flow in all events. This design might reduce the 10-year discharge from 139 cfs to 52 and the 100-year from 582 to 400 cfs.



Benefits:

- Reduces flow to downstream residential areas.

Considerations:

- Would reduce discharge impacting the Cherokee Channel and might reduce inflow impacting Louise Ave.
- Requires the use of currently private land.

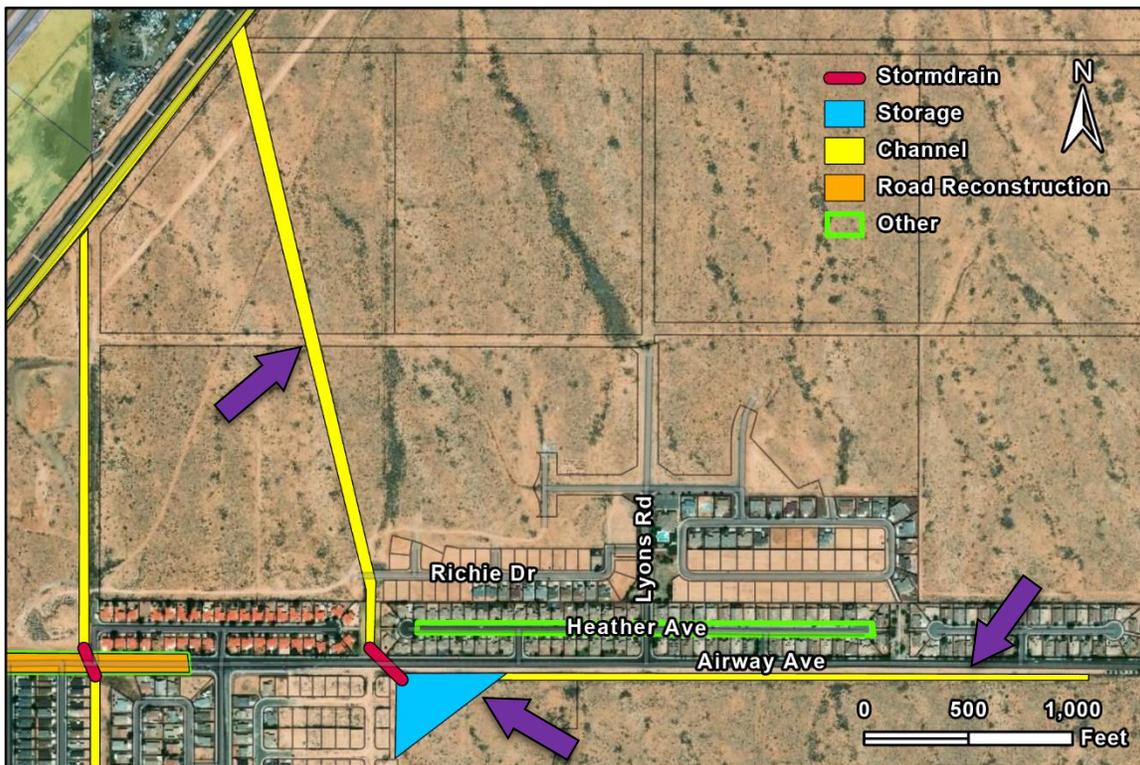
Solution Name: 4.1 Airway Avenue Retention	Location: South of Airway Ave. between McClintock St. and Prospector St.	Area: 4
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

Solution will intercept all flow approaching Airway Ave. from the south between McClintock St. and Prospector St. and route it into a retention basin at the corner of Airway Ave. and McClintock St. The basin will discharge through a pipe to the channel north of McClintock St. and the downstream channel will convey all runoff to the north to the railroad channel.

A variation would be to not construct the downstream channel to the railroad until the area develops. This would remove all offsite runoff from Heather Ave.

The Airway channel would be a 4 ft deep triangular riprapped channel. The basin could reasonably provide approximately 10 ac-ft of storage and would outlet through a 4 ft x 10 ft RCBC across Airway Ave. to the north. The downstream channel would be a 4 ft deep trapezoidal channel with a 10 ft wide bottom.



Benefits:

- Remove most runoff from Heather Ave. and Airway Ave.
- Provide attenuation and infiltration opportunities

Considerations:

- Increase in discharge downstream of McClintock St.
- If the downstream channel is not constructed it may adversely impact the downstream properties
- Must coordinate with development of lot to south

Solution Name: 4.2 Airway Drainage	Location: Airway Ave. near Castle Rock Rd.	Area: 4
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution includes possible reconstruction of Airway Ave. in the vicinity of Castle Rock Rd. Although the road does have a stormdrain system with curb inlet catchbasins, there are still reports of flooding on the road in larger events. Due to the existing conditions, this solution was not developed but should be considered if other projects are completed in the area.



Benefits:

- Increased all weather access
- Reduction in maintenance

Considerations:

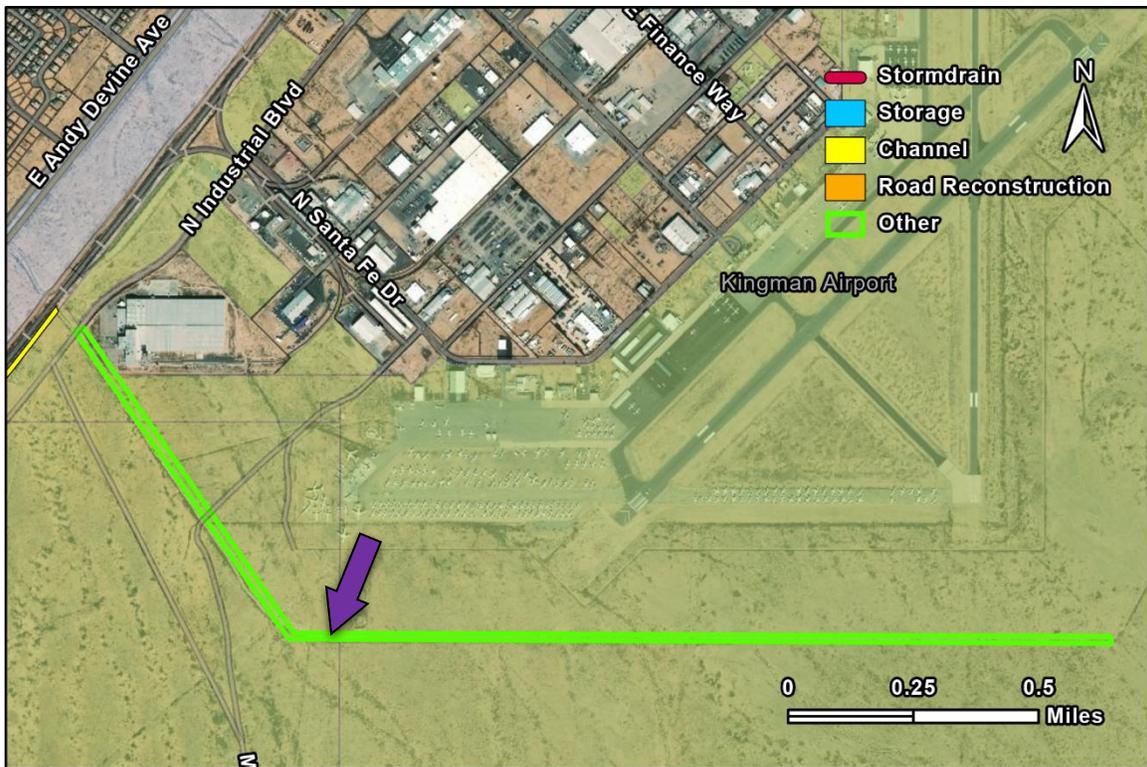
- Project could be constructed in conjunction with the Castle Rock Channel

Solution Name: 4.3 Airport Berm Reinforcement/Channel	Location: Kingman Regional Airport	Area: 4
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution includes evaluation and possible reconstruction of the berm surrounding Kingman Regional Airport. In conjunction, a collector channel could be constructed with the berm to promote conveyance to the west.

This solution was not developed since it should be considered in conjunction with future airport work or development of the surrounding land if necessary.



Benefits:

- Protection of the airport if the existing berm were to breach

Considerations:

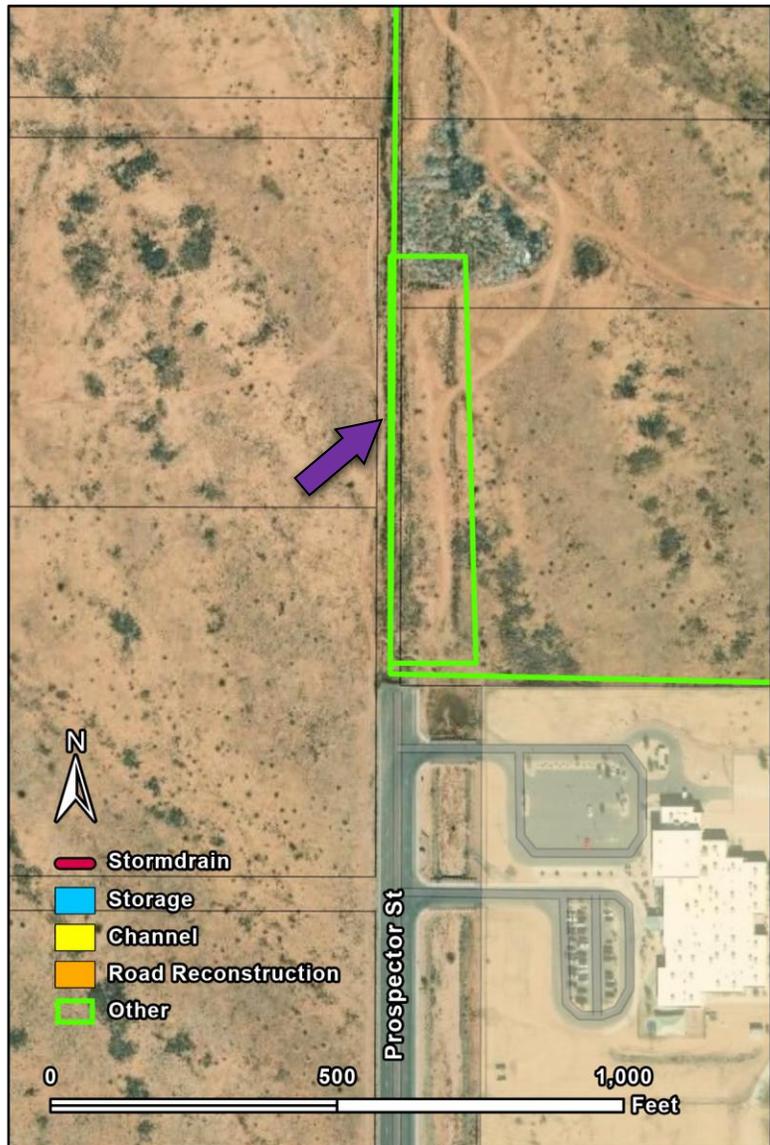
- Should be considered with the potential development upstream of the berm.

Solution Name: 4.4 Prospector Channel Outlet	Location: Prospector Channel	Area: 4
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This project includes channel grading downstream of the north end of the existing channel east of Prospector St. The current channel dead ends, and reconstruction of the outlet would help limit the current backup.

The problem does not currently impact buildings or infrastructure and should be considered when development occurs downstream of the current channel.



Benefits:

- Increased conveyance capacity at the north end of the Prospector Channel

Considerations:

- Should be considered with additional development to the north

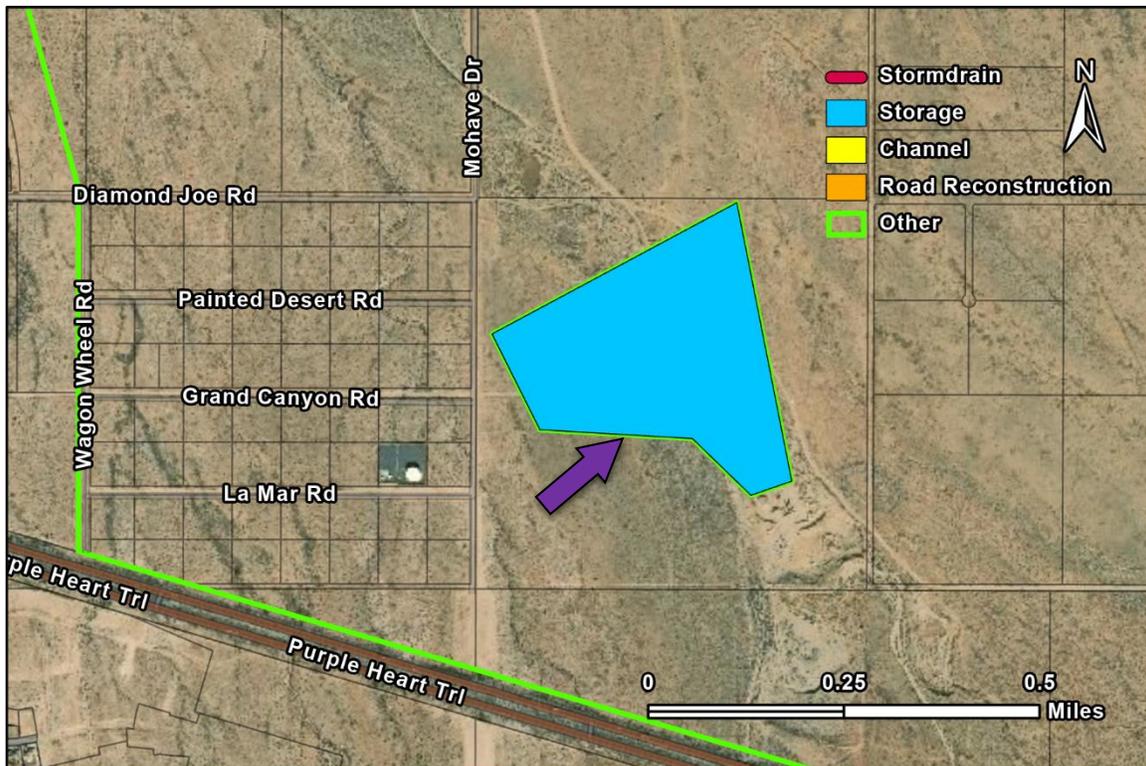
Solution Name: 4.5 Rattlesnake Regional Retention	Location: Rattlesnake Wash north of I-40	Area: 4
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

There is potential for implementation of large regional retention/infiltration basins within or adjacent to Rattlesnake Wash, north of I-40.

While these may not provide a direct benefit to current development, they may prove beneficial to future development and provide infiltration opportunities.

The solution was not developed further here since basins should be considered with the preparation of a Rattlesnake Wash Masterplan.



Benefits:

- Infiltration opportunities
- Flood attenuation

Considerations:

- Must be developed in conjunction with Rattlesnake Wash Masterplan

Solution Name: 4.6 Rattlesnake Wash Drainage Master Plan	Location: Rattlesnake Wash north of I-40	Area: 4
Type of Solution: <input type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure <input checked="" type="checkbox"/> Masterplan	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

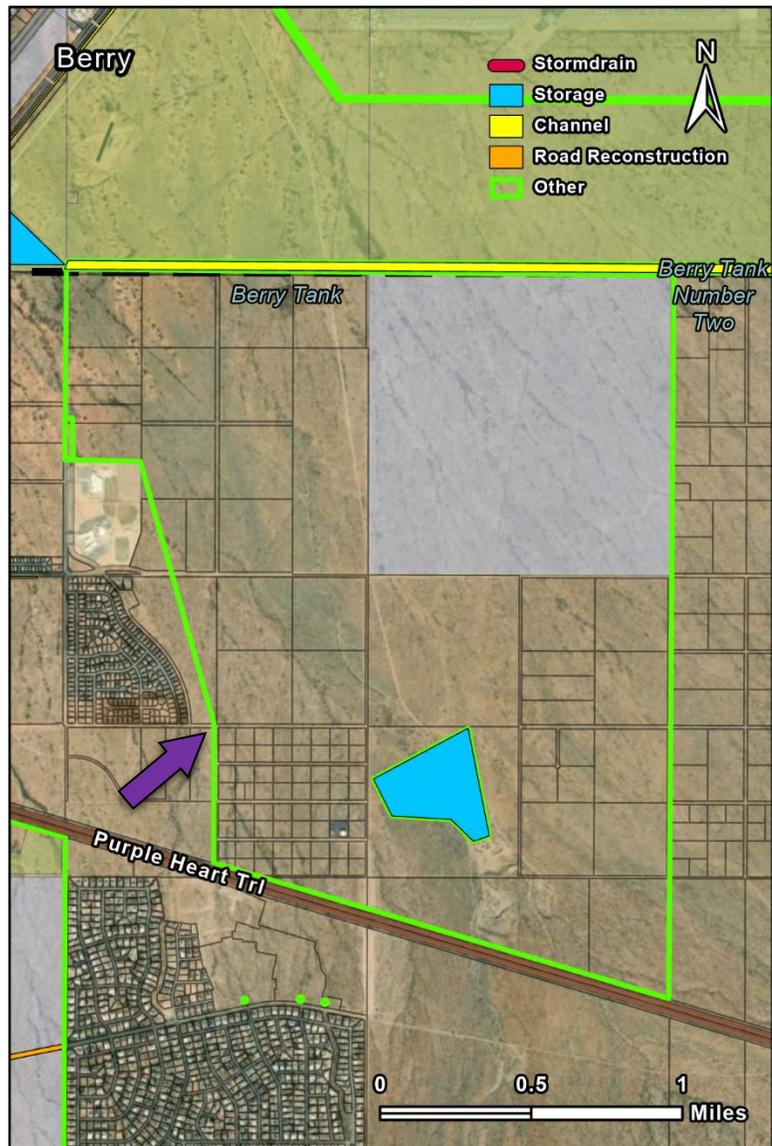
Description:

There is a significant area of undeveloped land east of the developments and schools on Airway Ave. There is also a proposed traffic interchange on I-40 that would provide access to this area.

