McKellips Road Storm Drain (Drawings P-18, P-19, & P-20)..... **$1,847,798**

1. Location: In Maricopa County within the north right-of-way of McKellips Road between Hawes Road and the Spook Hill FRS (Segment T).
2. Purpose: To intercept off-site stormwater from the residential areas north of McKellips Road and convey it to the Spook Hill FRS.
3. Project Elements: The proposed system consists of a buried storm drain pipe with inlets and junction structures to collect local flows into the storm drain pipe. The 100-year, 24-hour discharge in the storm drain varies from 40 cfs at Hawes Road to 400 cfs at the Spook Hill FRS. Storm drain sizes vary from 36" to 90".
4. Special Considerations: The design of this segment will have to be coordinated with the City of Mesa Parks and Recreation Department and integrated/incorporated into their proposed golf course design to the extent possible.
5. 404 Permit: The storm drain and collector channel will cross seven washes designated as regulatory waters by the Corps, however, low flows are maintained and no special restrictions are anticipated.
6. Right-of-Way: The storm drain is located within the existing McKellips Road right-of-way; therefore, no additional right-of-way is required.
7. Utility Conflicts: The alignment is crossed by gas and telephone lines. It was assumed that all would require relocation.
8. Possible Project Participants: The District and City.

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	36" CMP Aluminized w/ paved invert	$91.00	LF	1,960	$178,360
2	48" CMP Aluminized w/ paved invert	$119.00	LF	1,500	$178,500
3	54" CMP Aluminized w/ paved invert	$142.00	LF	500	$71,000
4	72" CMP Aluminized w/ paved invert	$202.00	LF	500	$101,000
5	78" CMP Aluminized w/ paved invert	$210.00	LF	500	$105,000
6	84" CMP Aluminized w/ paved invert	$224.00	LF	500	$112,000
7	90" CMP Aluminized w/ paved invert	$238.00	LF	598	$142,324
10	Export	$2.50	CY	9,120	$22,800
11	Manholes	$6,000.00	EA	12	$72,000
12	Outlet Headwall	$4,000.00	EA	2	$8,000
13	Utility Relocations (G,T)	$6,000.00	EA	8	$48,000
14	Splitter Structures	$60,000.00	EA	5	$300,000
				SUBTOTAL:	$1,338,984
				CONTINGINCIES	
				Construction (25%)	$334,746
				Engineering (7%)	$93,729
				Const. Admin. (6%)	$80,339
				Subtotal of Contingencies	$508,814
				TOTAL:	$1,847,798

Ellsworth Detention Basin & Outlet (Drawings P-21 & P-22)..... **$2,489,739**

1. Location: In Maricopa County at the northwest corner of the intersection of McDowell Road and Ellsworth Road (Basin O).
2. Purpose: The basin will attenuate the peak upstream discharge before it enters the proposed Upper Ellsworth Storm Drain system.
3. Project Elements: The proposed off-line basin has a footprint of 6.4 acres, a peak storage volume of 19.2 acre-feet, and is located on an 8.8 acre parcel. The diversion of stormwater into the basin is accomplished via a splitter structure which will allow more frequent (smaller) flows to pass by unimpeded but divert less frequent (larger) flows into the basin for temporary storage. The bypass flow is 478 cfs and the peak diversion into the basin in the 100-year, 24-hour event is 611 cfs. Storm drain sizes are 18", 36", 84", and 102".
4. Special Considerations: There is a large ironwood tree located along the eastern edge of the basin which the final designer should locate and preserve. Bedrock may be encountered during excavation; therefore, the preliminary cost estimate assumes this and may have to be adjusted as additional information becomes available.
5. 404 Permit: The construction of the detention basin will intercept one regulatory wash; permitting is required. Low flows will be maintained at all regulatory washes.
6. Right-of-Way: An 8.8 acre parcel will be acquired.
7. Utility Conflicts: No utility conflicts are anticipated.
8. Possible Project Participants: The District and City.

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Basin Excavation	$4.00	CY	101,286	$405,144
2	Splitter Structures	$60,000.00	EA	2	$120,000
3	Landscaping	$1.29	SF	383,328	$494,493
4	Outlet Headwalls	$4,000.00	EA	3	$12,000
5	102" CMP Aluminized w/ paved invert	$278.00	LF	250	$69,500
6	84" CMP Aluminized w/ paved invert	$224.00	LF	498	$111,552
7	36" CMP Aluminized w/ paved invert	$91.00	LF	211	$19,201
8	18" CMP Aluminized w/ paved invert	$52.00	LF	89	$4,628
9	Export	$2.50	CY	2,437	$6,093
10	Manholes	$6,000.00	EA	1	$6,000
				SUBTOTAL:	$1,248,611
				CONTINGINCIES	
				Construction (25%)	$312,153
				Engineering (7%)	$87,403
				Const. Admin. (6%)	$74,917
				Subtotal of Contingencies	$474,472
				SUBTOTAL:	$1,723,083
11	Basin Land Acquisition	87,120.00	AC	8.8	$766,656
				TOTAL:	$2,489,739

Upper Ellsworth Storm Drain & Swale (Drawings P-22 & P-23) **$1,828,604**

1. Location: In the City of Mesa within the west right-of-way of Ellsworth Road between McDowell Road and McKellips Road (Segment K).
2. Purpose: To convey the discharge and bypass flow from the Ellsworth Detention Basin system and to intercept sheetflow reaching the east side of Ellsworth Road and convey it south toward the Signal Butte Floodway.
3. Project Elements: The proposed system consists of a buried storm drain pipe with a parallel, at-grade collector channel to collect local sheet flows, and catch basins inlets to discharge the runoff into the storm drain pipe. The 100-year, 24-hour discharge in the storm drain is approximately 478 cfs from McDowell Road to McKellips Road. Storm drain sizes are 78", 90", and 96".
4. Special Considerations: The existing culvert under McDowell Road just west of Ellsworth Road is used to convey the vegetative maintenance flow to the downstream wash.
5. 404 Permit: No 404 impacts are anticipated.
6. Right-of-Way: No additional right-of-way is required for the construction of this storm drain.
7. Utility Conflicts: The alignment is crossed by water, gas, power, telephone, and cable TV lines. It was assumed that all would require relocation.
8. Possible Project Participants: The District and the City.

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	78" CMP Aluminized w/ paved invert	$210.00	LF	3,658	$768,180
2	90" CMP Aluminized w/ paved invert	$238.00	LF	500	$119,000
3	96" CMP Aluminized w/ paved invert	$262.00	LF	564	$147,768
4	Channel Excavation	$4.00	CY	1,750	$7,000
5	Landscaping	$1.29	SF	56,664	$73,097
6	Export	$2.50	CY	12,012	$30,030
7	Manholes	$6,000.00	EA	10	$60,000
8	Utility Relocations (W,G,P,T,C)	$6,000.00	EA	10	$60,000
9	Splitter Structures	$60,000.00	EA	1	$60,000
				SUBTOTAL:	$1,325,075
				CONTINGINCIES	
				Construction (25%)	$331,269
				Engineering (7%)	$92,755
				Const. Admin. (6%)	$79,505
				Subtotal of Contingencies	$503,529
				TOTAL:	$1,828,604

School Detention Basin & Outlet (Drawings P-24, P-25, & P-26)... **$7,161,409**

1. Location: In the City of Mesa northeast of the intersection of McKellips Road and Ellsworth Road and within the property owned by the Mesa School District (Basin L).
2. Purpose: The basin will attenuate the peak discharge from the East McKellips Road Storm Drain system.
3. Project Elements: The proposed off-line basin has a footprint of 18.6 acres, a total storage volume of 51.2 acre-feet, and is located on a 32.2 acre parcel. The diversion of stormwater into the basin is accomplished via an underground splitter structure which will allow more frequent (smaller) flows to pass by unimpeded but divert less frequent (larger) flows into the basin for temporary storage. The bypass flow is 200 cfs and the peak diversion into the basin in the 100-year, 24-hour event is 957 cfs. Storm drains are 36" and 84".
4. Special Considerations: The school has expressed a strong interest in a multi-use basin facility with the potential for a baseball diamond and/or a football/ soccer field. The final designer should coordinate these requests with the City of Mesa and the Flood Control District. Bedrock may be encountered and the excavation could be significantly more difficult. The preliminary cost estimate assumes this and may have to be adjusted as additional information becomes available.
5. 404 Permit: Construction of the detention basin and collector system impacts three regulatory washes, requiring a 404 permit.
6. Right-of-Way: A 32.2 acre parcel needs to be acquired. Although the basin is irregular in shape, the parcel must be rectangular and this resulted in additional acquisition beyond the 18.8 ac. basin footprint.
7. Utility Conflicts: No utility conflicts are anticipated.
8. Possible Project Participants: The District, the City, and the Mesa School District.