The flow is highly distributed throughout the site, and there are proposed floodplains that have been defined, though not yet approved by FEMA at this time.

Any development should be regulated to these proposed floodplain limits. In order to limit adverse impacts to surrounding properties as single properties develop, a drainage masterplan for the area should be prepared by the primary landowner working closely with the City of Kingman.

Further development of this plan is not included with this solution.



Benefits:

- Would provide a coherent and coordinated approach for design the drainage element implementation in the area.

Considerations:

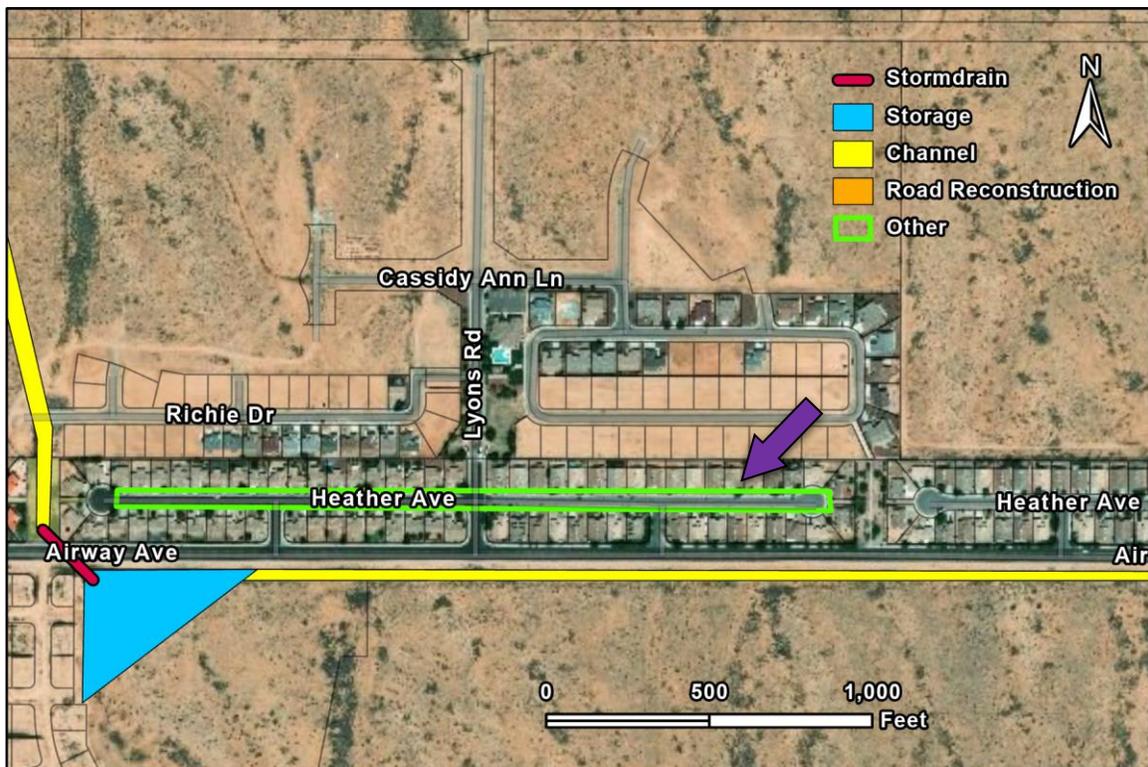
- Development will likely cause drainage pattern changes if it is done in sections rather than in a larger coordinated masterplan fashion.
- Consider volumetric increases to runoff

Solution Name: 4.7 Heather Avenue Dry Wells	Location: Heather Ave.	Area: 4
Type of Solution: <input type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input checked="" type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input checked="" type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution includes implementation of LID measures along Heather Ave. Possible solutions include integrating landscaped parkways along the roads that drain with drywells or other infiltration techniques.

This solution does not directly improve existing flooding issues in the area and is not further developed with this plan.



Benefits:

- LID infrastructure
- Infiltration opportunities

Considerations:

- Could be implemented as a streetscape type project

Solution Name: 4.8 Castle Rock Channel	Location: From I-40 to BNSF following Castle Rock Rd.	Area: 4
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Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

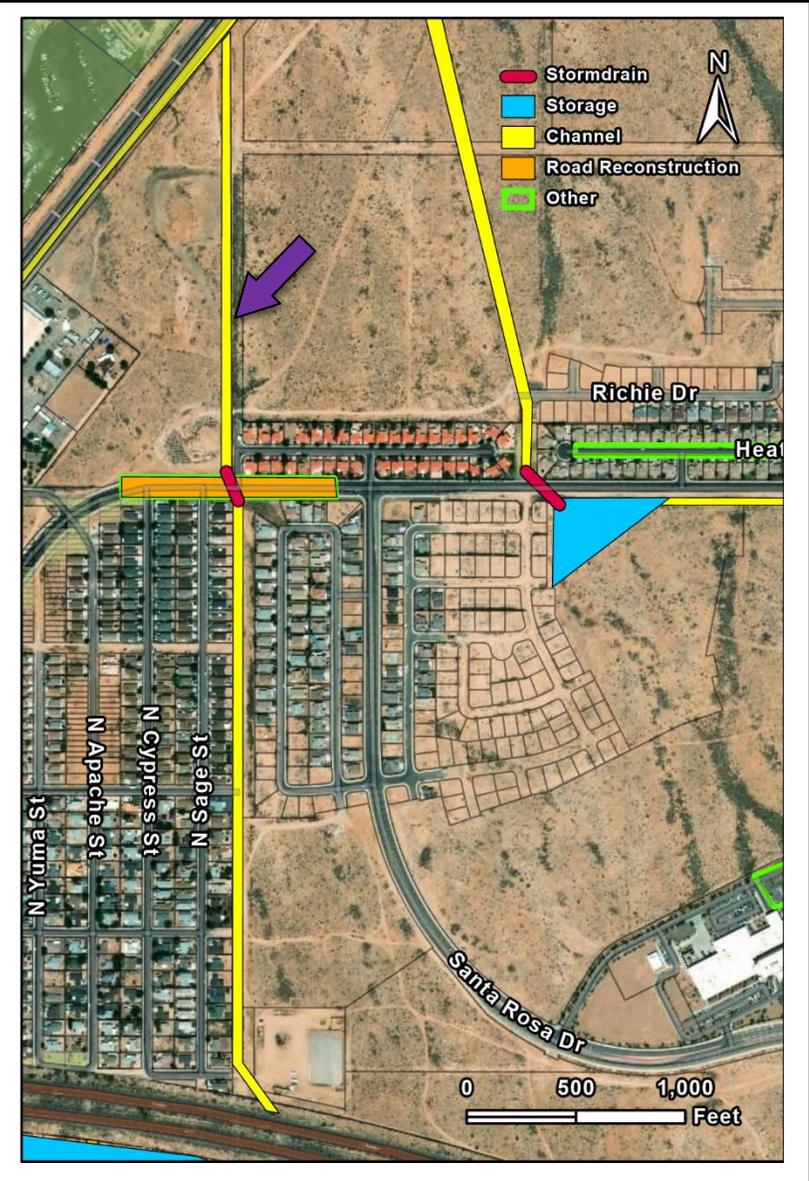
Description:

Solution will convey flow from the 2-4 ft x 8 ft box culverts at I-40, north to Airway Ave. along Castle Rock Rd.

Due to the variability of development south of I-40, the channel would be sized to convey the full flow of the I-40 box culverts. The channel would be a 4 ft deep trapezoidal channel with a 10 ft bottom width and riprap lining.

The channel would cross Airway Ave. with 2-4 ft x 8 ft RCBC and continue north to the railroad channel through a similar sized trapezoidal channel.

The channels and box could serve as the stormdrain connection for draining Airway Ave.



Benefits: <ul style="list-style-type: none"> Remove most runoff from Sage St. Limit the runoff that impacts Airway Ave. Limit impacts of future upstream development 	Considerations: <ul style="list-style-type: none"> Property/easement acquisition required Coordination with existing electric easement
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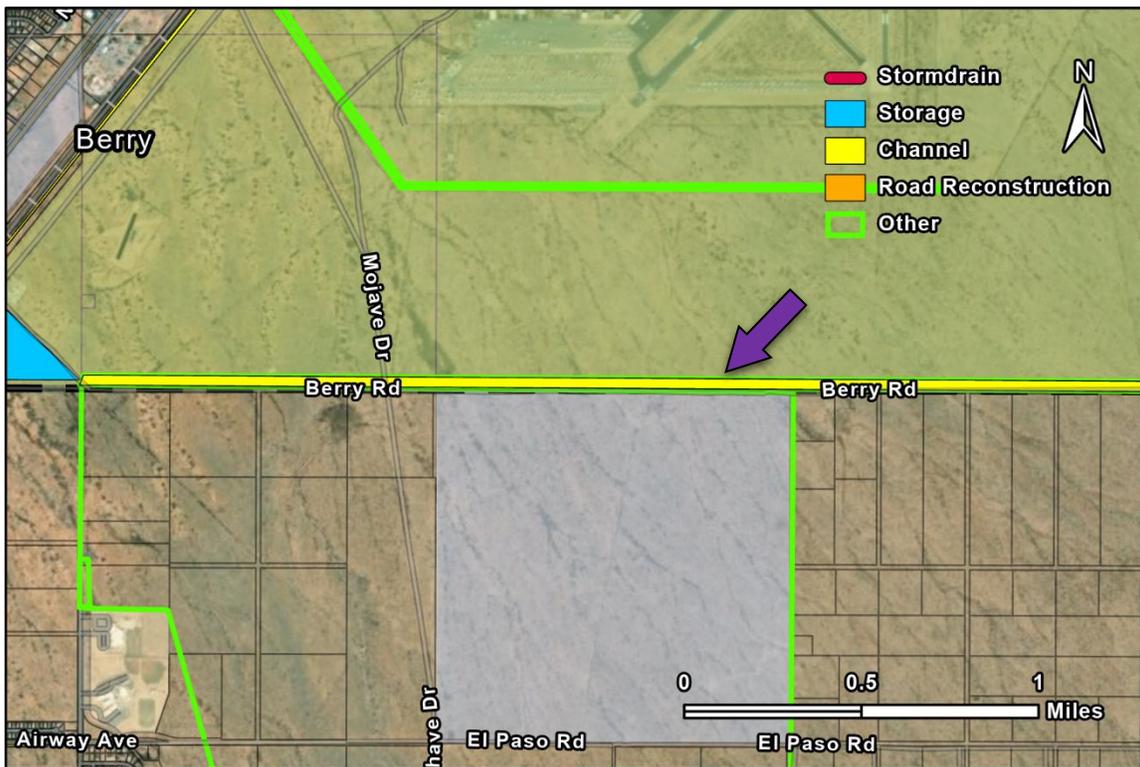
Solution Name: 4.9 Berry Collector Channel	Location: Berry Rd. future alignment	Area: 4
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution involves construction of a regional conveyance channel that would direct all runoff approaching the city limit line to the west towards the railroad. This would limit the flood risk on the City-owned parcel directly north of the City limit line and reduce the risk to the airport.

Development of a drainage master plan for the area may, however, show that the flood risk to the City parcel could be mitigated further upstream.

Planning for this project should be done in conjunction with preparation of the Rattlesnake Wash Masterplan, however if the regional channel needs to be constructed first, it needs to be designed to intercept up to 7,500 cfs. The channel could have a slope of approximately 1% and would vary in size up to a 75' bottom width trapezoidal channel with 2:1 side slopes.



Benefits:

- Flood protection of the city parcel to the north as well as the airport.

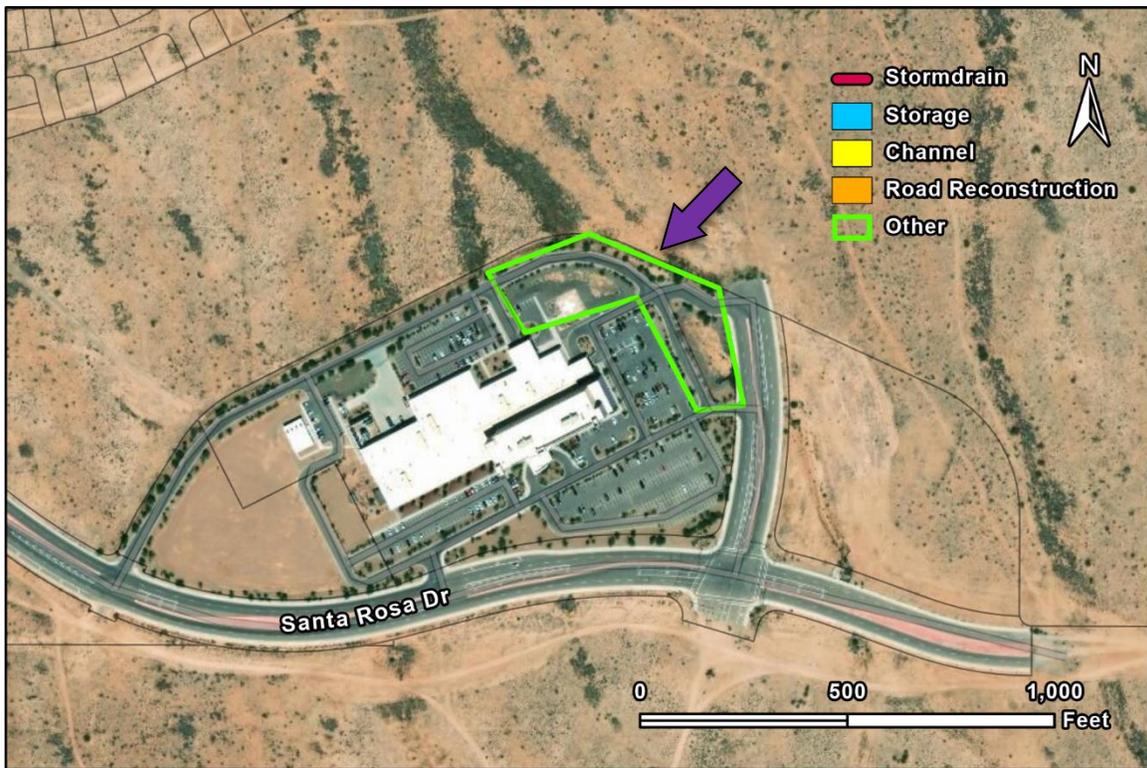
Considerations:

- Should be planned in conjunction with the Rattlesnake Wash Masterplan
- Need to determine downstream impacts

Solution Name: 4.10 Hualapai Medical Center Dry Wells	Location: Hualapai Medical Center retention basins	Area: 4
Type of Solution: <input type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input checked="" type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input type="checkbox"/> Local <input checked="" type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution includes installing dry wells in the Hualapai Mountain Medical Center retention basins. The solution is not further developed in this plan since it is a solution specific to the medical center.



Benefits:

- LID implementation
- Infiltration opportunities

Considerations:

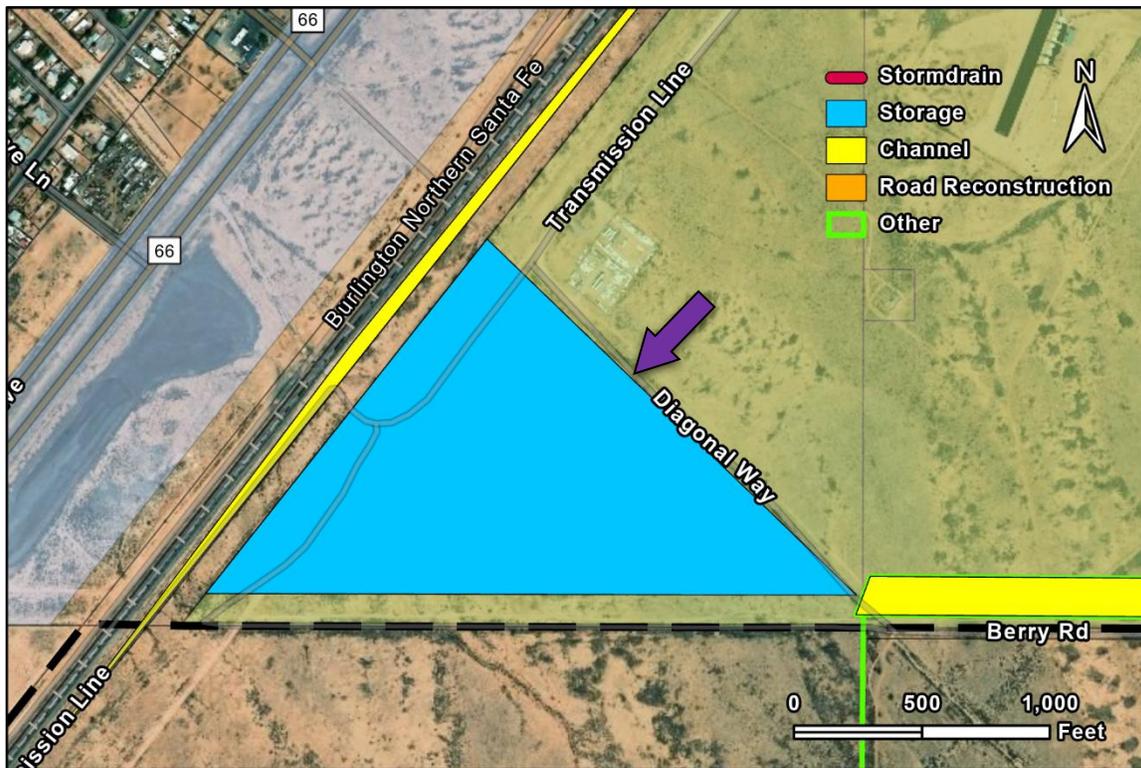
- Should be pursued by the medical center

Solution Name: 4.11 TI Drainage Improvements	Location: South of the Hualapai Mountain Medical Center on I-40	Area: 4
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input checked="" type="checkbox"/> State <input type="checkbox"/> Federal	
Description: <p>There may be drainage improvements included with the construction of the proposed I-40 traffic interchange. Those improvements should be coordinated with the existing FLO-2D modeling to provide a benefit to the surrounding area.</p> <p>Further development of this solution is not included with this project.</p>		
Benefits: <ul style="list-style-type: none"> Possible benefits to the surrounding areas 	Considerations: <ul style="list-style-type: none"> Should be done with consideration of the existing modeling to limit potential adverse impacts. 	

Solution Name: 4.12 Berry Road Basin	Location: North of the Berry Rd. future alignment, east of BNSF	Area: 4
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution will provide a retention basin that is up to 40 acres in size. At 6 ft deep and 3:1 side slopes, the total volume could reach 200 ac-ft. This could potentially contain full 100-year volume of the current flow that reaches it and could reduce the flow reaching the downstream channel. This solution could be constructed with or without upstream improvements. It should, however, be coordinated with the Rattlesnake Wash Masterplan.



Benefits:

- Infiltration opportunities
- Reduce downstream flows and impacts to BNSF and Andy Devine Ave.

Considerations:

- Impact effectiveness of basin if upstream drainage patterns change
- Should be developed in conjunction with the Rattlesnake Wash Masterplan

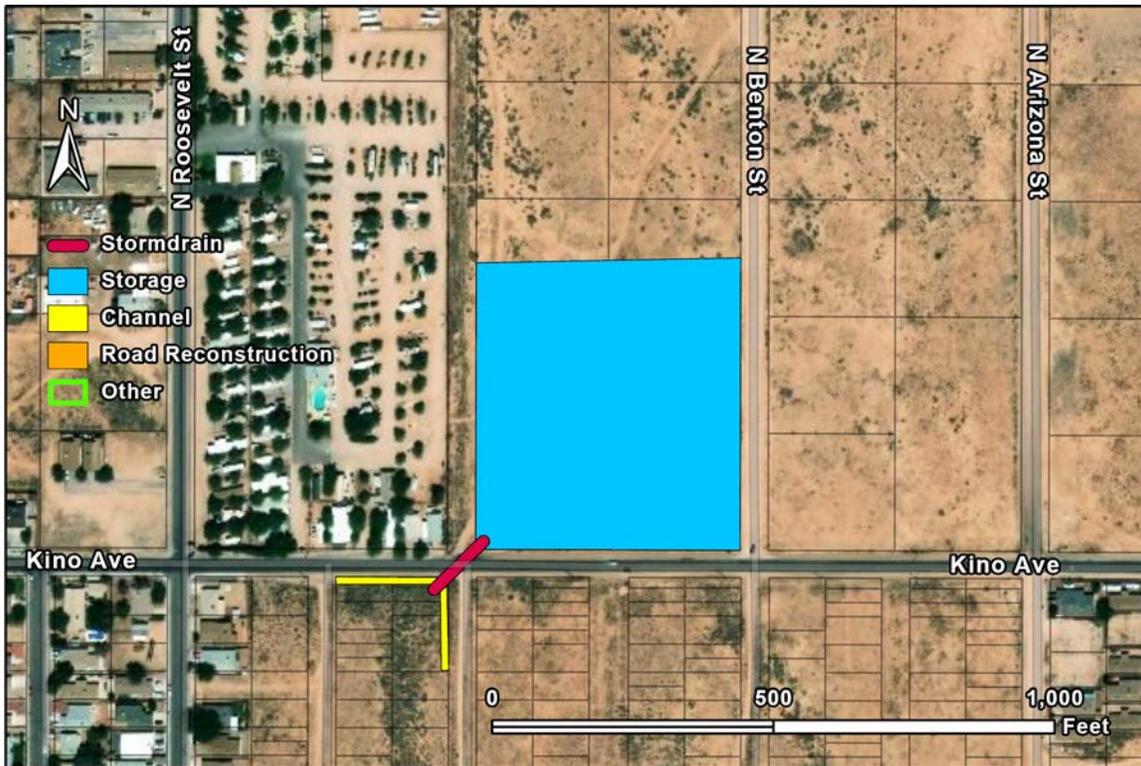
Solution Name: 5.1 Pinal Street Basin	Location: East of Pinal St., west of Benton St., north of Kino Ave. and south of Coronado Ave.	Area: 5
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution involves the construction of a retention basin east of Pinal St., west of Benton St., north of Kino Ave. and south of Coronado Ave. The proposed location is on 7 ac of vacant, but privately owned land.

At a depth of 6 ft, there is approximately 30.1 ac-ft of storage available. Construction of the basin would include grading a 400 ft channel on the south side of Kino Ave. and the east side of Pinal St. to direct flow into a culvert crossing Kino Ave. and empty into the proposed basin.

The basin would capture most of the 10-year volume crossing Kino Ave. at this location. A second basin could also be constructed to the north providing additional storage.



Benefits:

- Remove runoff from Swing St. and Benton St.
- Reduce runoff crossing Kino Ave.
- Reduce runoff through neighborhoods east of Kingman High School.

Considerations:

- Will not retain the 100-year storm
- May be less effective or unnecessary after completion of railroad channel

Solution Name: 5.2 Airway Basin	Location: Southwest corner of Airway Ave. and Swing St.	Area: 5
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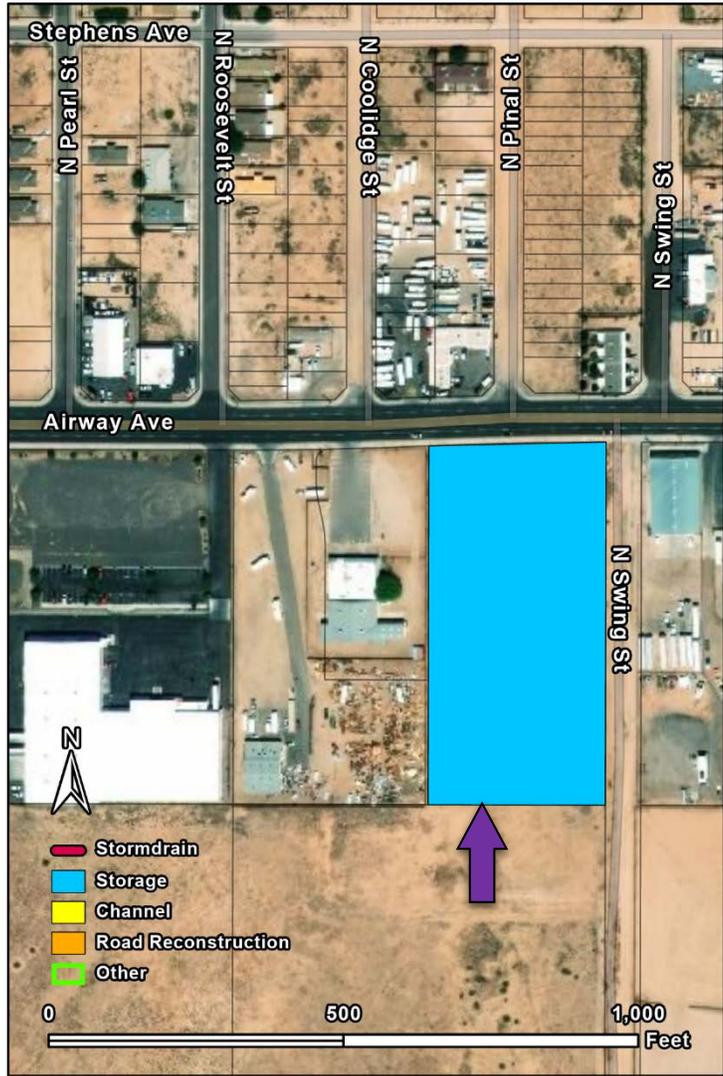
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

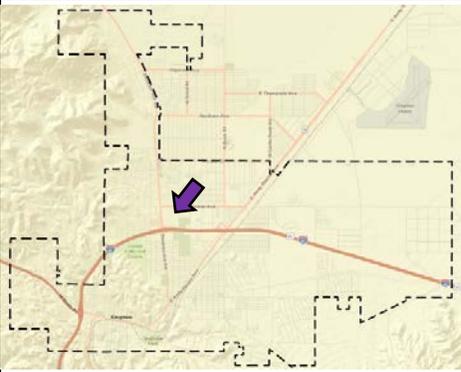
This solution involves the construction of a retention basin on two vacant privately owned parcels on the southwest corner of Airway Ave. and Swing St.

The combined area of the two parcels is 4.16 ac. At a depth of 5 ft, there is approximately 11.4 ac-ft of storage available.

A collector channel would be installed to the south of the basin to divert runoff into the basin. Swing St. would be reconstructed to divert runoff into the basin as well.



Benefits: <ul style="list-style-type: none"> • Reduce runoff crossing Airway Ave. and down Swing St. • Potential infiltration opportunities 	Considerations: <ul style="list-style-type: none"> • Property acquisition • Will not retain the 100-year storm • Long term maintenance
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Solution Name: 5.3 Harrison Basin	Location: North of Veterans Centennial Recreation Complex and west of Harrison St.	Area: 5
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution involves construction of a retention basin on a Mohave County-owned parcel adjacent to the Veterans Centennial Recreation Complex.

The proposed location for the retention basin is 3.76 ac of the eastern half of the parcel currently used as a soccer field. At a depth of 5 ft, there is approximately 10.5 ac-ft of storage available.

Construction of a stormdrain on Harrison St. would probably be required to divert flow from Harrison St. into the basin.

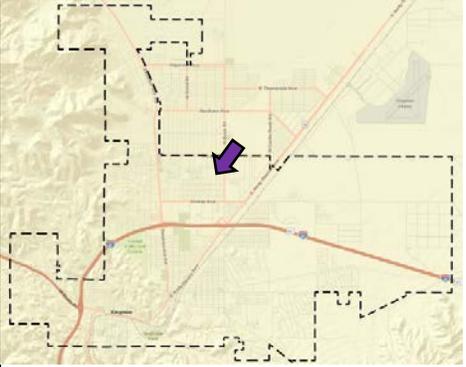


Benefits:

- Storage for 10 -year storm volume
- Potential infiltration opportunities
- Reduced flow in Willow Rd. and Verdugo Rd.

Considerations:

- Would require reconstructing soccer fields
- Would require construction of stormdrain in Harrison St.
- Limitations in field use

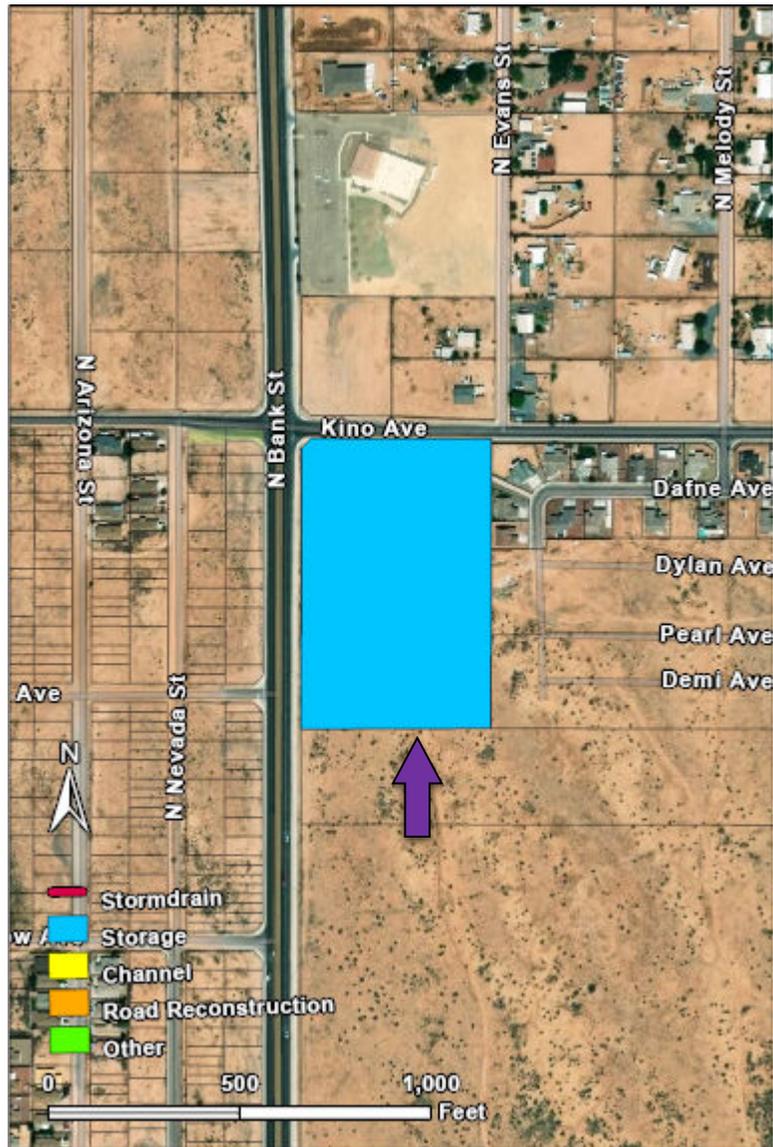
Solution Name: 5.4 Kino Avenue Basin	Location: Southeast corner of Bank St. and Kino Ave.	Area: 5
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution involves construction of a retention basin on a vacant, privately-owned parcel on the southeast corner of Bank St. and Kino Ave.

The proposed area is 7.63 ac. At a depth of 5 ft, there is approximately 25.1 ac-ft of storage available.

The basin would intercept overland flow from the vacant area to the southeast. In addition, curb cuts could be installed on Bank St. to allow runoff from the road to flow into the basin.

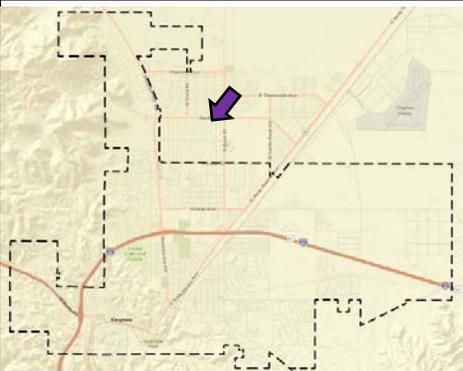


Benefits:

- Reduced runoff on Bank St.
- Potential infiltration opportunities

Considerations:

- Property acquisition
- The basin is over an area that is currently used as a small detention basin.

Solution Name: 5.5 Bank Street Channel	Location: West side of Bank St. from the south end of Kingman High School, north to Mohave Wash	Area: 5
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution proposes construction of a channel on the west side of Bank St. to intercept sheet flow runoff approaching from the west and divert it north to the Mohave Wash before it impacts Bank St.

The channel would have capacity for at least the 10-year event of 70 cfs. The 100-year event of 478 cfs would not be contained in the channel. However, the flow rate would be reduced if retention basins are installed upstream or the Railroad Channel is completed, diverting much of the offsite runoff to the neighborhood.

The channel would extend to a point south of Sierra Vista Ave., cross Sierra Vista Ave. with a box culvert, and outfall into the Mohave Wash, west of Bank St.



Benefits:

- Channel avoids major utility conflicts
- Removes significant flow from Bank St.

Considerations:

- Possible easement or property acquisition required
- Potential utility conflicts

Solution Name: 5.6 Diagonal Channel Improvements	Location: Diagonal channel from BNSF Railroad, northwest to Northern Ave., and north into Mohave Wash	Area: 5
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution involves improving the channel from the BNSF Railroad, northwest to Northern Ave., and north into Mohave Wash.

The 100-year flow at the upstream end of the channel is 1669.3 cfs. The slope of the existing channel is fairly constant at 1 percent. The drainage easement is 100 ft wide with maintenance roads on either side, leaving approximately 60ft for channel width.

Constructing a gunnite (or other lining) 6 ft deep and 20 ft wide channel would contain the 100-year event.

All channel street crossings are currently low water crossings except for Northern Ave. The area should be evaluated to determine the roads which need to be all weather access and raised crossings could be constructed similar to the existing Northern Ave. crossing.