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	Basin Excavation	$4.00	CY	278,003	$1,112,012
2	Splitter Structures	$60,000.00	EA	1	$60,000
3	Landscaping	$1.29	SF	1,402,632	$1,809,395
4	Outlet Headwalls	$4,000.00	EA	3	$12,000
5	Weir Structure	$60,000.00	EA	1	$60,000
6	36" CMP Aluminized w/ paved invert	$91.00	LF	570	$51,870
7	84" CMP Aluminized w/ paved invert	$224.00	LF	140	$31,360
8	Export	$2.50	CY	796	$1,990
9	Manholes	$6,000.00	EA	3	$18,000
				SUBTOTAL:	$3,156,627
				CONTINGINCIES	
				Construction (25%)	$789,157
				Engineering (7%)	$220,964
				Const. Admin. (6%)	$189,398
				Subtotal of Contingencies	$1,199,518
				SUBTOTAL:	$4,356,145
10	Basin Land Acquisition	87,120.00	AC	32.2	$2,805,264
				TOTAL:	$7,161,409

East McKellips Storm Drain & Swale (Drawings P-25 & P-26) **$907,052**

1. Location: In the City of Mesa within the north right-of-way of McKellips Road between Ellsworth Rd. and 96th Street (Segment R).
2. Purpose: To convey the discharge and bypass flow from the School Detention Basin system and to intercept sheetflow reaching the north side of McKellips Road and convey it west to the Lower Ellsworth Storm Drain system.
3. Project Elements: The proposed system consists of a buried storm drain pipe with a parallel, at-grade collector channel to collect local sheet flows and catch basins inlets to discharge the runoff into the storm drain pipe. The 100-year, 24-hour discharge in the storm drain varies from 330 cfs at the eastern edge of the Boulder Mountain subdivision to 1000 cfs at the School Basin. The peak discharge in the storm drain is approximately 200 cfs west of the School Basin. Storm drain sizes vary from 48" to 78".
4. Special Considerations: None identified.
5. 404 Permit: The storm drain and collector channel will cross three washes designated as regulatory waters by the Corps, however, low flows are maintained and no special restrictions are anticipated.
6. Right-of-Way: No additional right-of-way is required.
7. Utility Conflicts: The alignment is crossed by water, sewer, gas, telephone, and cable TV lines. It was assumed that all would require relocation. There is a sanitary sewer line which crosses the proposed storm drain alignment approximately ½ mile east of Ellsworth Road, however, it is relatively shallow and the proposed storm drain is intended to pass under it. The segment of sewer line which crosses the storm drain can be replaced with ductile iron and sleeved if necessary.
8. Possible Project Participants: The District and City.

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	48" CMP Aluminized w/ paved invert	$119.00	LF	1,088	$129,472
2	54" CMP Aluminized w/ paved invert	$142.00	LF	187	$26,554
3	60" CMP Aluminized w/ paved invert	$155.00	LF	760	$117,800
4	(2) 78" CMP Aluminized w/ paved invert	$210.00	LF	908	$190,680
5	Channel Excavation	$4.00	CY	687	$2,748
6	Landscaping	$1.29	SF	22,260	$28,715
7	Splitter Structures	$60,000.00	EA	1	$60,000
8	Export	$2.50	CY	6,926	$17,315
9	Utility Relocations (W,S,G,T,C)	$6,000.00	EA	8	$48,000
10	Manholes	$6,000.00	EA	6	$36,000
				SUBTOTAL:	$657,284
				CONTINGINCIES	
				Construction (25%)	$164,321
				Engineering (7%)	$46,010
				Const. Admin. (6%)	$39,437
				Subtotal of Contingencies	$249,768
				TOTAL:	$907,052

East McKellips Open Channel (Drawings P-26 & P-27) **$390,227**

1. Location: In the City of Mesa within the north right-of-way of McKellips Road between 96th Street and Crismon Road (Segment Q).
2. Purpose: To intercept stormwater runoff from the Usery Mountain Park and convey it westward to the East McKellips Road storm drain system. This channel could also serve as a multi-use path connecting the Pass Mountain diversion structure to the Boulder Mountain subdivision.
3. Project Elements: The proposed system consists of an open, earth lined trapezoidal channel with 4:1 (max) side slopes along the south (roadway) side and 4:1 (min), 3:1 (max) side slopes along the north (park) side. The 100-year, 24-hour discharge in the channel varies from 0 cfs at Crismon Road to 330 cfs at the eastern edge of the Boulder Mountain subdivision. The only storm drain is 54" in diameter.
4. Special Considerations: The existing ground is relatively flat through this reach and, in some cases, the channel flows against grade. The overall elevation change, however, is minimal and positive grade to the west is achievable.
5. 404 Permit: No 404 impacts are anticipated.
6. Right-of-Way: The channel is designed to fit within the existing 55' north right-of-way and no additional right-of-way acquisition is anticipated.
7. Utility Conflicts: The alignment is crossed by a gas line. It was assumed that it would require relocation.
8. Possible Project Participants: The District and the City.

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	54" CMP Aluminized w/ paved invert	$142.00	LF	666	$94,572
2	Export	$2.50	CY	882	$2,205
3	Channel Excavation	$4.00	CY	12,700	$50,800
4	Landscaping	$1.29	SF	92,400	$119,196
5	Manholes	$6,000.00	EA	1	$6,000
6	Utility Relocations (G)	$6,000.00	EA	1	$6,000
7	Outlet Headwall	$4,000.00	EA	1	$4,000
				SUBTOTAL:	$282,773
				CONTINGINCIES	
				Construction (25%)	$70,693
				Engineering (7%)	$19,794
				Const. Admin. (6%)	$16,966
				Subtotal of Contingencies	$107,454
				TOTAL:	$390,227

Lower Ellsworth Storm Drain & Swale (Drawings P-28 & P-29).... **$2,890,377**

1. Location: In the City of Mesa within the east right-of-way of Ellsworth Road between McKellips Road and the Signal Butte Floodway (Segments M & N).
2. Purpose: To convey the discharge from the Upper Ellsworth Storm Drain and the East McKellips Storm Drain southward to the outfall into the Signal Butte Floodway.
3. Project Elements: The proposed system consists of a buried storm drain pipe with a parallel, at-grade collector channel to collect local sheet flows, and catch basins inlets to discharge the runoff into the storm drain pipe. The 100-year, 24-hour discharge in the pipe is approximately 700 cfs from McKellips Road to the Signal Butte Floodway. Due to the interception of flows along east McKellips Road and the timing of the hydrographs, the peak discharge in the Signal Butte Floodway downstream of the confluence did not change appreciably (it was slightly lower) and, therefore, modifications to improve the Signal Butte Floodway capacity were not required. In addition to 96" storm drain, both a 10x5 box culvert and a 12x5 box culvert section will be required.
4. Special Considerations: This system will transition from pipe culvert to box culvert just north of McLellan Road and back to pipe culvert just south of McLellan Road. This transition was necessary due to changes in the natural ground slope and the vertical clearance constraint at McLellan Road imposed by a gravity sewer crossing. Special transition structures should be designed to minimize potential head loss at the transition points. There is the potential to coordinate a portion of the storm drain construction with a roadway improvement project planned by MCDOT which overlaps this segment. The MCDOT project extends north as far as McLellan Road and would overlap ½ mile of this segment.
5. 404 Permit: The storm drain and collector channel will cross one wash designated as regulatory waters by the Corps, however, low flows are maintained and no special restrictions are anticipated.
6. Right-of-Way: No additional right-of-way is required for the construction of this storm drain.
7. Utility Conflicts: The alignment is crossed by water, sewer, gas, and cable TV lines. It was assumed that all would require relocation. The most significant potential conflict is a gravity sewer line crossing at McClellan but the storm drain was designed to pass over it without conflict.
8. Project Participants: The District, the City, and MCDOT.

ITEM	DESCRIPTION	UNIT PRICE	UNIT	QUANTITY	AMOUNT
1	10' x 5' Box Culvert	$470.00	LF	499	$234,530
2	12' x 5' Box Culvert	$510.00	LF	1,304	$665,040
3	96" CMP Aluminized w/ paved invert	$262.00	LF	3,387	$887,394
4	Channel Excavation	$4.00	CY	1,922	$7,688
5	Landscaping	$1.29	SF	62,280	$80,341
6	Export	$2.50	CY	16,593	$41,483
7	Manholes	$6,000.00	EA	14	$84,000
8	Utility Relocations (W,G,T,C)	$6,000.00	EA	15	$90,000
9	Outlet Headwall	$4,000.00	EA	1	$4,000
				SUBTOTAL:	$2,094,476
				CONTINGINCIES	
				Construction (25%)	$523,619
				Engineering (7%)	$146,613
				Const. Admin. (6%)	$125,669
				Subtotal of Contingencies	$795,901
				TOTAL:	$2,890,377

Recommended Alternative Summary

The Preliminary (15%) plans for the Recommended Alternative are located in Appendix A at the end of this report. The engineering calculations for the associated elements (storm drains, channels, detention basins, etc.) are included opposite of the plan sheet depicting those elements. The total cost of the Recommended Alternative is just over $31.8 Million (see Table 2 on the following page).