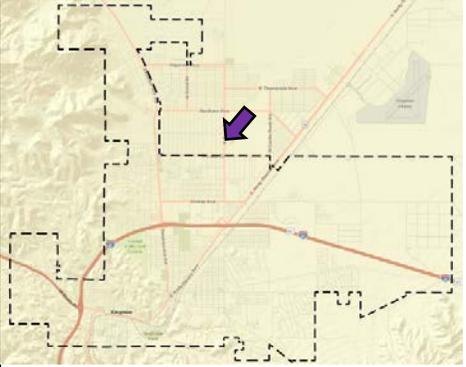
Benefits:

- Reduced flood and debris spreading through neighborhood

Considerations:

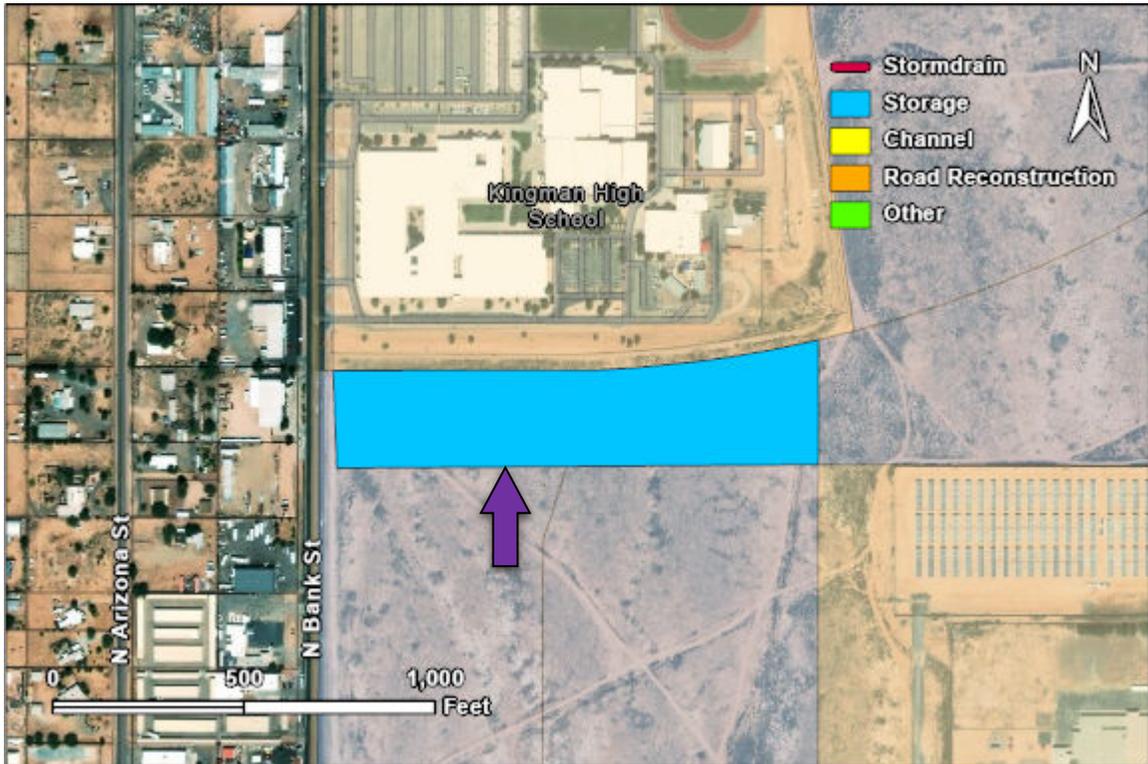
- Construction should include road crossing improvements

Solution Name: 5.7 Mohave Channel DCR for future extension	Location: Mohave Channel north of Thompson Ave.	Area: 5
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	
Description: <p>This solution includes preparation of a future plan for channelizing the Mohave Wash.</p> <p>Since this project includes significant variability, this solution has not been developed further as a part of this plan.</p>		
Benefits: <ul style="list-style-type: none"> • Contained flood risk downstream of Thompson Ave. 	Considerations: <ul style="list-style-type: none"> • This should be a stand-alone project considering growth in the area. 	

Solution Name: 5.8 High School Retention Basin	Location: Directly south of Kingman High School and east of Bank St.	Area: 5
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input type="checkbox"/> City / County <input checked="" type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution involves construction of a retention basin on a portion of a State-owned parcel directly south of Kingman High School and east of Bank St. The proposed location is 12.15 ac. At a depth of 5 ft, there is 41.9 ac-ft of storage available. This solution would need to be integrated with road reconstruction in Bank St. to drain the road into the basin.

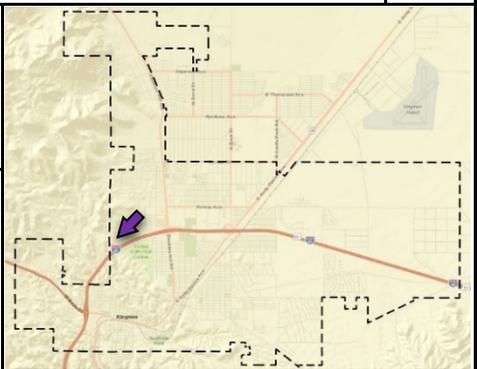


Benefits:

- Remove runoff from Bank St.
- Reduce runoff across high school property

Considerations:

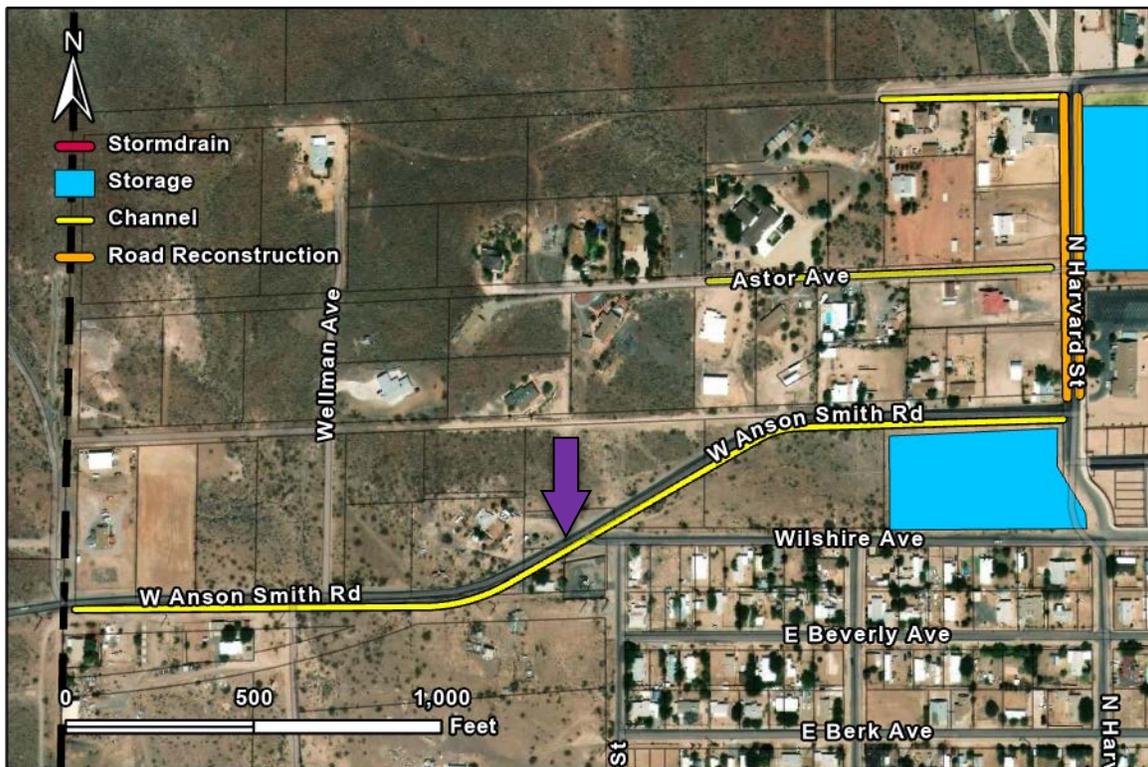
- Basin overflow would outlet to the east requiring improvements to the channel on the east side of the high school.

Solution Name: 6.1 Anson Smith Road Collector Channel	Location: Along Anson Smith Rd. from Indian Canyon Rd. to Harvard St.	Area: 6
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution involves constructing a channel along Anson Smith Rd. from Indian Canyon Rd. to Harvard St. The channel would capture runoff generated by the undeveloped watersheds to the north and convey it east to a logical release point or potentially a detention basin (Solution 6.2).

To convey the 100-year event, a concrete channel that has a total depth of 4 ft (2.5 ft flow conveyance, 1.5 ft freeboard) would be used. The channel would have a bottom width of 3 ft and a top width of 11 ft, which would reduce the amount of ROW needed. It is anticipated that runoff would enter the channel as sheet flow overtopping Anson Smith Rd. Should a culvert be used to divert runoff underneath Anson Smith Rd., the culvert would consist of a 4 ft x 10 ft RCBC.



Benefits:

- Diversion of runoff to detention basin
- Reduced flows for the Beverly Ave./Berk Ave. area.

Considerations:

- Driveway conflicts
- Potential drainage easements required

Solution Name: 6.2 Anson Smith Basin	Location: Within a vacant parcel located south of Anson Smith Rd. and north of Wilshire Ave.	Area: 6
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

The project considers capturing runoff from the west within a basin located within a vacant parcel located south of Anson Smith Rd. and north of Wilshire Ave. Assuming a maximum basin depth of 5 ft (4 ft of storage and 1 ft of freeboard), the basin has the potential to provide 10.6 ac-ft of storage, which would completely retain the 100-year storm event.

The flow would drain via percolation or evaporation, though drywells could be added should the need to drain the basin quicker be necessary.

An emergency spillway of 106 ft would be used to convey the peak 100-year discharge should it be necessary to do so.

The results of the hydraulic analysis indicate that the basin would not intercept runoff as located, so a conveyance component would be necessary to convey flow to the basin.



Benefits:

- Reduction in downstream flows
- Infiltration opportunities

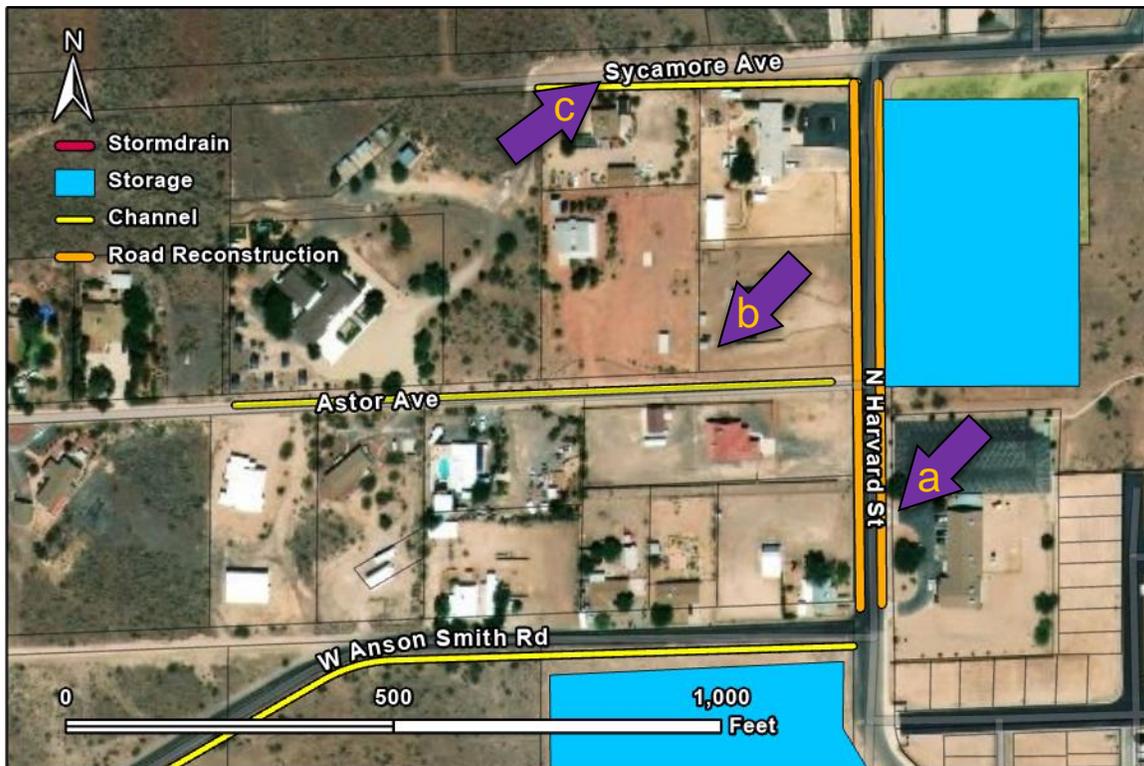
Considerations:

- Needs to be designed in conjunction with Harvard St. improvements and the Anson Smith Channel

Solution Name: 6.3 Harvard Street Improvements	Location: Multiple locations – see a) through c) below	Area: 6
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

- a) Harvard St.: This consists of roadway improvements to Harvard St. Improvements would be designed to convey runoff from the roadway to future basins (Solution 6.4 or Solution 6.2) and would be complementary to improvements made to Astor Ave. and Sycamore Ave. The revised roadway would consist of wedge curb with sidewalk and inverted crown street section. The capacity of this roadway section is 58 cfs.
- b) Astor Ave.: This consists of construction of a channel within the Astor Ave. ROW that terminates in a culvert that will discharge runoff into a future basin (Solution 6.4). To convey the 100-year event, an earthen channel that has a total depth of 3 ft, (2.0 ft flow conveyance, 1.0 ft freeboard) would be used. The channel would have a bottom width of 3 ft and a top width of 22 ft. The culvert would consist of a single barrel 4 ft x 10 ft RCBC.
- c) Sycamore Ave.: This consists of construction of a channel within the Sycamore Ave. ROW that terminates in a culvert that will discharge runoff into a future basin (Solution 6.4). To convey the 100-year event, an earthen channel that has a total depth of 3 ft, (2.0 ft flow conveyance, 1.0 ft freeboard) would be used. The channel would have a bottom width of 3 ft and a top width of 22 ft. The culvert would consist of a single barrel 4 ft x 6 ft RCBC.



Benefits:

- Structure protection
- Downstream flood reduction

Considerations:

- All items need to be coordinated
- Should be implemented with detention basins

Solution Name: 6.4 Harvard/Sycamore Basins	Location: Within a vacant parcel located south of Sycamore Ave. along the west side of Harvard St.	Area: 6
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution considers capturing runoff from the west within a basin located within a vacant parcel located south of Sycamore Ave. along the west side of Harvard St. Assuming a maximum basin depth of 5 ft, (4 ft of storage and 1 ft of freeboard), the basin has the potential to provide 10.5 ac-ft of storage, which would completely retain the 100-year storm event. The flow would drain via percolation or evaporation though drywells could be added should there be a need to drain the basin quicker. An emergency spillway of 103 ft would be used to convey the peak 100-year discharge should it be necessary to do so.



Benefits:

- Reduction in downstream flows
- Infiltration opportunities

Considerations:

- Needs to be designed in conjunction with Harvard St. improvements and the Sycamore Ave./Astor Ave. channels

Solution Name: 6.5 Western Avenue Storm Drain	Location: From Sycamore Ave. to Beverly Ave. along Western Ave.	Area: 6
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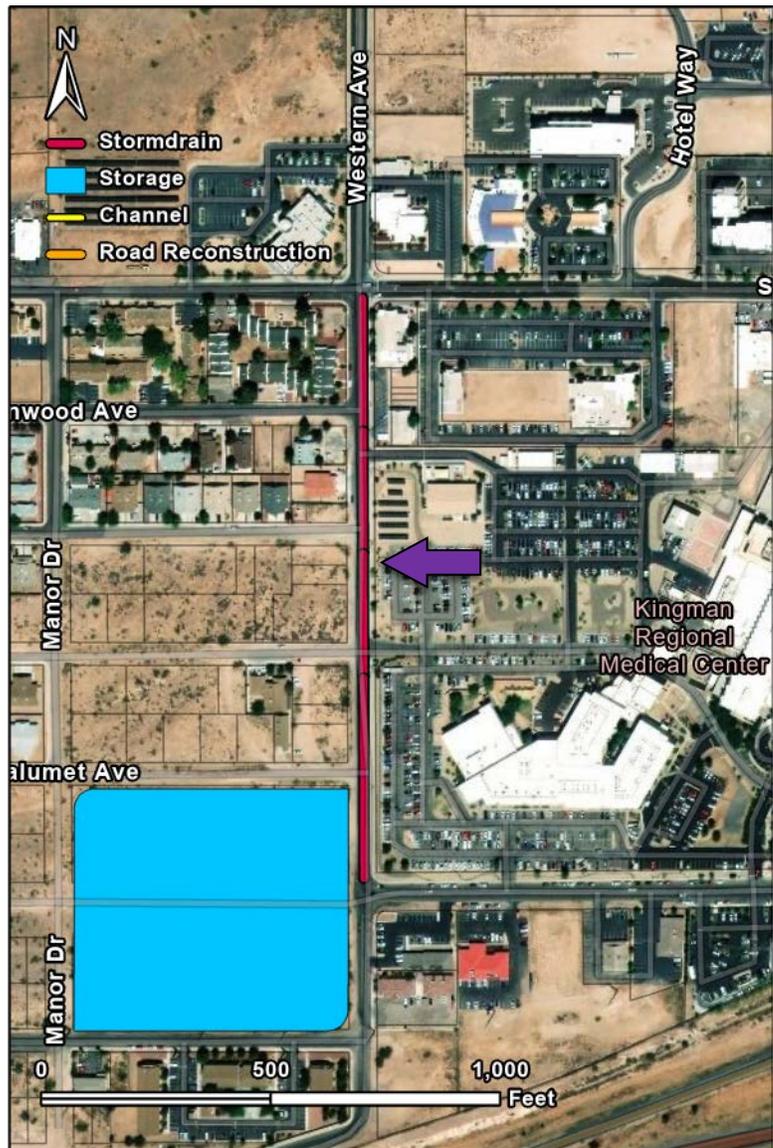
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution consists of constructing a stormdrain from Sycamore Ave. to Beverly Ave. along Western Ave. The stormdrain would consist of a 42" pipe with transverse grates constructed south of Kenwood Ave., Astor Ave. and Sheldon Ave. The stormdrain would tie into the existing stormdrain within Sycamore Ave. east of Western Ave. In addition, Western Ave. will be improved to include vertical curb and sidewalk.

The roadway could be reconfigured with an inverted crown cross-section to allow for additional surface flow conveyance and reduce the depth of flow in the street such that runoff does not overtop the east side curb.

The system should provide conveyance for the 100-year flow and an outfall for a future basin (Solution 6.16).



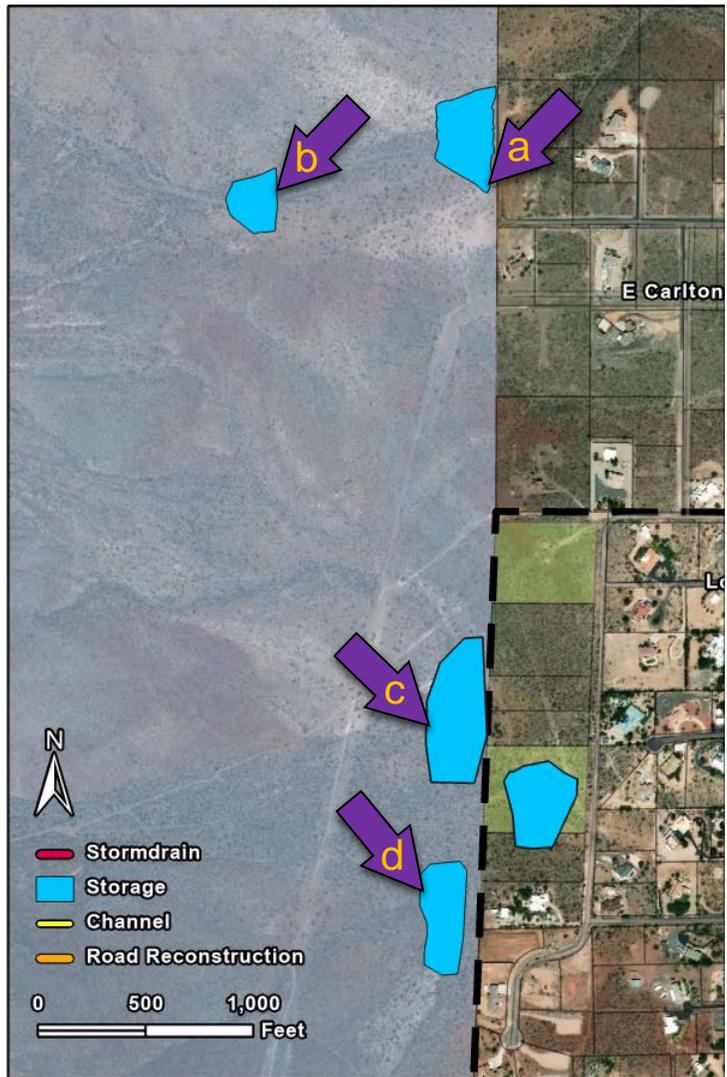
Benefits: <ul style="list-style-type: none"> Reduction in flows reaching Kingman Regional Medical Center 	Considerations: <ul style="list-style-type: none"> Needs to be considered in conjunction with upstream improvements
--	---

Solution Name: 6.6 State Land Basins	Locations: Multiple – see locations a) though d) below	Area: 6
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input type="checkbox"/> City / County <input checked="" type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

These basins were studied previously as a part of the West Kingman Recharge Basins Study completed by JE Fuller.

- a) Downstream - This solution would consist of constructing a 2 ac basin within the undeveloped land directly west of Hidden Ridge Rd., a parcel owned by the Arizona State Land Department (ASLD). The basin have a ponding depth of 8 ft and a total storage volume of 11 ac-ft. The basin would have an emergency spillway capable of conveying the 100-year storm (e.g. a 121 ft wide weir with a depth of 2 ft).
- b) Upstream - This solution would consist of constructing a basin upstream of the basin proposed in Solution 6.6a. As with the previous basin, this basin also is located within the undeveloped land owned by ASLD. The basin would encompass 2 ac having a ponding depth of 8 ft and a total storage volume of 6 ac-ft. To accommodate larger events, the basin would have an emergency spillway capable of conveying the 100-year storm (e.g. a 187 ft wide weir with a depth of 1.5 ft).
- c) North - This solution would consist of constructing a basin west of Cerbat Vista Dr. outside the limits of City of Kingman on undeveloped ASLD land. It would encompass 3.1 ac, having a ponding depth of 8 ft and a total storage volume of 18 ac-ft. It would have an emergency spillway capable of conveying the 100-year storm (e.g. a 112 ft wide weir with a depth of 1.5 ft).
- d) South - This solution would consist of constructing a basin west of Cerbat Vista Dr. just outside the limits of the City of Kingman on undeveloped ASLD land. This proposed basin would encompass 1.9 ac, having a ponding depth of 6 ft and a total storage volume of 9.7 ac-ft. It would have an emergency spillway capable of conveying the 100-year storm (e.g. a 92 ft wide weir with depth of 1.5 ft).



Benefits:

- Significant reduction in downstream flow rates and volumes

Considerations:

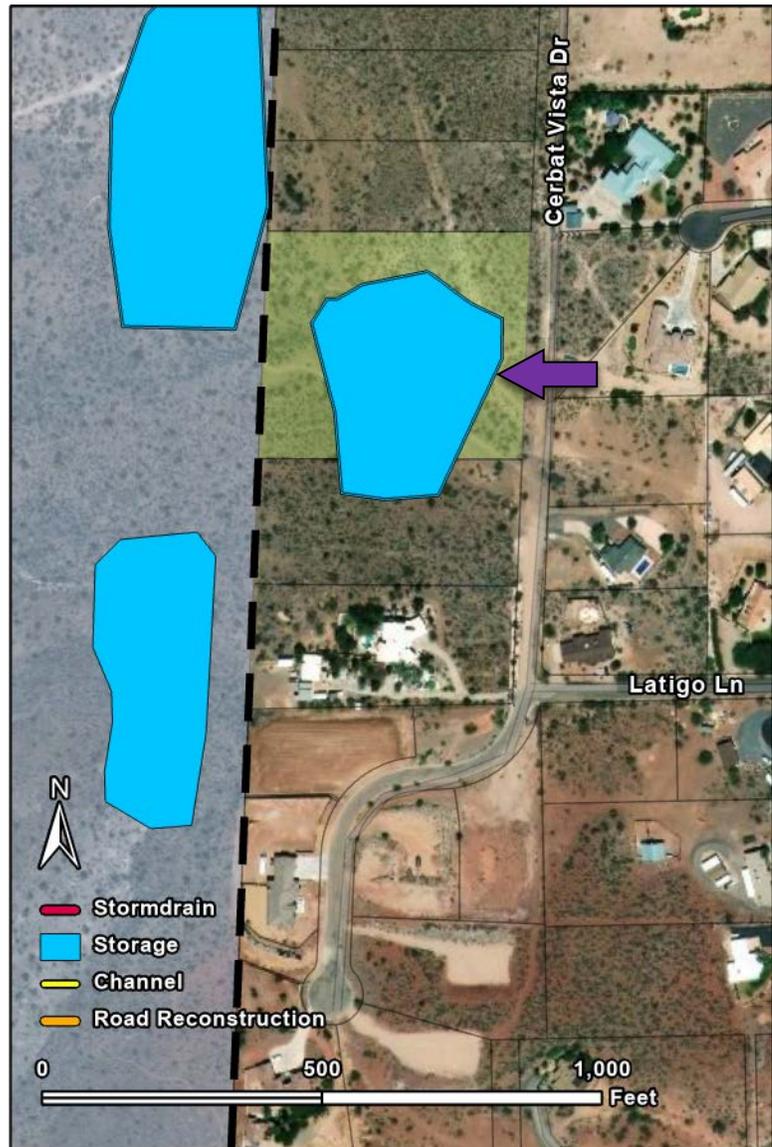
- Significant coordination with ASLD
- Safety considerations with volume and basin depth

Solution Name: 6.7 Vista Basin	Location: West of Cerbat Vista Dr. within the limits of the City of Kingman	Area: 6
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution would consist of constructing a basin west of Cerbat Vista Dr. within the limits of the City of Kingman. The area in question is undeveloped land.

The basin should be considered an alternative solution should the basin presented in Solution 6.6c not be constructed. The proposed basin would encompass 2.0 ac, having a ponding depth of 8 ft and a total storage volume of 13.7 ac-ft. This would allow the basin to completely retain runoff from a 10-year event. The basin would contain an emergency spillway capable of conveying the 100-year (e.g. a 112 ft wide weir with a depth of 1.5 ft).



Benefits:

- Significant reduction in downstream flow rates and volumes

Considerations:

- Safety considerations with volume and basin depth

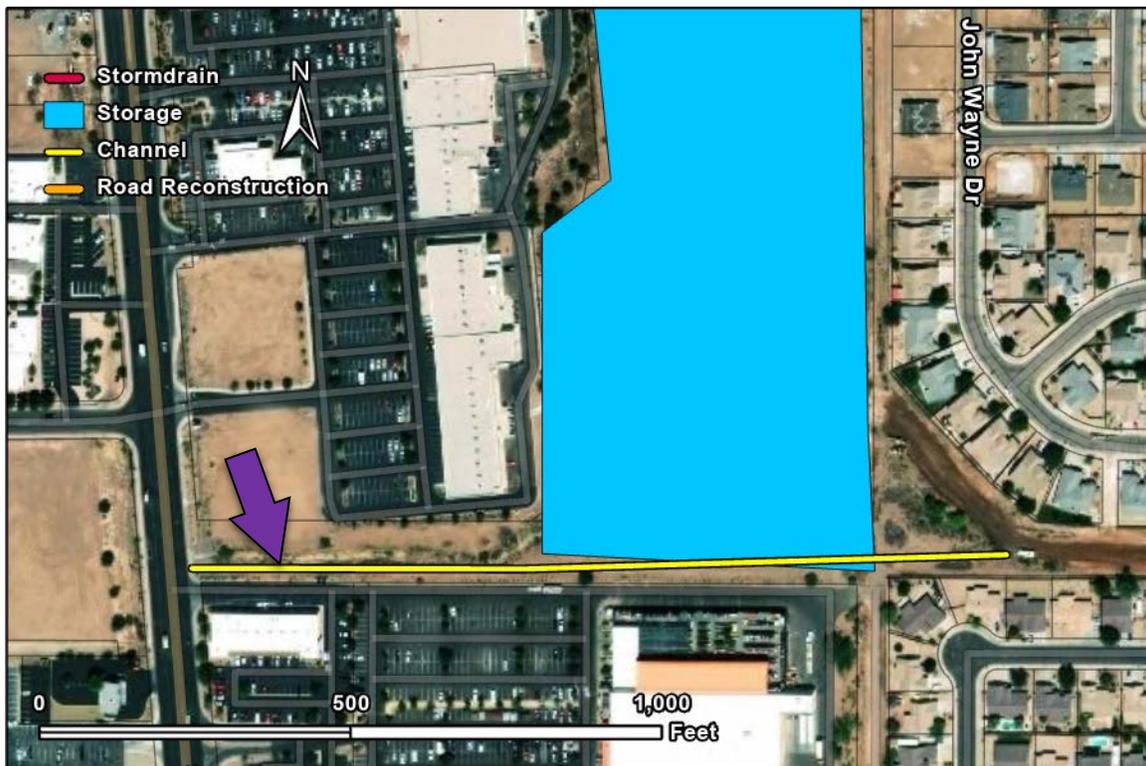
Solution Name: 6.8 Lower Crestwood Channel	Location: Within the Coronado Channel alignment	Area: 6
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution would consist of the construction of a new channel within the Coronado Channel alignment. The channel would capture runoff that impacts the Home Depot and the commercial retail complex to the north.

The channel could potentially discharge runoff into a future basin or directly into the existing constructed channel to the east. The channel would be rock-lined with a 20 ft bottom width, 3:1 side-slopes, and a depth of 5 ft (1 ft freeboard).

The channel would have the capacity to convey the 100-year event. It should be observed that that improvements to Hillcrest Dr. and potentially Stockton Hill Rd. should be considered as part of this solution to provide the necessary drainage infrastructure to ensure that the channel is fully utilized.

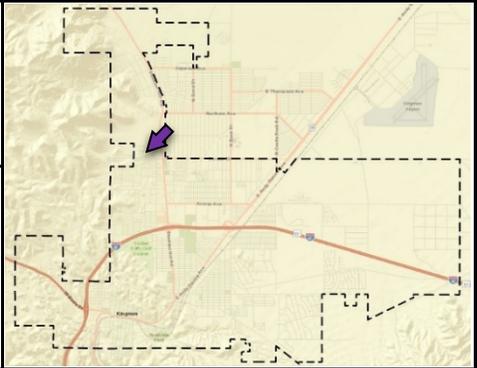


Benefits:

- Connectivity in existing drainage infrastructure
- Capacity for upstream 100-year flows

Considerations:

- Channel will be underutilized if work to Hillcrest Dr. and Stockton Hill Rd. do not occur

Solution Name: 6.9 Canyon Hills Road Reconstruction and Downstream Channel	Location: a) Canyon Hills Rd. from Harvard St. to Canyon Hills Dr. b) From east end of Canyon Hills Rd. to culvert under Stockton Hill Rd.	Area: 6
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

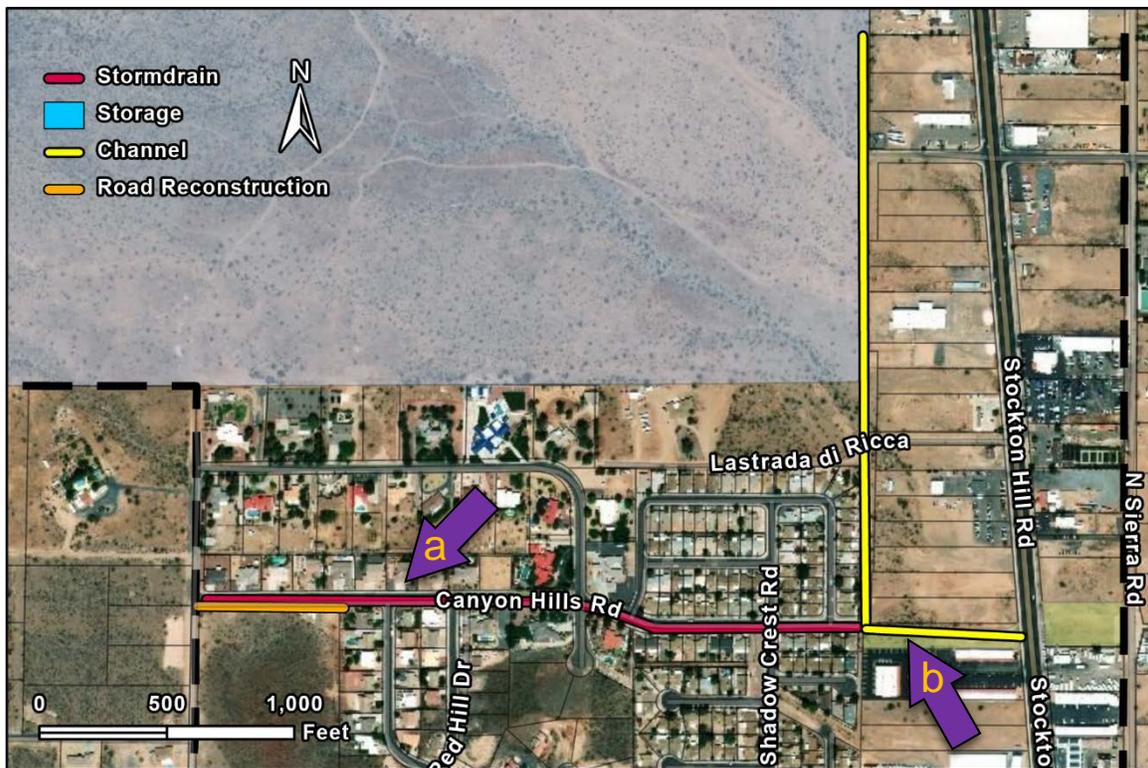
Description:

a) Canyon Hills Rd.

This solution would consist of reconfiguring Canyon Hills Rd. from Harvard St. to Canyon Hills Dr. It is recommended that the street be reconfigured to be an inverted crown roadway with one or multiple 42" stormdrain pipes added to the project such that the 622 cfs can be captured. Flow into the stormdrain would be via transverse grates and/or slotted drain placed within the inverted crown.

b) Downstream Channel

This solution would consist of providing a constructed channel from the east end of Canyon Hills Rd. to the culvert beneath Stockton Hill Rd. As the downstream channel is currently earthen, it is recommended that the upstream channel also be earthen. Because the channel would be integrated into Solution 6.9a, it will need to be able to convey the 100-year flow from upstream (assuming that Solution 6.6a does not come to fruition). With that intent, the channel will be 3.5 ft deep, with a 10 ft wide bottom, a 38 ft wide top, and 4:1 side-slopes. Should the Bull Mountain Channel (Solution 6.10) be connected to this Canyon Hills Channel, the channel would need to be upsized to accommodate an additional 2000 cfs.