Table 2 - Element Cost Breakdown for Recommended Alternative

Element	Description	Raw Cost	Contingencies Const.	Contingencies Engin.	Const. Admin.	Construction Cost	Land Acquisition	Total Cost		Landscape Cost*
A	*Las Sendas Channel*	$0	$0	$0	$0	$0		**$0**		$0
H	*Sossaman Detention Basin & Outfall*	$391,576	$97,894	$27,410	$23,495	$540,375	**$226,512**	**$766,887**		$201,618
B	*McDowell Rd. Storm Drain & Swale*	$1,998,611	$499,653	$139,903	$119,917	$2,758,083		**$2,758,083**		$139,581
D	*Thunder Mountain West Channel & Storm Drain*	$76,101	$19,025	$5,327	$4,566	$105,019		**$105,019**		$0
E	*Upper Hawes Rd. Storm Drain & Swale*	$106,821	$26,705	$7,477	$6,409	$147,413		**$147,413**		$0
I	*Oak Street Detention Basin & Outlet*	$1,315,102	$328,776	$92,057	$78,906	$1,814,841	**$818,928**	**$2,633,769**		$728,928
F	*Oak Street Storm Drain & Swale*	$424,385	$106,096	$29,707	$25,463	$585,651		**$585,651**		$71,208
C	*Thunder Mountain South Channel & Storm Drain*	$77,565	$19,391	$5,430	$4,654	$107,040		**$107,040**		$0
J	*88th Street Detention Basin & Outlet*	$1,478,675	$369,669	$103,507	$88,721	$2,040,572	**$897,336**	**$2,937,908**		$798,719
G	*88th Street Storm Drain & Swale*	$117,692	$29,423	$8,238	$7,062	$162,415		**$162,415**		$13,886
V	*East McDowell Rd. Storm Drain & Swale*	$437,569	$109,392	$30,630	$26,254	$603,845		**$603,845**		$35,426
W	*Hawes Road Storm Drain & Swale*	$462,822	$115,706	$32,398	$27,769	$638,694		**$638,694**		$47,680
X	*Hermosa Vista East Storm Drain*	$1,105,588	$276,397	$77,391	$66,335	$1,525,711		**$1,525,711**		$0
Y	*Hermosa Vista West Storm Drain*	$951,981	$237,995	$66,639	$57,119	$1,313,734		**$1,313,734**		$0
T	*McKellips Road Storm Drain*	$1,338,984	$334,746	$93,729	$80,339	$1,847,798		**$1,847,798**		$0
O	*Ellsworth Detention Basin & Outlet*	$1,248,611	$312,153	$87,403	$74,917	$1,723,083	**$766,656**	**$2,489,739**		$682,400
K	*Upper Ellsworth Storm Drain & Swale*	$1,325,075	$331,269	$92,755	$79,505	$1,828,604		**$1,828,604**		$100,874
L	*School Detention Basin & Outlet*	$3,156,627	$789,157	$220,964	$189,398	$4,356,145	**$2,805,264**	**$7,161,409**		$2,496,965
R	*East McKellips Storm Drain & Swale*	$657,284	$164,321	$46,010	$39,437	$907,052		**$907,052**		$39,627
Q	*East McKellips Open Channel*	$282,773	$70,693	$19,794	$16,966	$390,227		**$390,227**		$164,490
MN	*Lower Ellsworth Storm Drain & Swale*	$2,094,476	$523,619	$146,613	$125,669	$2,890,377		**$2,890,377**		$110,871
		$19,048,318	$4,762,080	$1,333,382	$1,142,899	**$26,286,679**	**$5,514,696**	**$31,801,375**		**$5,632,274**

***NOTE: The landscape cost is already included in the total cost and is only provided here for reference. Land acquisition costs are not included in the landscape cost shown in this table.**

Environmental Considerations

This section summarizes the existing natural, physical, social, and cultural environment in relation to the Recommended Drainage Alternative. The Recommended Drainage Alternative consists of three general types of flood control structures: underground pipe culverts, open collector channels, and off-line detention basins.

The inventory of the environmental resources of the study area consisted of gathering existing resource data and information from various local, state, and federal regulatory agencies having jurisdiction within the study area. For a complete listing of these regulatory agencies and the resource data inventoried for the entire study area, see the *Level I Analysis Report: Part 2* (January 2001), and *Level II Analysis Report: Part 2* (August 2001). Separate technical reports on the cultural and ecological resources have been prepared and are on file with the District.

Natural and Physical Environment

Ecological Assessment

Biotic Communities. Three of the five detention basin sites (Oak Street, Ellsworth, and 88th Street) are relatively undisturbed, native desert properties. The vegetation should be surveyed and salvaged prior to clearing and grubbing so that the revegetation plan for the basins uses the same species and replicates similar density as the existing habitat. The vegetation survey should also identify specimen plants for salvaging as well as plants that should not be disturbed. The City of Mesa requested that a Native Plant Preservation Plan (NPPP) be prepared by a Landscape Architect and reviewed by the City's Planning staff for each basin site during final design.

Wildife. Three of the five detention basin sites (Oak Street, Ellsworth, and 88th Street) are relatively undisturbed, native desert properties. Approximately 52 acres of Sonoran Desertscrub habitat at these three basins locations would be lost until the basins could be revegetated and the new vegetation reaches sufficient height and coverage to replace the loss of habitat. Portions of the remaining two basins (Sossaman and School) have native vegetation, but there is evidence of previous ground disturbance, and therefore, the native vegetation is relatively sparse. The proposed fencing for the Oak Street basin should be game fencing to more easily provide for wildlife movement. For example, the lowest rail should be 18 inches minimum above the ground surface.

In those areas recommended for culverts and channels, impacts to habitat would be negligible since the vegetation within the right-of-way is minimal and lacks sufficient vegetation density and coverage for most wildlife. The roadway right-of-way has previously been disturbed where the underground pipe culverts and open collector channels would be constructed.

Sensitive Species. The proposed basin locations may have suitable habitat for the federally listed endangered species, Cactus Ferruginous Pygmy-Owl (*Glaucidium brasilianum cactorum*) and the Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*). In addition, there may also be suitable habitat for the Sonoran Desert Tortoise (*Gopherus agassizzii*), Wildlife of Special Concern in Arizona. Suitable habitat also exists within the Spook Hill ADMP study area for the American Peregrine Falcon (*Falco peregrinus anatum*), Bald Eagle (*Haliaeetus leucocephalus*), Lowland Leopard frog (*Rana yavapaiensis*), Mapleleaf false snapdragon (*Mabrya acerifolia*), Maricopa leafnose snake (*Phyllorhynchus browni lucidus*), Pima Indian mallow (*Abutilon parishii*), and the Southwestern Willow Flycatcher (*Empidonax trillii extimus*). However, the area associated with the Recommended Drainage Alternative does not contain any suitable habitat for these species.

Because suitable habitat for the Cactus Ferruginous Pygmy-owl, Lesser long-nosed bat, and Sonoran Desert Tortoise may occur at the basin sites, surveys for the Cactus Ferruginous Pygmy Owl may be necessary prior to any land disturbing activities. If the Cactus Ferruginous Pygmy-owl or Lesser long-nosed bat were identified within the Recommended Drainage Alternative areas, the District would act in accordance with Section 10 Habitat Conservation Plan of the Endangered Species Act (ESA) or, if there is a federal nexus, then TES Section 7 consultation would be required with the United States (U.S.) Fish and Wildlife Service. A site-specific biological evaluation should be completed prior to final design and would be required as part of any Section 404 permit application.

404 Permit Requirements

Construction of the basins will cut off and/or obliterate small washes, impact native vegetation, and potentially impact waters of the U.S. Approximately 2.5 acres of waters of the U.S. may be permanently disturbed by the construction of the Recommended Alternative. Impacts to waters of the U.S. may require permit(s) from the U.S. Army Corps Engineers and mitigation as part of the requirements of Sections 404 and 401 of the Clean Water Act. A site-specific biological evaluation and cultural resource investigation would be required as part of any Section 404 permit application.

Hazardous Materials

A review of various federal and state government records was completed to identify evidence of hazardous materials within and immediately adjacent to the Recommended Drainage Alternative. These databases included the National Priority List (NPL); Proposed NPL; the Comprehensive Environmental Response, Compensation, and Liability Information (CERCLA) system; the Resource Conservation and Recovery Information System (RCRIS); the Emergency Response Notification System (ERNS); the Superfund Program List; the Directory of Solid Waste Landfills; the Underground Storage Tank (UST) listing; the Leaking Underground Storage Tank (LUST) list; the State's Water Quality Assurance Revolving Fund (WQARF) Registry; the Drywell list; and the Hazardous Materials Incident Logbook (HMIL). The search radii for these regulatory sites were in accordance with ASTM Standards (Standard Designation E 1527-00).

Two hazardous materials incidents and three facilities with drywells were identified in the search. The ADEQ Emergency Response unit documents chemical spills and incidents that they are referred to in the Hazardous Material Incident Logbook (HMIL). Two incidents were identified within, or immediately adjacent to, the project area (Facility IDs: 96-006-A and 00-018-B). A threat of drug lab chemicals at a private residence located at 8840 E. McDowell Road was reported on January 11, 1996. On September 5, 1999, 165 gallons of an unknown liquid were dumped at a private property located at the intersection of McKellips and Usury Pass Road. Both of these incidents have been remediated.

Drywells are bored, drilled, or driven shafts or holes whose depth are greater than their width and are designed and constructed specifically for the disposal of stormwater. Drywells rely on gravity to drain liquid wastes into the ground; their construction provides minimal to no protection against potential ground water contamination. Thirty drywells, located at three facilities, are located within the project area: 4 drywells (Registration No. 22162) at Falcon Hill Ward (7752 E. McDowell Rd); 4 drywells (Registration No. 2178) at Savona (8240 E. McKellips Rd.); and 22 drywells (Registration No. 13868) at Sonora Parke (North of Adobe Road on Ellsworth).

No Superfund sites, USTs, LUSTs, WQARF Registered sites, or landfills are found in the area associated with the Recommended Drainage Alternative. Based on the results of the record search, there are no known hazardous materials concerns within the existing right-of-way where the underground pipe culverts and open collector channels would be constructed. A Phase I Environmental Site Assessment (ESA) should be completed prior to land acquisition or construction activities to reduce the potential for unidentified hazardous materials to be encountered during construction. If hazardous materials were encountered during construction, work would stop at that location and the District would contact the respective agencies to arrange for the proper assessment.

Air Quality

The Recommended Drainage Alternative is in an area where the State Implementation Plan (SIP) contains transportation control measures and the National Ambient Air Quality Standards (NAAQS) are not being met for carbon monoxide, ozone, and particulate matter less than 10 microns (PM_{10}). Some deterioration of air quality may be expected during construction due to the operation of construction equipment combined with the slower traffic speeds associated with a construction zone. This localized condition will be discontinued when the project is completed. Dust generated from construction activities will be controlled and minimized. The contractor would have to observe and comply with all air pollution ordinances, regulations, orders, etc., from those agencies having expertise and/or jurisdiction. Maricopa County Rule 310, Open Fugitive Dust Services would be enforced by the Maricopa County Environmental Services Department. The proposed flood control improvements would not cause or contribute to a violation or increase the frequency or severity of an existing PM_{10} violation once construction is completed. Therefore, there would be no substantial impact to air quality with the implementation of the Recommended Drainage Alternative.

Visual Resources

Visual resources of the entire study area were evaluated in terms of the existing visual conditions and landscape character. The visual conditions analysis included the identification of distinct features, relative scenic quality and visual intactness, visual sensitivity, and location of major viewpoints. The existing landscape character is based on defining areas of similar land use, vegetation, spatial enclosure, landform, or architectural/cultural patterns. The methodology, terms, and premises used in the evaluation of the visual resources are based on the USDA Forest Service's *National Forest Landscape Management Volumes 1 and 2* (1974), and *Landscape Aesthetics: A Handbook for Scenery Management* (1995), but were modified for this study. The existing visual resources, conditions, and ten landscape character units are described in the *Level II Analysis Report: Part 2* (August 2001).

Impacts to the surrounding environment from the construction of underground pipe culverts along the existing roadways such as McDowell Road, Hermosa Vista Drive, and McKellips Road should be minimal because the disturbance would be limited to within the existing right-of-way and the culverts would not be visible. Shallow, landscaped channels would be placed at the ground surface, above the pipe culverts. A larger, landscaped collector channel would be constructed along the north side of McKellips Road starting just east of 96th Street and extending to the Signal Butte Floodway. Refer to following sections (Aesthetic Considerations) of this *Level III Analysis Report: Part 2 and Part 10* (July 2002) for further analysis and recommendations regarding visual resources regarding the Recommended Drainage Alternative components.

Social Environment

Property Acquisition

The five off-line detention basins would require the total acquisition of approximately 63 acres from private landowners. The property owners would be compensated for the loss of their land. No business or residential relocations would be required to construct the basins because the proposed basin sites are currently vacant/undeveloped. Since the culvert structures would be built within the existing roadway right-of-way, there would be no private property acquired for the culverts and channels.

Construction-Related Considerations

Temporary construction easements may be necessary in some locations. Construction activities adjacent to roadways would slow traffic movement and inconvenience motorists, typical of short-term impacts related to construction. Motorists would most likely take alternative routes to avoid the construction zone, which may result in an increase in cut-through traffic on residential streets.

Construction of the basins would have greater impacts to local traffic than the culvert structures since trucks hauling material to and from the basins would add additional traffic volume to the roadways and slow traffic movement. Access to properties would be provided at all times, and roads would remain open to traffic during construction except during brief periods of time to move equipment or large construction material. The contractor should place signs prior to the start of construction along McKellips Road, McDowell Road, and Usery Pass Road/Ellsworth Road according to current agency standards to notify motorists so that they are not surprised by the potential delays and inconveniences. Along Hermosa Vista Drive, Oak Street, Hawes Road, and 88th Street, adjacent residents should be individually notified by the contractor in addition to the placement of signs prior to the start of construction.

Noise

Noise levels would increase during the earthmoving activities and operation of construction equipment associated with the construction of the Recommended Drainage Alternative components. This localized condition will be discontinued when the project is completed.

Title VI/Environmental Justice

While the anticipated activities recommended by this study are not expected to utilize Federal monies and the District is not a Federal agency, this analysis was conducted to ensure that the current activities also considered this regulation. The conclusion of this analysis is that no Title VI/Environmental Justice issues are anticipated for flood control activities for the Recommended Drainage Alternative components.

Cultural Environment

Cultural Resources

The area associated with the Recommended Drainage Alternative has not been surveyed for the presence of cultural resources. The archival information from the Class I Cultural Resource Assessment did not identify any previously known cultural resources near any of the Recommended Drainage Alternative components. Therefore, there would be no affect on known properties considered eligible for the National Register of Historic Places (NHRP). For a summary of the archaeological inventory and site records searched for the Class I Cultural Resource Assessment, refer to the *Recommended Alternative Report: Part 2* (January 2001). Additionally, a separate technical report, *Class I Cultural Resources Report, Spook Hill Area Drainage Master Plan Maricopa County, Arizona* (March 2000), has been prepared and is on file with the District.

The completion of a Class III intensive pedestrian cultural resource survey is recommended for those sites that are relatively undisturbed, such as some of the basin sites. If cultural resources are encountered during construction, work would stop at that location and the District would contact the respective agencies to arrange for the proper assessment or treatment of those resources.

MEASURES TO REDUCE IMPACTS

1. Minimize disturbance to native vegetation, specifically xeroriparian vegetation during construction by avoiding mature/key vegetation and natural features such as washes when feasible. Incorporate unique topographical features such as washes and rock outcroppings where possible. Salvage and transplant native trees and cactus where feasible.
2. Complete a biological evaluation for sensitive species impact prior to final design to specifically identify areas of suitable habitat to be avoided. Restore any habitat lost to existing conditions in terms of plant density and mix and variety of species.
3. The proposed fencing for the Oak Street basin should be game fencing to more easily provide for wildlife movement.
4. Avoid disturbance to waters of the U.S.
5. If hazardous materials are encountered during construction, work would stop at that location, and the District would contact the respective agencies to arrange for the proper assessment or treatment of those materials and resources.
6. The completion of a Phase I ESA during the design phase is recommended to identify any recognized environmental concerns.
7. The contractor would have to observe and comply with all air pollution ordinances, regulations, orders, etc., from those agencies having expertise and/or jurisdiction to be followed. Maricopa County Rule 310, Open Fugitive Dust Services, which would be enforced by the Maricopa County Environmental Services Department.
8. The contractor should place signs prior to the start of construction along McKellips Road, McDowell Road, and Usery Pass Road/Ellsworth Road according to current agency standards to notify motorists. Along Hermosa Vista Drive, Oak Street, Hawes Road, and 88th Street, adjacent residents should be individually notified by the contractor in addition to the placement of signs prior to the start of construction.
9. The completion of a Class III intensive pedestrian cultural resource survey at the basin locations during final design is recommended to identify any impacts to potentially eligible or eligible NRHP cultural resource sites.

Multi-Use/Recreation Consideration

Information from existing municipalities and planning organizations were utilized in identifying multi-use and recreation opportunities. Within the study area, there are numerous multi-use opportunities to be developed in conjunction with existing and planned recreation facilities, and contribution to the integration of regional and local open space systems. For a complete listing of these municipalities and planning organizations along with the inventory of the regionally and locally significant multi-use and recreation opportunities for the entire study area, see the *Level I Analysis Report: Part 2* (January 2001), and *Level II Analysis Report: Part 2* (August 2001).

Trails/Pathways

There are no existing or proposed multi-use trails identified along McDowell Road by Maricopa County. The proposed shallow collector channel adjacent to McDowell Road could be use as an informal pedestrian path to provide an east-west link between the Usery Mountain Recreation Area and the CAP Canal trail. The informal pedestrian path in this case would consist of using the bottom of the channel as a pathway. The channel bottom would have a surface treatment of compacted inert material such as decomposed granite or other smooth surface material. The collector channels along the local/residential streets such as Hermosa Vista Drive, Hawes Road, Oak Street, and 88th Street could also serve as informal pedestrian paths. The informal pedestrian path would provide an opportunity for future designated pathway. McKellips Road is designated as a Road of Regional Significance and has existing and proposed bike lanes within the project area. The collector channels along McKellips Road would therefore not necessarily provide any additional multi-use opportunities to the community, but could serve as informal pedestrian circulation. The Ellsworth and School Basins have the potential to be connected by existing and planned pathways and bikeways to the Usery Mountain Recreation Area. Refer to Figure 16 – Planning Influences from the *Level I Analysis Report: Part 2* (January 2001).

Parks/Open Spaces

The off-line detention basins would provide active and passive recreation opportunities for the adjacent neighborhoods. Three of the basins will function primarily as passive, preserved, open space due to the natural surroundings and community's views, and will be available to accommodate additional future recreational needs of the community as the City of Mesa identifies need. The approximately 2.6-acre Sossaman Basin (76th Street & McDowell Road) could be utilized as part of the Las Sendas trail/open space system because of its close proximity to the Las Sendas development. The area just north of the proposed Boulder Mountain Elementary School Basin (96th Street/McKellips Road) is being developed as a public elementary school. The proposed 18.6-acre basin adjacent to the Boulder Mountain Elementary School facility would provide a multi-use opportunities for a level grassed-area that could be used for field sports and a hilly, desert open space for cross-county running or mountain bike use. The Boulder Mountain Elementary School Basin site will be used as a Mesa city park. Design details and criteria for the multi-use facility would be determined and coordinated during final design with/through the City of Mesa and the Mesa Public School District.