Benefits:

- Directs flow to Bull Mountain Channel
- Addresses several downstream drainage problems

Considerations:

- Potential utility conflicts
- Property acquisition

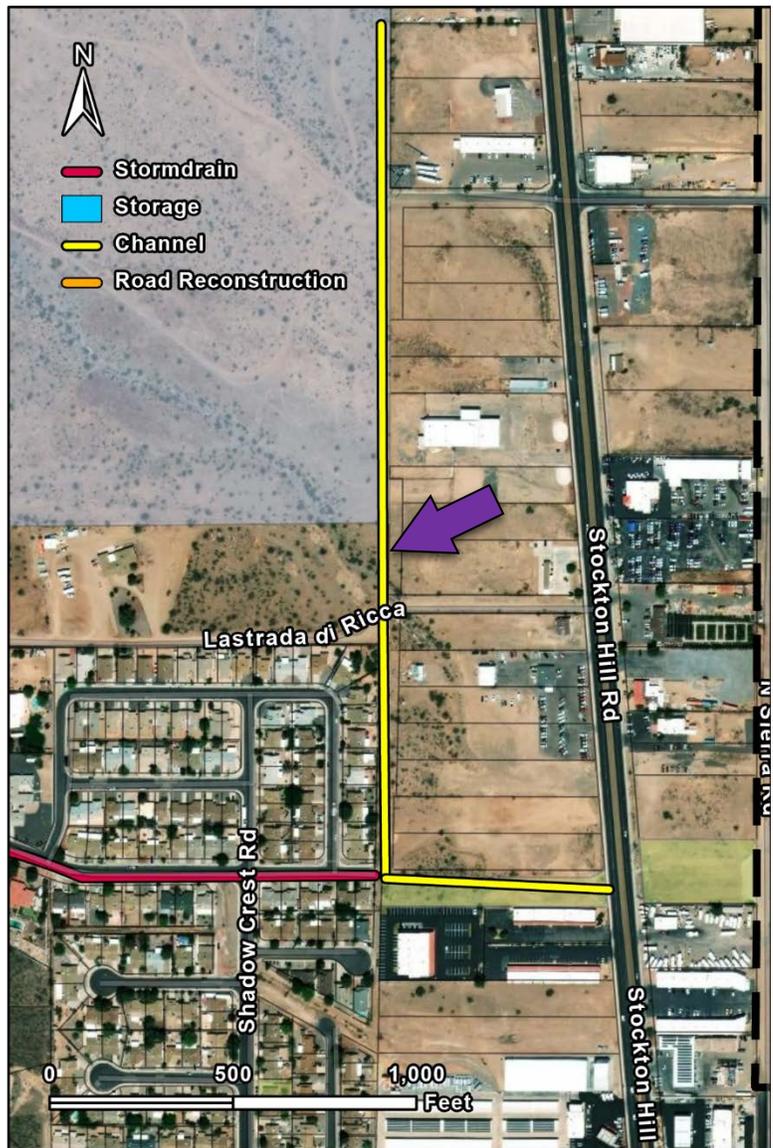
Solution Name: 6.10 Bull Mountain Channel	Location: West of Stockton Hill Rd. between Canyon Hills Rd. and Sierra Vista Dr.	Area: 6
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution would add a constructed channel starting at Stockton Hill Rd. heading west to the Canyon Hill Road and then turning north and extending 470 ft beyond Sierra Vista Ave (Total Channel Distance = 3000 ft). This alignment was previously proposed as part of the Bull Mountain Channel *Conceptual Drainage Conveyance Plan – East side of S36 from Northern to Stockton Hill Road prepared by Mohave Engineering*. Note that while the channel could be extended further to the north. However, doing so would capture runoff that is not necessarily part of the watershed considered and would result in an added burden to the existing drainage east of Stockton Hill Rd.

While this channel was previously designed, the design should be revisited using updated hydrology and potentially a non-hardscape cross-section. Some considerations are that the Bull Mountain Channel would be an earthen channel and designed to capture the 100-year runoff. With that intent, the channel will be 5.6 ft deep, with a 15 ft wide bottom, a 60 ft wide top, and 4:1 side-slopes.

It should be noted that the culvert beneath Stockton Hill Rd. may need to be upsized to accommodate the additional runoff.



Benefits:

- Structure protection
- Improved access along Stockton Hill Rd.
- Lower maintenance to neighborhood areas

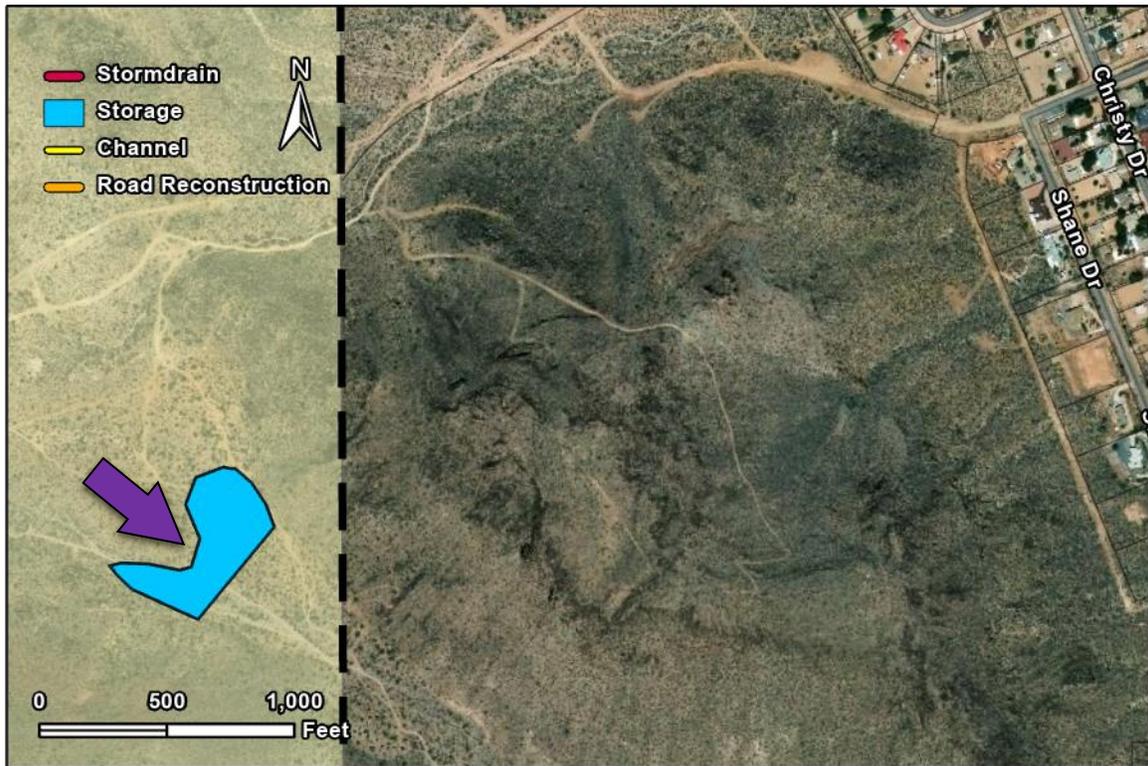
Considerations:

- Property acquisition
- Analyze downstream impacts based on updated hydrology

Solution Name: 6.11 BLM Basins	Location: Undeveloped Bureau of Land Management land, outside the Kingman City Limits and north of the Northern Ave. alignment	Area: 6
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input type="checkbox"/> City / County <input type="checkbox"/> State <input checked="" type="checkbox"/> Federal	

Description:

This solution considers construction of a basin on a portion of the undeveloped land owned by the Bureau of Land Management, outside the Kingman City Limits and north of what could be considered as the Northern Ave. alignment. To avoid the jurisdictional dam designation, the basin could not provide storage volume in excess of 50 ac-ft and as such could not provide 100-year retention. For this solution, the basin would encompass 3.6 ac, having a ponding depth of 10 ft and a total storage volume of 26.17 ac-ft. The basin would contain an emergency spillway capable of conveying the 100-year storm (e.g. a 264 ft wide weir with depth of 2.0 ft).



Benefits:

- Significant reduction in downstream flows during all events
- Sediment reduction to downstream areas

Considerations:

- Safety considerations with volume and basin depth
- BLM coordination
- Long term maintenance

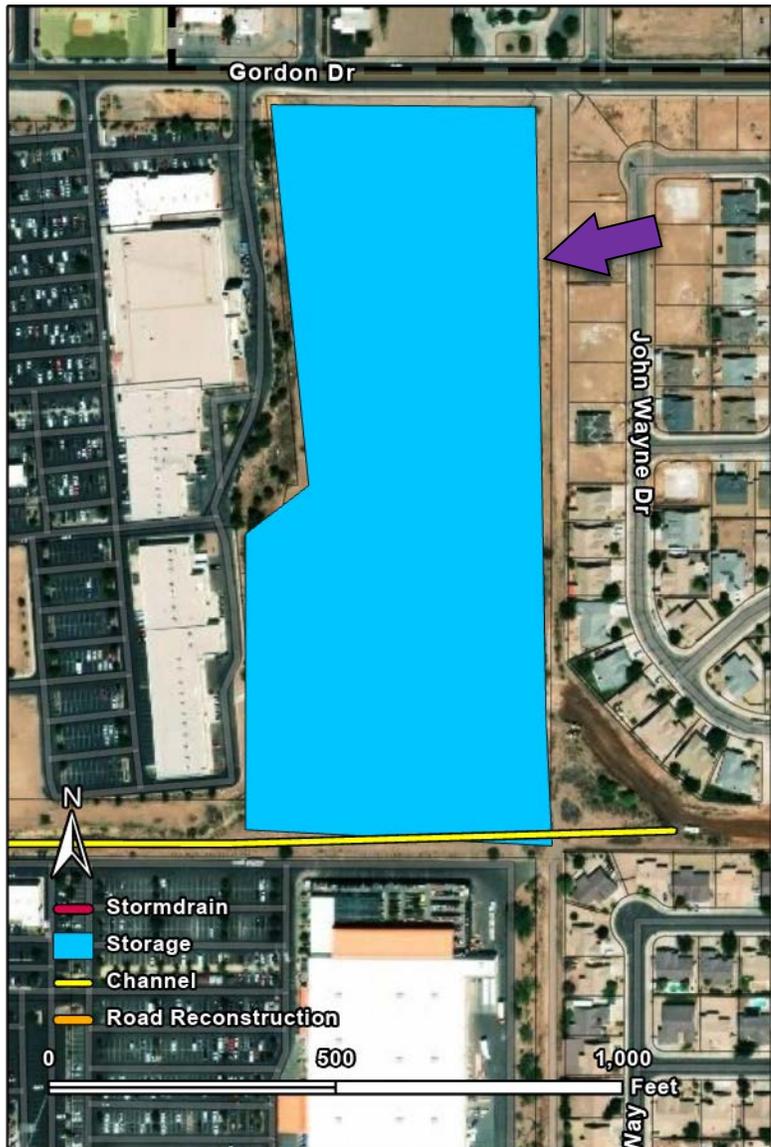
Solution Name: 6.12 Gordon Basin	Location: Vacant parcel south of Gordon Dr. and east of the retail center	Area: 6
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution considers acquiring and improving the vacant parcel south of Gordon Dr. and east of the retail center. Given that the flow from several major water courses coalesces at this location and is conveyed unabated into the subdivision to the east of the parcel, it is recommended that a basin be constructed at this location to capture, attenuate and discharge runoff into an existing drainage channel.

The basin would be 5 ft deep, providing 4 ft of storage, and 1 ft of freeboard. The total volume for the potential basin would be 51.6 ac ft. The basin would have the potential to retain runoff between the 2-year and 10-year storm events and would serve to capture runoff, store sediment and redirect the flow to a proper outfall.

It should be noted that the basin could potentially have a dual use as it contains sufficient acreage to serve as a local park to the surrounding residential areas. The basin could also serve as an infiltration opportunity.

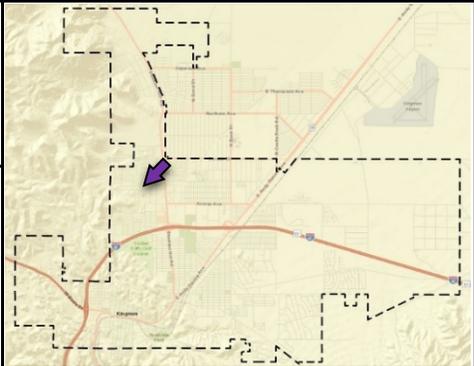


Benefits:

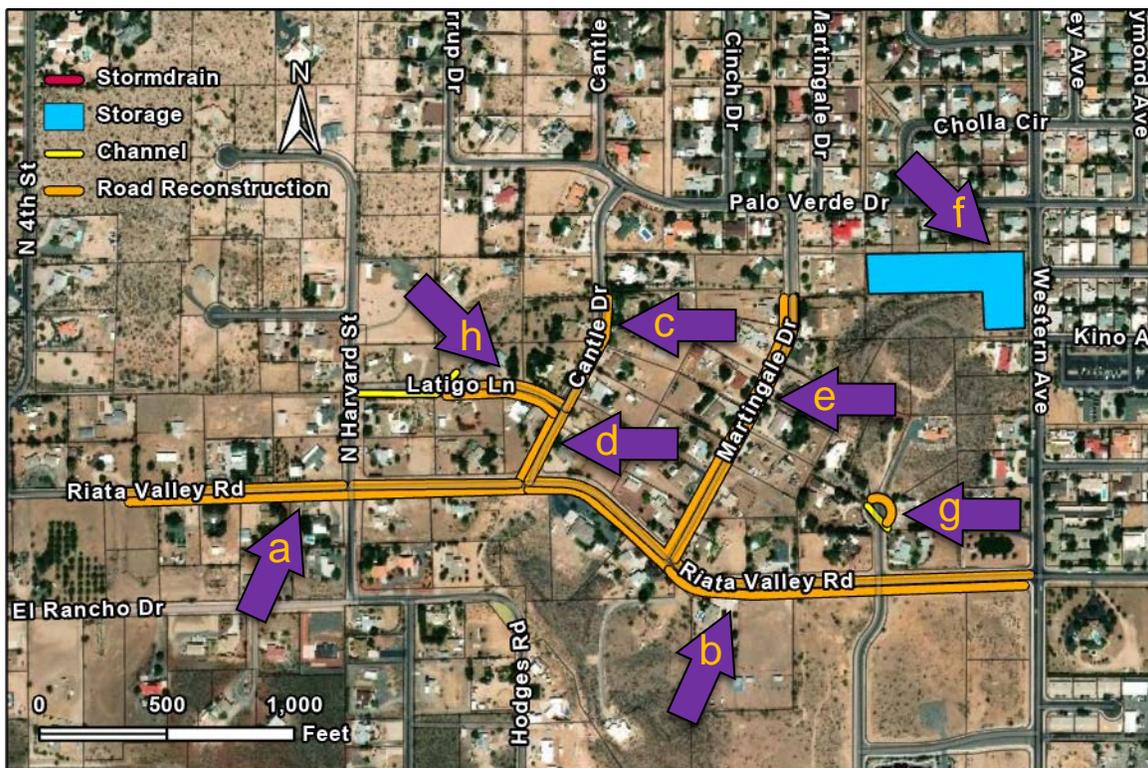
- Structure protection and flood attenuation
- Infiltration opportunities

Considerations:

- Property acquisition
- Possible Park?
- Long term maintenance

Solution Name: 6.13 Riata Valley Neighborhood Road Reconstruction	Location: Riata Valley Rd. and surrounding neighborhood	Area: 6
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input checked="" type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:



a) Riata Valley West

This solution considers improving Riata Valley Rd. from east of Cattle Dr. to east of Harvard St. A review of the street section found that the pavement width is approximately 40 ft. Runoff enters Riata Valley Rd. from the south and from the north. The runoff conveyed within the Riata Valley Rd. alignment enters Harvard St. and Cattle Dr. Improving the roadway to consist of an inverted crown segment with 8 in curbs would have the capacity to convey approximately 310 cfs, which exceeds the 10-year event. The roadway would need to be warped ahead of the intersections of Cattle Dr. and Martingale Dr. to allow runoff to continue to be conveyed down these streets such that additional runoff is not conveyed to the west.

b) Riata Valley East

This solution considers improving Riata Valley Rd. from Western Ave. to east of Cattle Dr. A review of the street section found that the pavement width is approximately 40 ft. The segment of road has been improved at several locations. Given this, it is recommended that the improvement effort be continued from Western Ave. to Cattle Dr. to provide 100-year conveyance within the street.

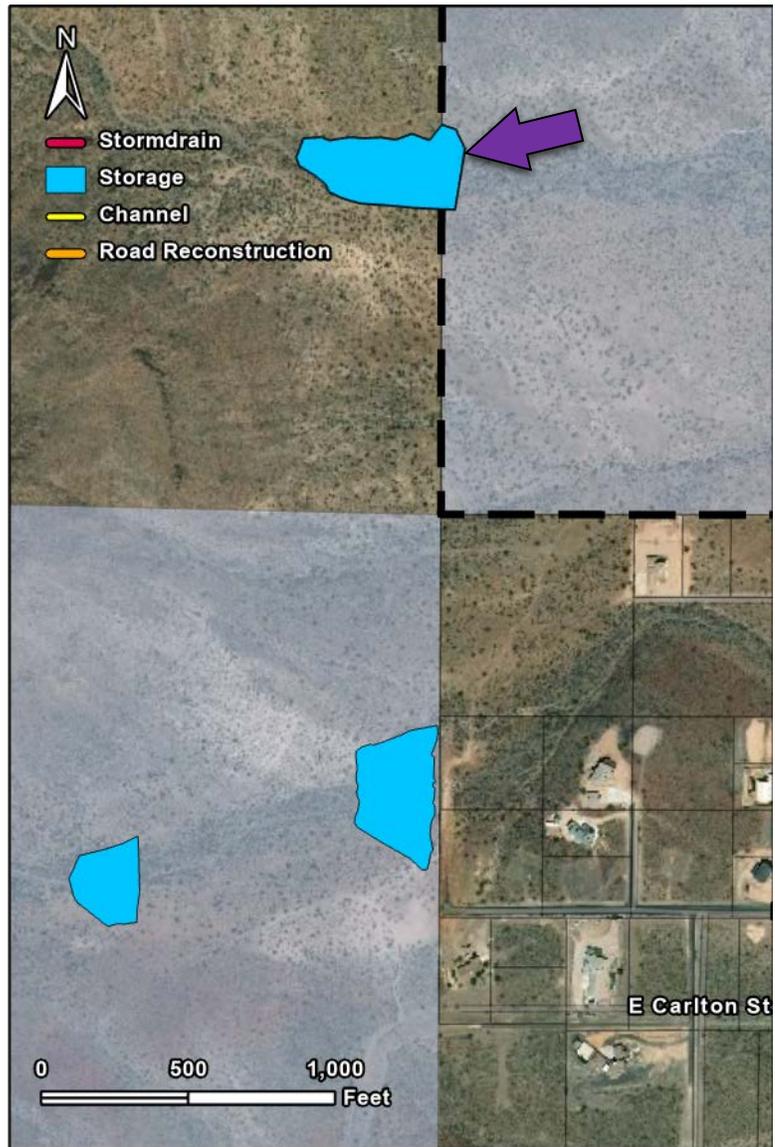
Solution Name: 6.13 Riata Valley Neighborhood Road Reconstruction	Location: Riata Valley Rd. and surrounding neighborhood	Area: 6
<p>c) <u>Cantle Dr. - North</u></p> <p>This solution considers improving a segment of Cantle Dr. from Latigo Ln. to the existing drainage channel approximately 500 ft to the north. The improvement would consist of inverting the crown of the roadway and at a minimum adding an 8 in curb or low-profile retaining wall along the east side of the road to divert runoff. In addition, the dip crossing at the channel would need to be improved such that it will be able to accept the runoff conveyed in the improved roadway. Assuming a 1 percent roadway slope, the roadway improvements would provide 100-year conveyance.</p> <p>d) <u>Cantle Dr. - South</u></p> <p>This solution considers improving a segment of Cantle Dr. from Latigo Ln. to Riata Valley Rd. The improvement would consist of inverting the crown of the roadway and at a minimum adding an 8 in curb or low-profile retaining wall along the east side of the road to divert runoff. As a standalone project, the recommended improvements would not provide 100-year flow conveyance. However, if coupled with improvements to Latigo Ln. and Riata Valley Rd. the improvements would serve to accommodate the runoff entering this segment of roadway.</p> <p>e) <u>Martingale Dr.</u></p> <p>This solution considers improvements to Martingale Dr. The recommendation is to improve the roadway cross-section, making it inverted crowned, with 6 in curbs. These improvements would serve to convey the 10-year event to the natural watercourse south of Palo Verde Dr. To provide 100-year conveyance, roadside ditches would be necessary to capture runoff and convey it to the aforementioned watercourse. The most effective configuration would be a single 10 ft x 4 ft vertical walled concrete lined channel could be constructed on the east side of the road.</p> <p>f) <u>Basin</u></p> <p>This solution considers constructing a basin west of Western Ave. within the vacant parcel located north of the existing hilltop. The basin would serve as a logical outfall to the runoff being collected in Martingale Dr. and the area to the west. The basin would be 7 ft deep including 1 ft of freeboard. It would provide 13.2 ac-ft of storage which is less than the 10-year volume, but would serve to attenuate the flow such that the full hydrograph is being discharged on Colby Dr. A 127 ft wide by 1 ft high emergency spillway would serve to convey the 100-year event, though a wider spillway is being recommended to encourage sheet flow at the basin outfall.</p> <p>g) <u>Riata Valley Circle</u></p> <p>This solution considers improving portions of Riata Valley Circle. The recommendations include adding curb along the eastern side of the cul-de-sac and adding a dip to the cul-de-sac that extends from the mouth of the channel on the westside to the headwater of the channel on the east side. While the anticipated calculated runoff during the 100-year event (344 cfs) exceeds the capacity of the proposed improvements, construction of the solutions further to the west would reduce this flow such that the redesign could provide 100-year flow conveyance. As proposed, the design would provide 10-year flow conveyance.</p> <p>h) <u>Latigo Ln.</u></p> <p>This solution considers improving Latigo Ln. from Harvard St. to Cantle Dr. The project recommends dedicating the western portion of the alignment as a drainage easement and adding flood/retaining walls to both sides to ensure channel conveyance. Note that the channel passes through private property once it exits the drainage easement before being released downstream. For the eastern portion of Latigo Ln., a slight high point should be added to the roadway along with pavement and curbs. These improvements will ensure flow conveyance within the roadway. The improvements could provide 100-year conveyance.</p>		
Benefits: <ul style="list-style-type: none"> • Multiple options to be implemented in a multi-phase project. • Many flooding/neighborhood benefits • Reduced maintenance and sediment removal 	Considerations: <ul style="list-style-type: none"> • Possible Improvement District • More limited options may work if upstream basins are constructed. 	

Solution Name: 6.14 West Basin	Location: West of the City of Kingman limits and in line with the Sierra Vista Ave. alignment	Area: 6
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input checked="" type="checkbox"/> State <input type="checkbox"/> Federal		

Description:

This solution would consist of capturing runoff from the west within a basin located on an undeveloped parcel outside the Kingman City Limits, north of the location of the basin proposed in Solution 6.6a.

For this solution, the basin would encompass 3.6 ac, having a ponding depth of 10 ft and a total storage volume of 26.3 ac-ft. The basin would contain an emergency spillway capable of conveying the 100-year storm (e.g. a 140 ft wide weir with depth of 1.75 ft).

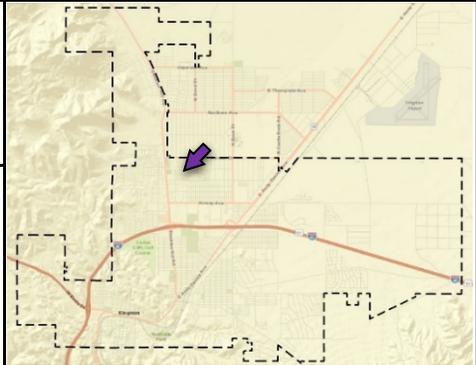


Benefits:

- Significant reduction in downstream flows during all events
- Sediment reduction to downstream areas

Considerations:

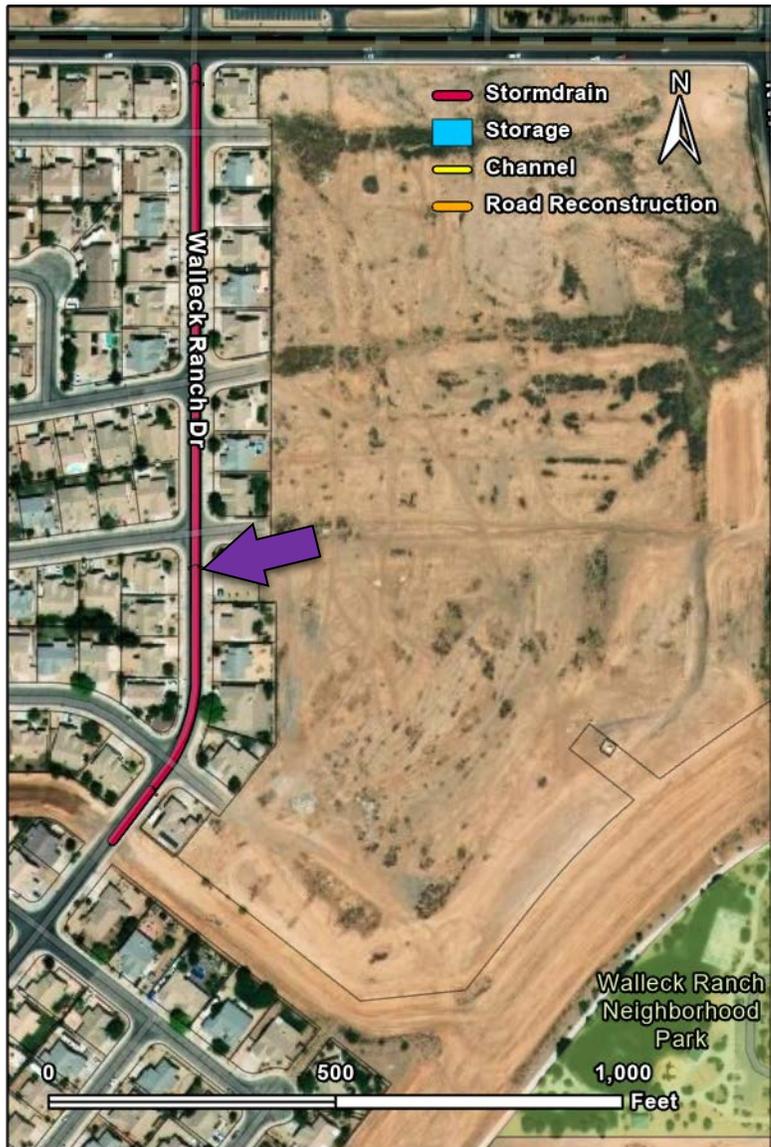
- Safety considerations with volume and basin depth
- Property acquisition
- Potential State Land coordination Issues
- Long term maintenance

Solution Name: 6.15 Walleck Ranch Stormdrain	Location: Walleck Ranch Dr., south of Gordon Dr.	Area: 6
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution would consist of the placement of a stormdrain within Walleck Ranch Dr. starting at Gordon Dr. and extending south to an existing drainage channel. The pipe would consist of a 48 in pipe, with transverse grates constructed south of Gordon Dr., Rex Allen Dr., Gene Autry Dr. and John Wayne Dr.

Because the pipe alone will be unable to provide 100-year conveyance, it is recommended that during the construction of the stormdrain, the crown of Walleck Ranch Dr. be inverted such that it has the capacity to contain the runoff within the ROW. To provide a logical discharge point, it is recommended that a 2-barrel 8 ft x 6 ft RCBC culvert be constructed to replace the at-grade roadway crossing.



Benefits:

- Improved local drainage
- Flood protection of downstream undeveloped land

Considerations:

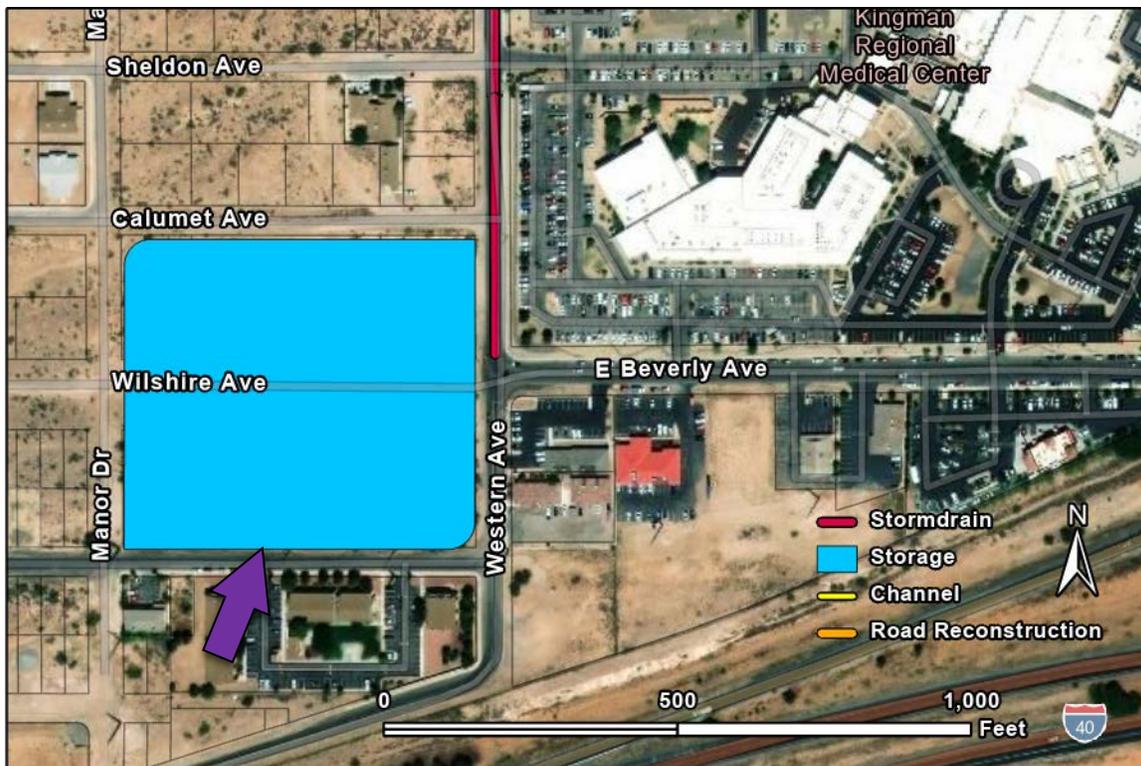
- Potential utility conflicts

Solution Name: 6.16 Hospital Basin	Location: Within two vacant parcels located west of Western Ave. and north of Beverly Ave.	Area: 6
Type of Solution: <input type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input checked="" type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution would consist of capturing runoff from the west within a basin located within two vacant parcels to the west of Western Ave. and north of Beverly Ave. Assuming a maximum basin depth of 5 ft, (4 ft of storage and 1 ft of freeboard), the basin has the potential to provide 27 ac-ft of storage, which would completely retain the 100-year storm event.

An 18" pipe fitted with orifice plate could be used to drain the basin to a logical discharge point downstream or into the stormdrain system proposed in Solution 6.5. An emergency spillway of 39 ft in length would be used to convey the peak 100-year discharge should it be necessary to do so.



Benefits:

- Reduced flood risk to Kingman Regional Medical Center
- Reduced runoff approaching Stockton Hill Rd.

Considerations:

- Property acquisition
- Long term maintenance
- Need to analyze effectiveness if other upstream basins are constructed

Solution Name: 7.1 College Trails Channel Reinforcement	Location: North of Jagerson Ave. on College Trails Dr.	Area: 7
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This channel conveys approximately max 819 cfs of water for the 100-year rainfall event (155 cfs for the 10-year event and 4 cfs for the 2-year event). The distance between walls is approximately 90 ft. The channel crosses College Trails Dr. Channel lining would provide several benefits including embankment stability and scour protection by ensuring long term functional and structural integrity. Channel regrading would restore the channel's flow capacity and reduce the flood risk to the adjacent land and properties.