Aesthetic Considerations

Background

The residential, recreation, and undisturbed natural lands are considered areas of high visual sensitivity based on the assumption that residents and recreationists would closely scrutinize these landscapes. Based on comments from citizens attending the public meetings for the Spook Hill ADMP, the aesthetics and preservation of the desert character of the area is a critical concern. The methodology, terms, and premises used in the evaluation of the visual resources/aesthetic considerations are based on the USDA Forest Service's *National Forest Landscape Management Volumes 1 and 2* (1974), and *Landscape Aesthetics: A Handbook for Scenery Management* (1995), but were modified for this study.

Visual resources/aesthetic considerations of the entire study area were evaluated in terms of the existing visual conditions and landscape character. The visual conditions analysis included the identification of distinct features, relative scenic quality and visual intactness, visual sensitivity, and location of major viewpoints. The existing landscape character is based on defining areas of similar land use, vegetation, spatial enclosure, landform, or architectural/cultural patterns. The existing visual resources, conditions, and character units are described in depth in the *Level II Analysis Report: Part 2* (August 2001). The landscape character units that encompass the area associated with the Recommended Drainage Alternative are summarized below with general planning guidelines for each.

"Las Sendas" Subdivision Unit

Character. This landscape character unit has similar architectural elements, consistent lot sizes, mixed ornamental and desert landscaping, and streetscape typical of a planned suburban area development setting in the Phoenix metropolitan area.

- Distinct features within the unit include Spook Hill, the streetscape and signage elements within the Las Sendas subdivision, and the complementary architecture of the buildings.
- The scenic quality of the unit is moderately high to high.
- The level of intactness of the unit is moderately high to high.
- The level of visual sensitivity of the unit is high.

Planning Guideline. Any flood control facility should consider views to Spook Hill and the surrounding mountains, and compliment the existing pathway system in place. Flood control solutions causing any vegetative manipulation should follow the existing patterns of the constructed landscape and be compatible with the existing palette of plant and hardscape material.

Desertscrub View Homes Unit

Character. This landscape character unit has varying architectural style and materials of the residences, but the Southwestern architecture character with stucco/adobe finishes are the most prevalent. The character of this unit is established by the varied building orientation, prominence of dirt roads, coarse texture of the desertscrub vegetation, and the dominance of the colors of the native landscape.

- Views are predominately of the Phoenix Metropolitan area, and the Usery, Las Sendas, and San Tan Mountains. Saguaros, ocotillos, and other cactus species, and rock outcroppings are the most notable natural features.
- The overall scenic quality of the unit is moderate to moderately high.
- The level of intactness of the unit is moderate.
- The level of visual sensitivity of the unit is high.

Planning Guideline. The native vegetation, drainage patterns, and rock outcrops should be preserved and restored where feasible. Construction of flood control facilities may create the opportunity to provide pathways, trail heads, and public recreation facilities for additional viewing opportunities. Introduced features could be visually disruptive if they create notable visual contrast.

Suburban Neighborhoods Unit

Character. Uniform-sized lots, single story residences, and limited vegetation typify the character of this unit. Vertical walls are seldom used to delineate property boundaries, instead vegetation or wood or chain-link fencing are used.

- There are no natural or built distinct features within the unit.
- The overall scenic quality of the unit is moderate to low.
- The level of intactness of the unit is moderate to low.
- The level of visual sensitivity of the unit is high.

Planning Guideline. Construction of flood control facilities may create the opportunity to provide pathways, trail heads, and public recreation facilities for additional viewing opportunities.

Mined/Exposed Earth Unit

Character. Large, earthmoving equipment, expansive areas of exposed earth, and remnants of landforms are the prominent visual elements that characterize this unit.

- Severe modification of landforms from the mining and clearing activities create a distinct pattern in the landscape.
- The scenic quality of the unit is low to very low.
- The level of intactness of the unit is low to very low.
- The level of visual sensitivity of the unit is low.

Planning Guideline. Restoration of the significantly modified setting to its natural topographic character and vegetation cover is desirable. Any opportunity to mitigate the visual impact resulting from the excavation and striping of the land would be beneficial.

Sonoran Desertscrub Unit

Character. The predominant characteristic of land within this unit is one of relatively undisturbed native desert.

- The most notable built features in this unit are the roadway corridors and overhead transmission lines and towers.
- The scenic quality of the unit is moderate to high.
- The level of intactness of the unit is moderate to high.
- The level of visual sensitivity of the unit is high.

Guideline. Preserve the desertscrub landscape either by expanding areas adjacent to designated open space land or restoring the natural vegetation. Vegetation manipulation should recognize existing vegetation patterns. Any introduced features should minimize contrast and not attract attention from the natural setting.

Mountain/Rock Outcrops Unit

Character. This character unit is dominated by the surrounding mountain ranges and rock outcrops in the background (three to five miles).

- Mountainous landforms are distinct natural features and are primary focal points.
- The scenic quality of the unit is very high to moderately high.
- The level of intactness of the unit is very high to moderately high.
- The level of visual sensitivity of the unit is high.

Planning Guideline. Mountain and rock outcrops should be preserved and maintained. Any flood control features adjacent to these landforms should be designed to provide views to the mountains and so that any built features do not detract from the natural features.

Characteristics Associated with the Recommended Drainage Alternative

The various components of the Recommended Drainage Alternative are proposed within different types of residential developments and native desert landscapes. Residential development is of various character types including low-density rural neighborhood and high-density, planned area development-type housing. The planned area developments, like Las Sendas and Thunder Mountain, have a more uniform appearance due to the similar architectural elements, narrow lots, mixed ornamental and desert landscaping, masonry perimeter walls, and street lights. The rural neighborhood categorized previously as the Desertscrub View Homes Landscape Character Unit (Level I & II Reports), has a variety of architectural styles and materials in a more irregular pattern with much of the natural desert vegetation preserved. Few overhead utilities exist, and arterial roadways are rural in character (i.e., without developed shoulders and most are unpaved). The terrain ranges from relatively flat to hilly with scattered rock outcroppings. Mature mesquite, palo verde, and ironwood trees and a variety of cacti including saguaros, are prevalent in the native desert areas. A more detailed description of the existing visual character and conditions are presented in Part 2 Characteristics of the Existing Corridor.

Conclusions and Recommendations

Culverts and Channels. The proposed collector channels would be earthened and landscaped in accordance with the City of Mesa's *Desert Uplands Development Standards* (Ordinance 3693) adopted by the City Council on September 21, 1999. Areas within the unincorporated area of Maricopa County would also follow the City's plant list because it identifies plant material native to the vicinity. See Table 5 for the plant list. The shallow landscape collector channels would improve the level of intactness of the area by providing visual interest and cohesiveness to the setting. Because the channels are located adjacent to streets, the landscaping of the channel would serve as a unifying streetscape element. The organization, density, and specific selection of plant material should reflect the various landscape character adjacent to the channel. For example, the channel along Hermosa Vista Drive would have a different plant palette to compliment the specific setting than the area adjacent to the Boulder Mountain Subdivision along Usery Pass Road.

Drop Structures. Any drop structures, which would be required along the collector channels, would be a dominant feature in the channel. To mitigate the aesthetic impact, the drop structures would incorporate the use of native rock and boulders to reflect the surrounding rocky character of the area or be constructed of integral colored material with a surface treatment that blends with the setting (Figure 3). The underground conveyance culverts, after construction, would not create a visual change in landscape character.

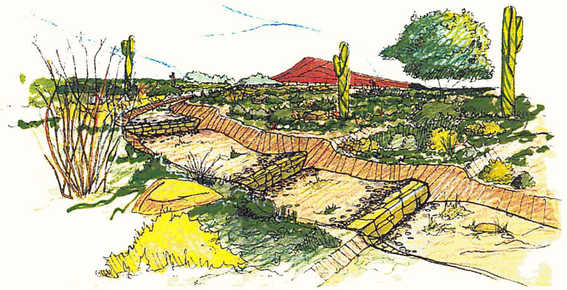


Figure 3. Boulder/Rock Drop Structure Concept Sketch

Basins. The off-line retention basins would be designed to blend with their immediate setting. The intent of the basin design is to create a functioning drainage structure that would be visually compatible with its immediate surrounding and would not contrast in terms of color, line, scale, and form, three years after construction.

Landscape Design Themes & Aesthetic Design Guidelines/Criteria

Aesthetic considerations of the entire study area were evaluated in terms of the existing visual conditions and landscape character. The existing visual resources, conditions, and character units are described in depth in the *Level II Analysis Report: Part 2* (August 2001). Summarized in the previous section are the landscape character units with their general themes and planning guidelines relative to the Recommended Drainage Alternative. The following section is a summary of specific aesthetic design guidelines for the Recommended Drainage Alternative components. The intent of the design guidelines is to provide a framework for the designer as they complete the next level of design based on the results of the inventory and analysis of the study area and input from the City of Mesa and their citizens. The City of Mesa's *Site Development Design Standards* (Section 11-15-1 through Section 11-15-5) should be considered in addition to the design guidelines provided below.

Landscape Design Themes. The Landscape Design Themes were developed based on the site's visual character and context, input from the City of Mesa and the community at the study's public meetings, the specific site characteristics such as topography and vegetation, on- and off-site opportunities/constraints, and the functional requirements of the drainage feature. The themes for the off-line detention basins could be accomplished at all the proposed basins except one: the Oak Street Basin (Hawes Road/Oak Street). The depth required for the Oak Street basin is approximately 28 feet at the upper end of the structure, and the constraints of the site would not accommodate an adequate buffer to screen the basin. This depth creates visual contrast in terms of scale and form that is considered a substantial aesthetic impact as well as a safety issue based on the preliminary basin design. The basin needs to be fenced, which is another introduced visual element into the landscape. The proposed fencing should be designed as a view-type fence to lessen the visual impact to the surrounding area. Figure 4 illustrates that by accommodating the depth needed for storm event storage, the Oak Street Basin would not be visually compatible with its surroundings and would create an obvious change in the landscape character of the area.