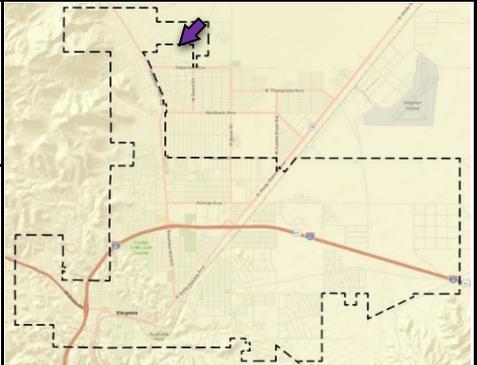


Benefits:

- Restore the channel's flow capacity
- Reduce the flood risk to the adjacent land and properties

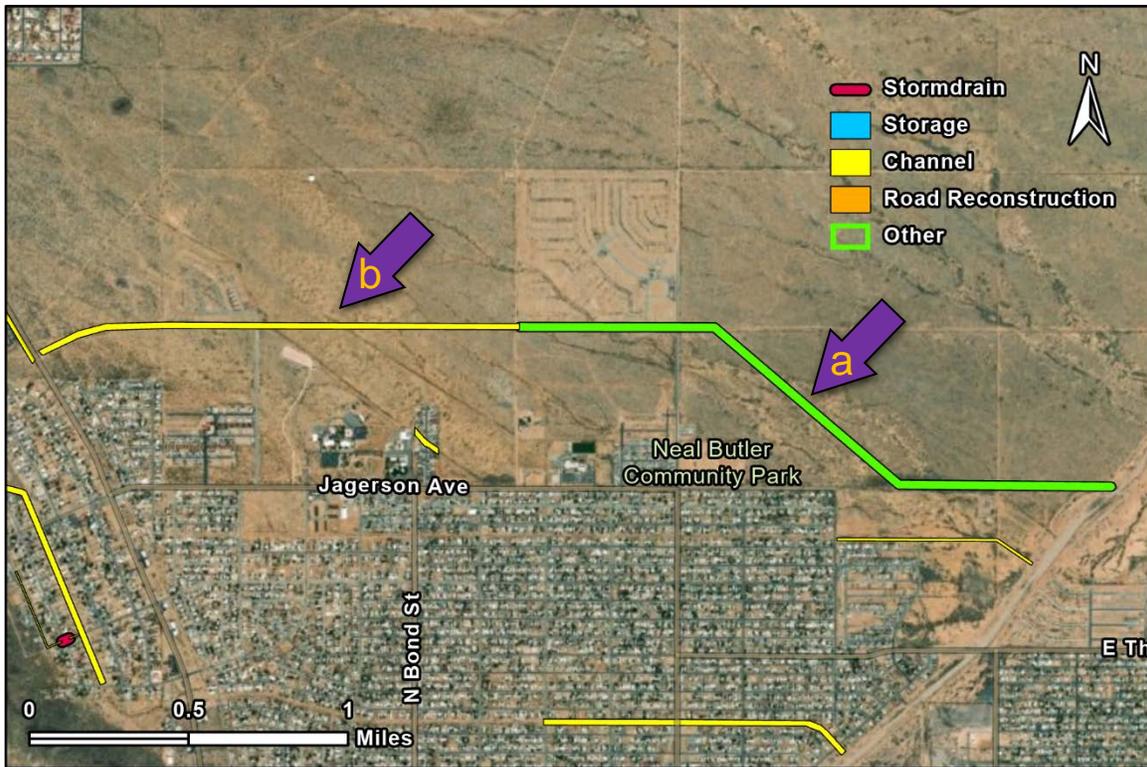
Considerations:

- This solution would not remove flood on properties adjacent to this solution area

Solution Name: 7.2 Grace Neal Channel	Location: Grace Neal Ave. alignment from Stockton Hill Rd. to Mohave Wash	Area: 7
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input checked="" type="checkbox"/> Federal	

Description:

The Grace Neal Channel system is a long-term regional drainage solution which is intended to divert the runoff impacting the north portion of Kingman, east to the Mohave Wash channel. A portion of the project has been completed (see “a” below), just east of the City limits. Planning, design and coordination with adjacent developers and land owners is needed to extend the channel west to Stockton Hill Road. The primary flows are intercepted at Eagle View Road and based on the previous design, the channel section from Eagle View to the recently constructed channel should be a trapezoidal channel with 50’ bottom width and 4:1 side slopes (see “b” below). Upstream of this point, the flows are significantly less and the channel can have a smaller footprint. Consideration should also be given to the potential of a channel on the east side of Stockton Hill Road and how that may influence the channel size across the existing state land.

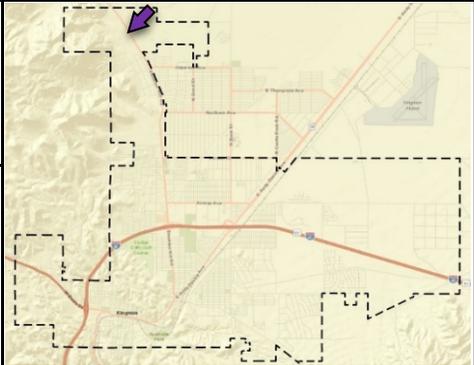


Benefits:

- Significant reduction in flood risk for a large portion of north Kingman

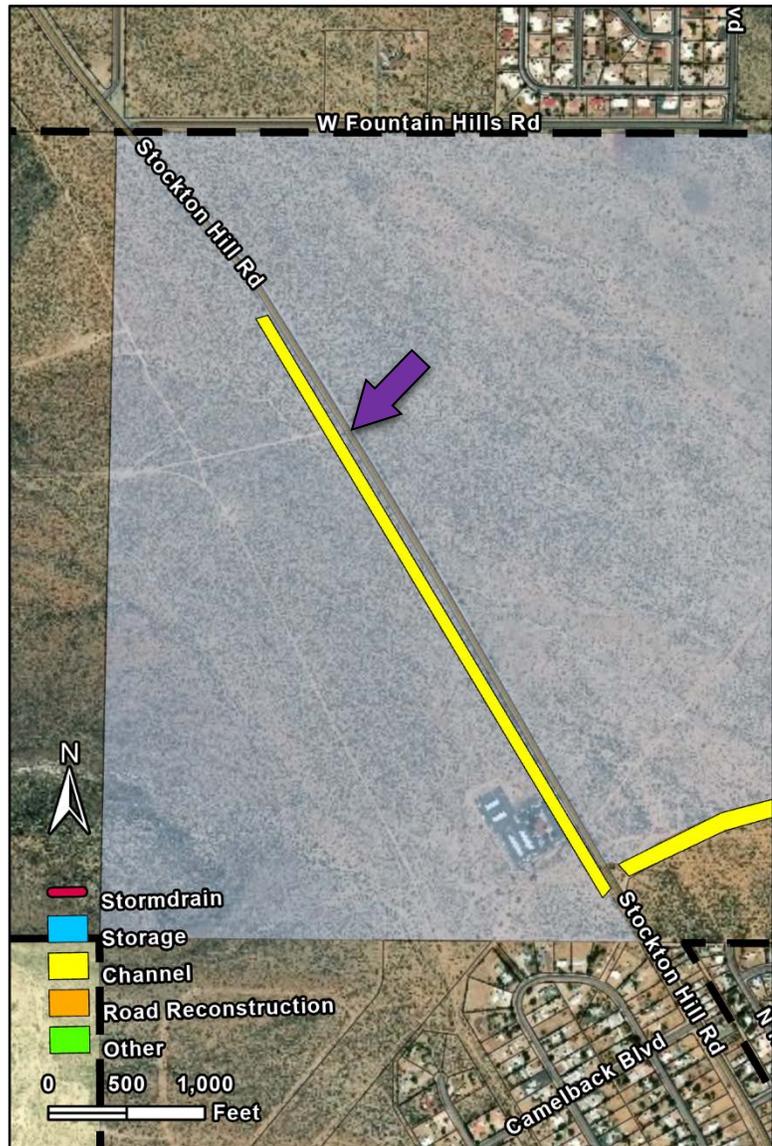
Considerations:

- A portion of the design and implementation is already underway.
- Consider construction of a channel west of Stockton Hill Rd.
- Significant County/City/ land owner coordination

Solution Name: 7.3 Stockton Hill Channel	Location: Stockton Hill Rd. north of Grace Neal	Area: 7
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input checked="" type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input checked="" type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution consists of a regional channel constructed on the west side of Stockton Hill Rd., north of the Grace Neal Channel. The purpose would be to reduce the runoff crossing Stockton Hill towards the Grace Neal Channel. It is not further developed within this plan since it is contingent upon and should be considered with the Grace Neal design and planning.



Benefits:

- Reduction in runoff crossing Stockton Hill Rd.

Considerations:

- Must be planned in conjunction with Grace Neal Channel

Solution Name: 7.4 Camelback Basin	Location: West of Camelback Blvd. and along Camelback channel	Area: 7
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input checked="" type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution includes construction of a basin adjacent to the western end of the Camelback Channel. The Camelback basin will have a bottom width of 50 ft and length of 260 ft, detaining approximately 2 ac-ft.

The purpose will be to reduce the flow slightly and to contain and convey the flow to the Camelback Channel. In its current condition, the Camelback Channel has a breakout just west of the neighborhood and that flow impacts several homes and adds additional runoff to the Shane Channel.



Benefits:

- Remove most runoff from Christy Dr.
- Eliminate the upstream breakout from channel.

Considerations:

- Property/easement acquisition required

Solution Name: 7.5 Camelback Channel	Location: From west of Camelback Blvd. and along Camelback Channel	Area: 7
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution includes reconstruction of the Camelback Channel to convey the 100-year event of 1,220 cfs. The reconstructed channel would have a typical earthen section of 3 ft deep and 60 ft wide with 6:1 side slopes. The purpose is to contain and convey the full 100-year flow from the western limits of the neighborhood to just downstream of Selma Dr. where it enters State Land.

This channel crosses three streets: Jagerson Ave., Potter Ave., and Selma Dr. Since this wash can restrict access to the neighborhood to the west, at least one of the crossings should be designed to be dry in a 100-year event. The other two crossings can be combination culvert/concrete low-water crossings to keep the road dry in the 2 to 10-year event. Each street crossing which will need to be armored with riprap on the upstream and downstream sides to prevent scour.



Benefits:

- Improved conveyance
- Lower maintenance

Considerations:

- The project design could be done with or without the Camelback Basin.

Solution Name: 7.6 Shane Channel	Location: Along Shane Dr. and Potter Ave.	Area: 7
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input checked="" type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution includes construction of an adequately designed channel on the east side of Shane Dr. to convey runoff to the Camelback Channel.

The channel will be a trapezoidal 4 ft deep, 1 ft wide bottom width rock-lined trapezoidal channel with 3:1 side slopes. The channel will have capacity for the 100-year event if the breakout in the upstream end of the Camelback channel is fixed through solution 7.4 or 7.5.

This channel bends at Potter Ave. and will convey water to Camelback Channel through culverts under Christy Dr.



Benefits:

- Reduce runoff caused by the inflow from west of Shane Dr. on properties between Shane Dr. and Christy Dr.

Considerations:

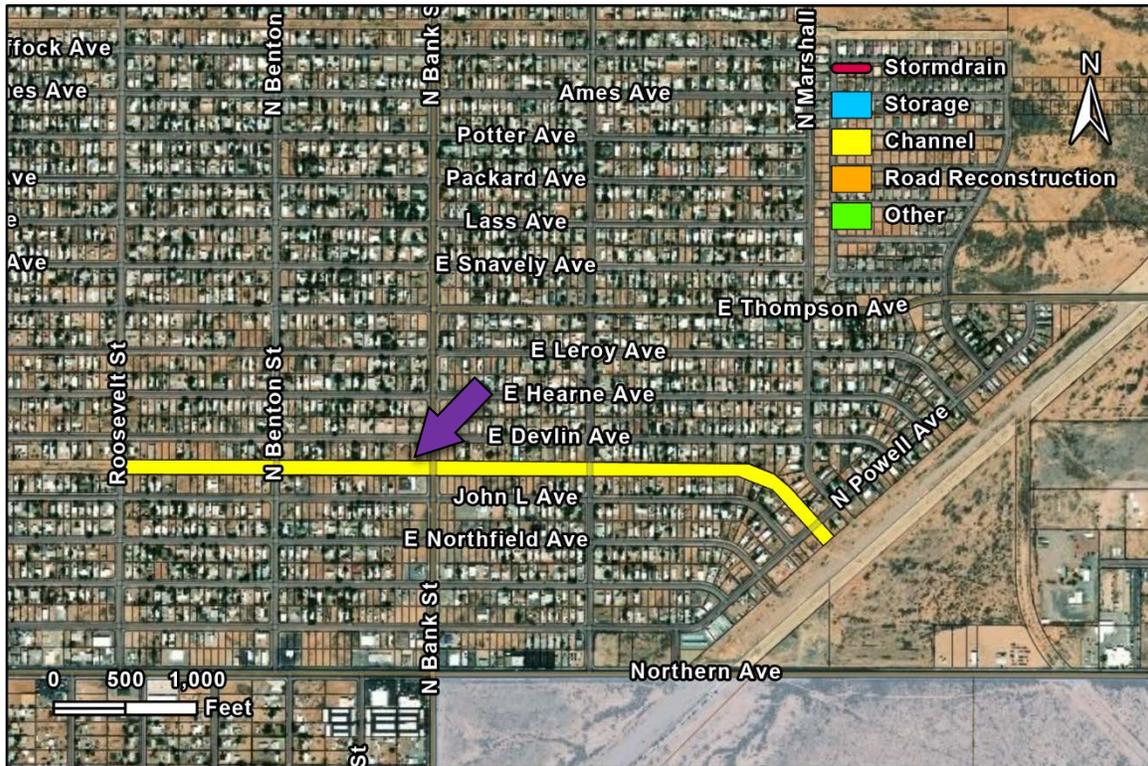
- Solutions 7.4 and 7.5 should be built to remove most runoff on properties between Shane Dr. and Christy Dr.

Solution Name: 7.7 Devlin Channel Lining	Location: Devlin Channel near Mohave Wash	Area: 7
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input checked="" type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input type="checkbox"/> Regional <input checked="" type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

The lower end of the Devlin Channel does not have capacity for the 100-year event, which is seen in the FLO-2D modeling and the current FEMA Zone A SFHA.

This solution includes designing the lower channel segment and road crossings to convey the 100-year event. Since this project is only within Mohave County, further development is not included with this plan.

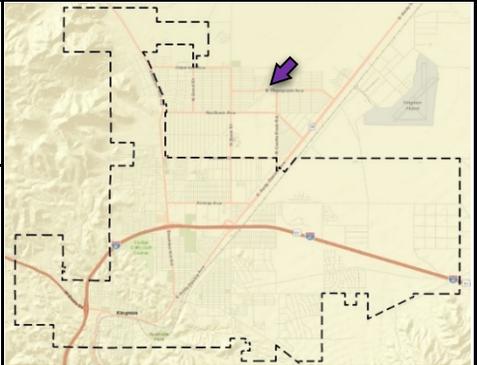


Benefits:

- Reduced flood risk to homes adjacent to the channel
- Potential Zone A remapping

Considerations:

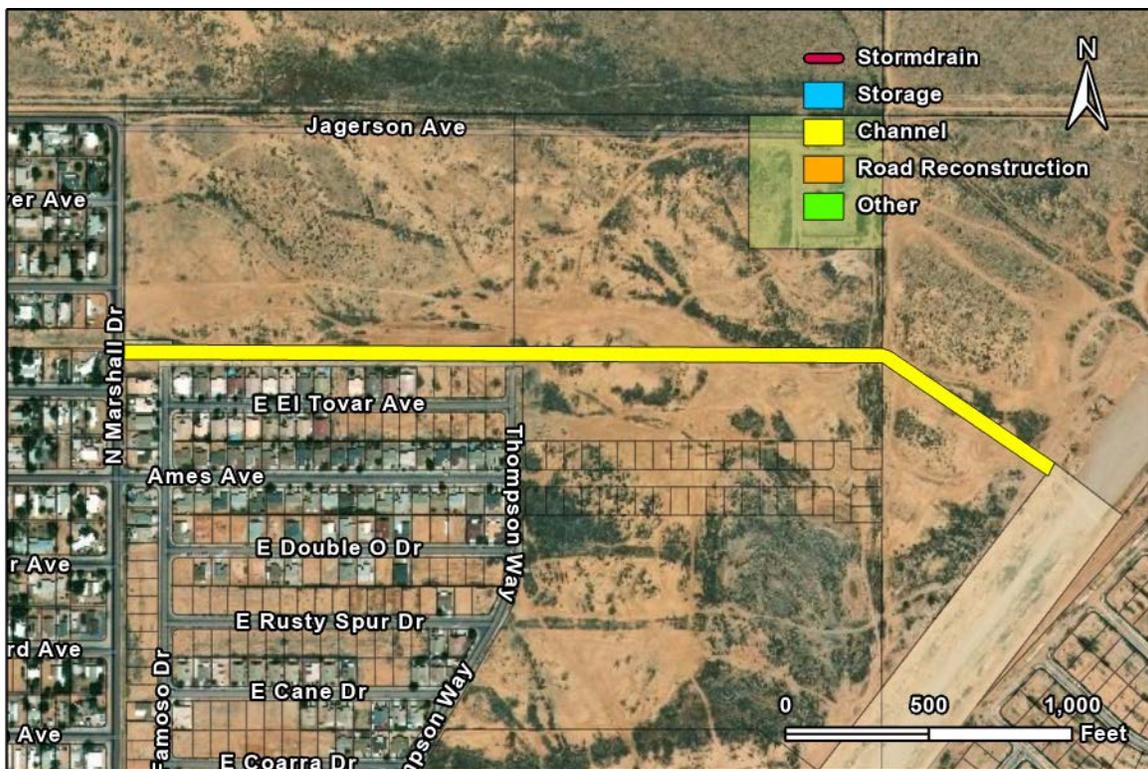
- Re-design of road crossings is critical component
- Potential utility conflicts

Solution Name: 7.8 Suffock Channel	Location: Near the intersection of N Marshal Dr. and Suffock Ave.	Area: 7
Type of Solution: <input checked="" type="checkbox"/> Conveyance <input type="checkbox"/> Attenuation <input type="checkbox"/> Infiltration <input type="checkbox"/> Structure Protection <input type="checkbox"/> Emergency Access <input type="checkbox"/> Sediment Control <input type="checkbox"/> Green Infrastructure	Project Classification: <input checked="" type="checkbox"/> Regional <input type="checkbox"/> Local <input type="checkbox"/> Individual	
	Land Ownership: <input checked="" type="checkbox"/> Private <input checked="" type="checkbox"/> City / County <input type="checkbox"/> State <input type="checkbox"/> Federal	

Description:

This solution includes construction of a channel from the eastern, downstream end of the Suffock Channel to convey runoff to Mohave Wash. The channel would need to convey approximately 628 cfs based on the existing conditions. The channel could be a 6 ft deep, 10 ft bottom width, trapezoid shape with 3:1 rock lined side slopes.

Note that once the Grace Neal Channel is completed, the flow reaching the channel may be significantly less. Since this project is only within Mohave County, further development is not included with this plan.



Benefits:

- Channelize runoff to open land for development

Considerations:

- Re-analyze flow conditions once the Grace Neal Channel is constructed
- Property/easement acquisition required