Culverts and Channels. The landscape design themes for the open conveyance channels consist of two different concepts: the Informal Pedestrian Path Channel, or the Zerariparian Channel. The new channels are located in areas where the natural desert vegetation has predominately been preserved. In both themes, the landscaped channel serves as the unifying element that would create an organic pattern of elements adjacent to the roadway. These two landscape design themes for conveyance channels are outlined in greater depth in the next section on the following pages.

Basins. The five off-line detention basins are referred by their location within the project area. Each of them has a different landscape design theme depending on its site characteristics and setting. The aesthetic design guidelines and criteria for each landscape design theme for the open conveyance channel and off-line basin facilities are outlined on the following pages. If a basin location changes, the landscape design theme will require reevaluation based on the surrounding site character and setting.

Table 3 - Preliminary Landscape Cost Breakdown

Element	Description	Landscape Cost
A	*Las Sendas Channel*	$0
H	*Sossaman Detention Basin & Outfall*	$201,618
B	*McDowell Rd. Storm Drain & Swale*	$139,581
D	*Thunder Mountain West Channel & Storm Drain*	$0
E	*Upper Hawes Rd. Storm Drain & Swale*	$0
I	*Oak Street Detention Basin & Outlet*	$728,928
F	*Oak Street Storm Drain & Swale*	$71,208
C	*Thunder Mountain South Channel & Storm Drain*	$0
J	*88th Street Detention Basin & Outlet*	$798,719
G	*88th Street Storm Drain & Swale*	$13,886
V	*East McDowell Rd. Storm Drain & Swale*	$35,426
W	*Hawes Road Storm Drain & Swale*	$47,680
X	*Hermosa Vista East Storm Drain*	$0
Y	*Hermosa Vista West Storm Drain*	$0
T	*McKellips Road Storm Drain*	$0
O	*Ellsworth Detention Basin & Outlet*	$682,400
K	*Upper Ellsworth Storm Drain & Swale*	$100,874
L	*School Detention Basin & Outlet*	$2,496,965
R	*East McKellips Storm Drain & Swale*	$39,627
Q	*East McKellips Open Channel*	$164,490
MN	*Lower Ellsworth Storm Drain & Swale*	$110,871
		$5,632,274

Tables 3 and 4 show preliminary cost estimates only. These costs reflect a higher value of landscape due to the mature vegetation of the area. More detailed options for vegetation will be developed during the final design phase of the project. The District's policy enables it to fund its share of landscape costs up to $40,000 per acre in a suburban setting.

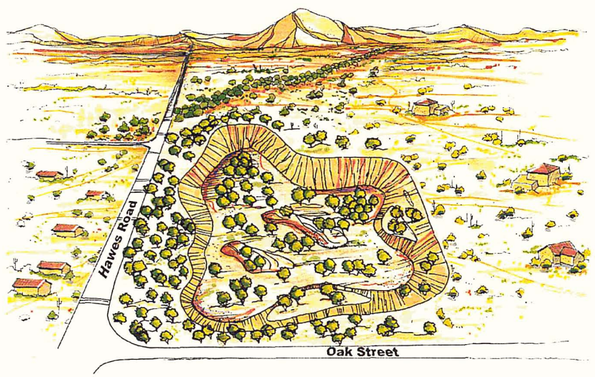


Figure 4. Oak Street Basin Conceptual Sketch

TABLE 4 - Preliminary Landscaping Cost Estimate

Salvaging Trees/Transport to Nursery

Item	Quantity	Caliper Inch per Tree	Total Caliper Inch	Cost per Caliper Inch	Extension
36" Box Tree	72	4	288	$50.00	$14,400.00
42" Box Tree	72	6	432	$50.00	$21,600.00
48" Box Tree	120	8	960	$50.00	$48,000.00
54" Box Tree	120	10	1200	$50.00	$60,000.00
60" Box Tree	120	12	1440	$50.00	$72,000.00
66" Box Tree	72	13.5	972	$50.00	$48,600.00
72" Box Tree	72	15.5	1116	$50.00	$55,800.00
78" Box Tree	36	16	576	$50.00	$28,800.00
84" Box Tree	36	18	648	$50.00	$32,400.00
				Subtotal	**$381,600.00**

Replanting of Salvaged Trees

Item	Quantity	Unit	Unit Cost	Total Cost
36" Box Tree	72	each	$250.00	$18,000.00
42" Box Tree	72	each	$250.00	$18,000.00
48" Box Tree	120	each	$250.00	$30,000.00
54" Box Tree	120	each	$250.00	$30,000.00
60" Box Tree	120	each	$250.00	$30,000.00
66" Box Tree	72	each	$250.00	$18,000.00
72" Box Tree	72	each	$250.00	$18,000.00
78" Box Tree	36	each	$250.00	$9,000.00
84" Box Tree	36	each	$250.00	$9,000.00
			Subtotal	**$180,000.00**

Salvage Nursery

	Quantity	Unit	Unit Cost	
Plant Guarantee-5% loss of Salvage Tree Cost	1	L. Sum	$19,080.00	$19,080.00
Nursery Set Up	1	L. Sum	$2,000.00	$2,000.00
Maintenance- 12 months	1	L. Sum	$5,400.00	$5,400.00
Above Ground Temp. Nursery Irr. System	1	L. Sum	$37,440.00	$37,440.00
Roping off of Salvage Site	1	L. Sum	$2,500.00	$2,500.00
Nursery Water- 12 months	1	L. Sum	$8,640.00	$8,640.00
			Subtotal	**$75,060.00**

Landscape/Irrigation

Item	Quantity	Unit	Unit Cost	Total Cost
Desert Pavement Install (No Stockpiling)/Fine Gra	60	acres	$3,921.00	$235,260.00
5 Gallon Shrubs- Nursery Purchased	5227	each	$14.00	$73,178.00
1 Gallon Shrubs- Nursery Purchased	26136	each	$4.00	$104,544.00
Hydroseed- Native Reveg.	60	acres	$2,200.00	$132,000.00
Hydroseed Temp. Irrigation	60	acres	$2,200.00	$132,000.00
Plant Material Temp. Irrigation	31843	each/plant	$12.00	$382,116.00
Soil Salvage (6 inch depth)	50820	cubic yards	$3.00	$152,460.00
Boulders - small (2-3 feet dia.)	3120	per 60 acres	$65.00	$202,800.00
Boulders - medium (3-6 feet dia.)	6240	per 60 acres	$108.00	$673,920.00
Boulders - large (6-10 feet dia.)	3120	per 60 acres	$208.00	$648,960.00
			Subtotal	**$2,737,238.00**
			Grand Total	**$3,373,898.00**
			Landscaping Cost Per Acre	$56,232
			Landscaping Cost Per Square Foot	$1.29

It should be noted that the landscaping costs for the detention basins assume that the entire parcel acquired for the basins will be landscaped. Due to the irregular shape of the basins, however, the basin footprint is, in some cases, substantially smaller than the area of the parcel and some areas of the parcel may remain in their natural condition. It was decided that, at this conceptual level, a conservative estimate would be more prudent and would give the final designer more opportunities for creativity in the design. Also note that the landscaping costs do not include any land acquisition.

Table 5 - City of Mesa's Desert Uplands Development Plant List

TREES	
ACACIA ABYSSINICA	*ABYSSINIAN ACACIA*
ACACIA ANEURIA	*MULGA*
ACACIA ANGUSTISSIMA	*FERN ACACIA*
ACACIA CAVENIA	
ACACIA CONSTRUCTA	*WHITE THORN ACACIA*
ACACIA CRASPEDOCAPPA	*LEATHER LEAF ACACIA*
ACACIA EBURNIA	*NEEDLE ACACIA*
ACACIA FARNESIANA	*SWEET ACACIA*
ACACIA GREGGH	*CATCLAW ACACIA*
ACACIA MILLEFOLIA	*SANTA RITA ACACIA*
ACACIA PENNATULA	
ACACIA OCCIDENTALLIS	
ACACIA SCHAFFNERI	
ACACIA SMALLII	*SWEET ACACIA*
ACACIA STENOPHYLLA	*SHOESTRING ACACIA*
ACACIA WILLARDIANA	*WHITE BARK ACACIA*
CANOTIA HOLACANTHA	*CRUCIFIXION THORN*
CELTIS PALLIDA	*DESERT HACKBERRY*
CELTIS RETICULATA	*NETLEAF HACKBERRY*
CERCIDIUM FLORIDUM	*BLUE PALO VERDE*
CERCIDIUM MICROPHYLLUM	*FOOTHILL PALO VERDE*
CERCIDIUM PRAECOX	*PALO BREA*
CHILOPSIS LINEARIS	*DESERT WILLOW*
CLIANTHUS FORMOSUS	*STURTS DESERT PEA*
DALEA SPINOSA	*SMOKE TREE*
HOLACANTHEA EMORYI	*CRUCIFIXION THORN*
LEUCAENA RETUSA	*GOLDEN LEAD BALL TREE*
MAYTENUS PHYLLANTHIODES	*GUTTA PERCHA MAYTEN*
OLNEYATESOTA	*IRONWOOD*
PITHECELLOBIUM BREVEFOLIUM	*APES EARRING*
PITHECELLOBIUM FLEXICAULE	*TEXAS EBONY*
PITHECELLOBIUM MEXICANA	*MEXICAN EBONY*
PROSOPSIS ALBA	*WHITE MESQUITE*
PROSOPSIS CHILENSIS	*CHILEAN MESQUITE*
PROSOPSIS JULIFLORA	*HONEY MESQUITE*
PROSOPSIS PUBESCANS	*FREMONT SCREWBEAN*
QUERCUS TURBINELLA	*SCRUB OAK*
SHRUBS	*t*
ALOYSIA LYCIOIDES	*WHITE BRUSH*
AMBROSIA DELTOIDEA	*BUR SAGE*
ASCLEPIAS SUBULATA	*DESERT MILKWEED*
ATRIPLEX CANESCENS	*FOUR WING SALT BUSH*
ATRIPUEX HYMENELYTRA	*DESERT HOLLY*
ATRIPLEX LENTIFORMIS	*QUAIL BUSH*
ATRIPLEX MULLERI	
ATRIPLEX NUMMULARIE	*OLD MAN SALT BUSH*
ATRIPLEX POLYCARPA	*DESERT SALT BUSH*
ATRIPLEX RHAGODIOIDES	
ATRIPLEX TORRYI	*NEVADA SALT BUSH*
BACCHARIS SAROTHROIDES	*DESERT BROOM (MALE)*
BUDDLEJA MARRUBIFOLIS	*WOOLY BUTTERFLY BUSH*
BURSERA MICROPHYLLA	*ELEPHANT TREE*
BURSERA FAGAROIDES	
CAESALPINIA CACALACO	
CAESALPINIA GILLESHI	*YELLOW BIRD OF PARADISE*
SHRUBS - Continued	
CAESALPINIA MEXICANA	*MEXICAN POINCIANA*
CAESALPINIA PLATYLOBA	*BIRD OF PARADISE*
CAESALPINIA PULCHERRIMA	*MEXICAN BIRD OF PARADISE*
CAESALPINIA PUMILA	*COPPER BIRD OF PARADISE*
CALLIANDRA CALIFORNIA	*RED FAIRY DUSTER*
CALLIANDRA ERIOPHYLLA	*FALSE MESQUITE*
CASSIA ARTEMESIOIDES	*FEATHERY CASSIA*
CASSIA BIFLORA	*TEXAS CASSIA*
CASSIA CANDOLEANA	*NEW ZEALAND CASSIA*
CASSIA CIRCINNATA	
CASSIA GOLDMANNII	
CASSIA LEPTOPHYLLA	*GOLD MEDALLION*
CASSIA NEMOPHYLLA	*GREEN FEATHERY CASSIA*
CASSIA PHYLLODENIA	*SILVER CASSIA*
CASSIA PURPUSSIAE	
CASSIA STURTH	*STURTS CASSIA*
CASSIA WISLEZENU	*SHRUBBY CASSIA*
CERCOCAPUS MONTANUS	*MOUNTAIN MOHOGANY*
CORDIA PARVIFLORA	*LITTLE LEAF CORDIA*
DALEA BICOLOR	*INDIGO BUSH*
DALEA FORMOSA	*FEATHER DALEA*
DALEA PULCHRA	*GREGG DALEA*
DALEA WISLEZENH	*INDIGO BUSH*
DASYLIRION WHEELERI	*DESERT SPOON*
DODONES ViSCOSA	*HOP BUSH*
ENCELIA FARINOSA	*BRITTLE BUSH*
EPHEDRATRIFURCA	*MORMON TEA*
ERIOGONUM FAGCICULATUM	*CALIFORNIA BUCKWHEAT*
EYSENHARDIA POLYSTACHIA	*KIDNEY WOOD*
FORESTIERIA NEOMEXICANA	*DESERT OLIVE*
HAPLOPAPPUS LARICIFOLIA	*TURPENTINE BUSH*
HYPIS EMORYI	*DESERT LAVENDER*
JATROPHA CARDIOPHYLLA	*UMBER BUSH*
JUSTICIA CANDICANS	*FIRECRACKER BUSH*
JUSTICIA CALIFORNIA	*CHUPAROSA*
JUSTICIA GHIESBREGHTIANA	*DESERT HONEYSUCKLE*
KRAMERIA GRAYI	*WHITE RATANY*
LARREA TRIDENTATA	*CREOSOTE BUSH*
LEUCOPHYLLUM FRUCTESCENS	*TEXAS SAGE*
LEUCOPHYLLUM LAEVIGATUM	*CHIHUAHUAN SAGE*
LYCIUM ANDERSONII	*ANDERSON THORNBUSH*
LYCIUM BREVIPES	*THORNBUSH*
LYCIUM FREMONTI	*WOLFBERRY*
LYSILOMA CANDIDA	*PALO BLANCO*
LYSILOMA THORNBERI	*FERN OF THE DESERT*
MIMOSA BIUNCIFERA	*WAIT A MINUTE BUSH*
MIMOSA DYSOCARPA	*VELVET POD MIMOSA*
PENSTEMON SPECIES	*PENSTEMON*
PITTOSPORUM PHLLIRAEOIDES	*WILLOW PITTOSPORUM*
RHAMNUS CALIFORNICA	*COFFEE BERRY*
RHAMNUS CROCEA	*REDBERRY*
RHUS OVATA	*MOUNTAIN LAUREL*
RUELLIA CALIFORNICA	
RUELLIA PENNINSULARIS	
SALVIA FARINACEA	*MEALY CUP SAGE*
SALVIA GREGGII	*AUTUMN SAGE*
SALVIA CHAMYORIOIDES	*BLUE SAGE*
SENECIO SALIGNUS	*WILLOW LEAF GROUNDSEL*
SENECIO ARIZONICA	*ARIZONA SOPHER*
SIMMONDSIA CHINENSIS	*JOJOBA*
SOPHORA SECUNDIFOLIA	*MESCAL BEAN*
SPHAERALCEA AMBIGUA	*DESERT MALLOW*
TECOMA STANS	*ARIZONA YELLOW BELLS*
TETRACOCCUS HALLII	
VAUQUELINA CALIFORNICA	*ARIZONA ROSEWOOD*
ZIZYPHUS OBITUSIFOLIA	*GREYHORN*
Ground Covers	
BERBERIS HAEMATORCARPA	*REDBERRY*
FALLUGIA PARADOXA	*APACHE PLUME*
MELAMPODIUM LEUCATHUM	*BLACKFOOT DAISY*
NOLINA BIGELOVII	*BIGELOW NOLINA*
NOLINA MICROCARPA	*BEAR GRASS*
VIGUIEIA DELTOIDEA	*GOLDEN EYE*
VfGUIERA TOMENTOSA	*GOLDEN EYE*
ZAUSCHNERIA LATIFOLIA	*HUMMINGBIRD FLOWER*
ANNUALS	
VERBENACEAE SPECIES	*VERBENA*
ARGEMONE PLEICANTHA	*PRICKLY POPPY*
BAERIA CHRYSOSTOMA	*GOLDFIELD*
BAHIA ABSINTHIFOLIA	*BAHIA*
BAILEYA MULTIRADIATA	*DESERT MARIGOLD*
DYSSODIA PENTACHAETA	*DYSSODIA*
ERODIUM TEXANUM	*FILLAREE*
ESCHCHOLOZIA MEXICANA	*MEXICAN GOLD POPPY*
LESQUERELLA GORDONII	*GOLD CRUCIFER*
LUPINUS SPARCIFLORA	*LUPINE*
ORTHOCARPUS PURPURASCENS	*OWLS CLOVER*
PECTIS PAPPOSA	*CINCH WEED*
PLANTAGO INSULARIS	*INDIAN WHEAT*
CACTI & SUCCULENTS	
AGAVE SPECIES	*CENTURY PLANTS*
CEREUS GIGANTEUS	*SAGUARO*
DASYLIRON WHEELERI	*DESERT SPOON*
ECHINOCEREUS ENGLEMANNII	*HEDGEHOG*
FEROCACTUS WISLIZENII	*BARREL CACTUS*
FOUQUIERIA SPLENDENS	*OCOTILLO*
HESPERALOE PARVIFLORA	*RED YUCCA*
OPUNTIA ACANTHORCARPA	*STAGHORN CHOLLA*
OPUNTIA BIGELOVH	*TEDDY BEAR CHOLLA*
OPUNTIA FULGIDA	*CHAIN FRUIT CHOLLA*
OPUNTIA FICUS INDICA	*TREE OPUNTIA*
OPUNTIA LEPTOCAULIS	*DESERT CHRISTMAS CACTUS*
OPUNTIA PHAECANTHA	*PRICKLY PEAR*
YUCCA SPECIES	*YUCCA*

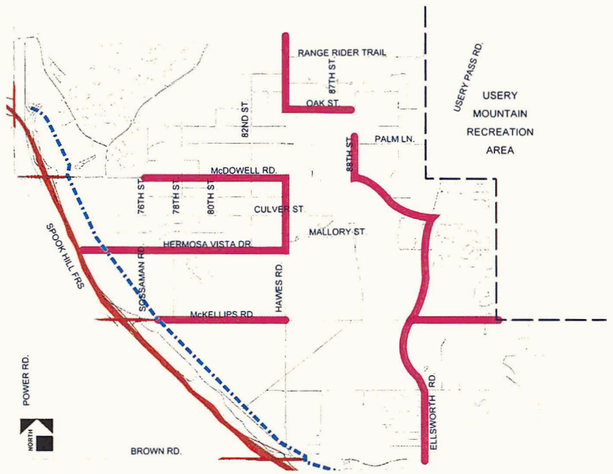
Informal Pedestrian Path Channel Landscape Design Theme

Landscape Design Theme: to create a meandering channel with plant material indigenous to the setting while to provide seasonal color and interest that would serve as an informal pedestrian path.

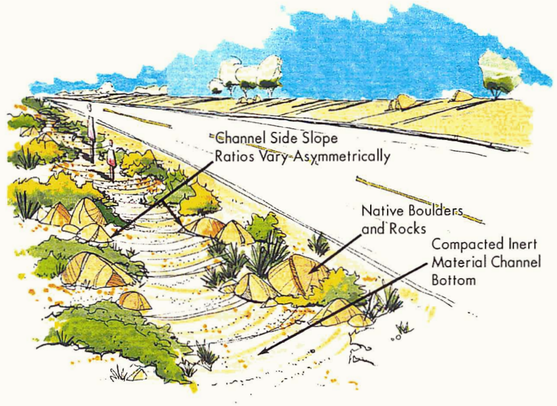
Applicable to: McDowell Road, Hermosa Vista Drive, Oak Street, Hawes Road, 88th Street, Usery Pass Road, and McKellips Road (Ellsworth Road to 96th Street).

Channel Criteria:

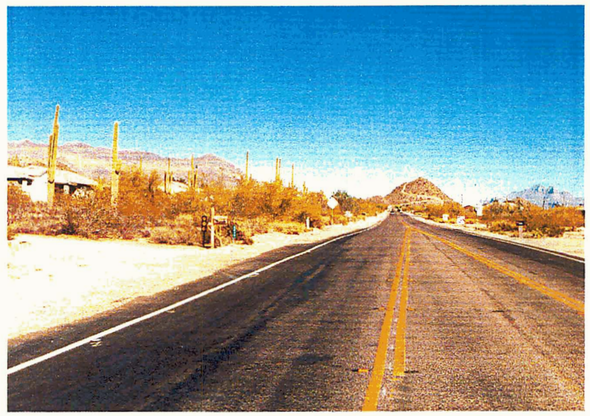
1. Configuration
   - Create an overall channel form that is more organic and less geometric.
   - Meander channel alignment in an irregular pattern.
   - Use integral colored material and surface treatments that would blend with the surrounding when drop structures are required. Construct the drop structures so that able-bodied pedestrians and mountain bikes would be able to safely pass through or around the structure.
   - Vary channel sides slope ratios asymmetrically from 3:1 to 4:1 along the length of the channel.
   - Minimal bottom width is 3 feet.
   - Round channel banks at the top.
   - If future conditions allow, provide 8 to 10-foot landscape buffer between road and pedestrian pathway.
2. Vegetation
   - Select plant material from the plant list in the City of Mesa's *Uplands Development Standards* (Ordinance 3693).
   - Prune trees to allow for pedestrians to pass underneath their canopies. Use trees as accents in order to not block panoramic views of surrounding mountains. Use no more than three different species of tree along any one street venue. Select specific 'street tree(s)' that fits with the adjacent landscape in terms of form, color, and texture for each street.
   - Place shrubs, ground covers, rocks, and boulders in an irregular pattern along the sides and top of the banks.
   - Remove plant material routinely from the surface bottom to provide walking surface for pedestrians.
   - Install irrigation system to maintain and establish plant material.
   - Select plant material to provide seasonal color and interest in either form or texture. Avoid using plant material with notable thorns or those plants considered hazardous to pedestrians.
3. Materials
   - Use compacted inert material for bottom surface to blend the color of the material with the surrounding native surface material to minimize visual contrast.



Informal Pedestrian Path Channel Locations



Conceptual Sketch of Informal Pedestrian Path Channel



View of McDowell Road looking east. Landscaped channel would be located on the north side of the roadway.

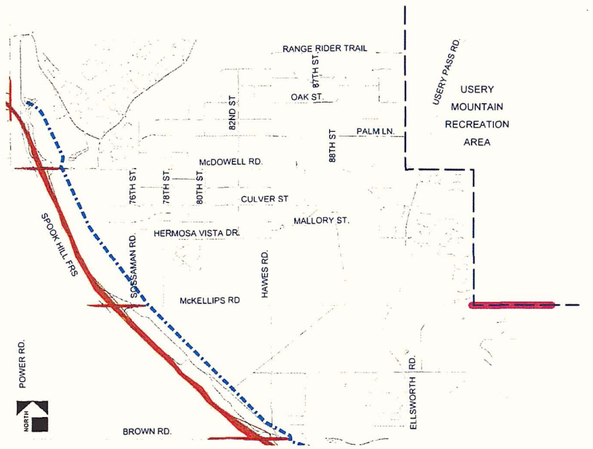
Xeroriparian Channel Landscape Design Theme

Landscape Design Theme: to create an organic pattern of unifying elements with the open collector channel that mimics a natural wash with its associated xeroriparian vegetation.

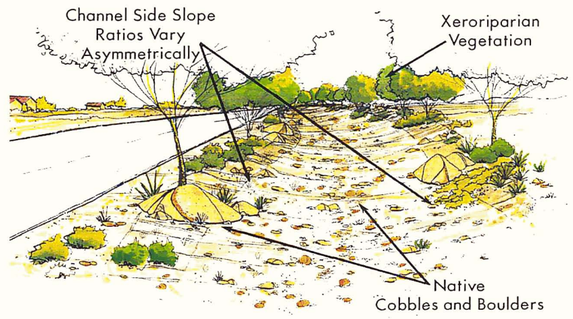
Applicable to: McKellips Road (96th Street to Signal Butte Floodway)

Channel Criteria:

1. Configuration
   - Construct irregular channel bottom slope. Accentuate the changes in grade by the placement of rocks, similar to a natural wash bottom.
   - Create an overall channel form that is more organic and less geometric.
   - Meander channel alignment in an irregular pattern to mimic natural washes in the project vicinity.
   - Use integral colored material and surface treatments that blend with the surrounding when drop structures are required. Construct the drop structures so that able-bodied pedestrians and mountain bikes would be able to safely pass through or around the structure.
   - Vary channel side slope ratios asymmetrically from 3:1 to 6:1 along the length of the channel.
   - Design minimum bottom width of 3 feet.
   - Round channel banks at the top.
   - If future conditions allow, provide 8 to 10-foot landscape buffer between road and pedestrian pathway
2. Vegetation
   - Select plant material from the plant list in the City of Mesa's *Uplands Development Standards* (Ordinance 3693).
   - Select plant species that attract birds.
   - Plant trees in a pattern to mimic the form, line, and density of trees associated with natural washes in the project vicinity.
   - Place shrubs, ground covers, rocks, and boulders in an irregular pattern along the sides and top of the banks.
   - Install irrigation system to maintain and establish plant material.
3. Materials
   - Scatter bottom surface of channel with cobbles and rocks, similar to natural ephemeral washes in the project area.
   - Blend bottom surface material with the surrounding native surface material to minimize visual contrast.



Xeroriparian Channel Location



Xeroriparian Channel Sketch

View of xeroriparian vegetation along natural wash in project area.

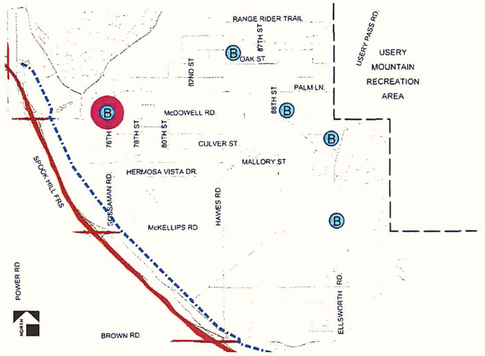
Sossaman Basin

Landscape Design Theme: to create an organic landform whose shape, side slopes, and bottom surface are undulating and irregular with plant material that transitions from a more unified landscape associated with the Las Sendas subdivision to the more natural setting of the Sonoran Desertscrub desert landscape.

Consider the City on Mesa's *Site Development Design Standards* (Section 11-15-1 through Section 11-15-5) in addition to the design guidelines provided below.

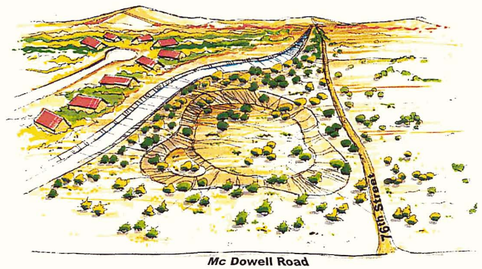
Basin Criteria:

1. Perimeter
   - Provide a 30 to 50-foot landscaped buffer zone around the basin that includes the operation and maintenance (O&M) road and McDowell Road.
   - Meander the O&M road to mimic the organic basin configuration.
   - Surface O&M road with native inert material.
2. Configuration
   - Create an overall basin form that appears more organic and less geometric.
   - Warp and vary side slope ratios from 3:1 to 8:1 in an irregular pattern.
   - Design basin bottom to be irregular and undulating, following the natural topography of the site.
   - Round top of basin side slopes.
3. Vegetation
   - Use plant material from the plant list in the City of Mesa's *Uplands Development Standards* (Ordinance 3693), but select specific species to respond to the context of this basin.
   - Transition the density, type, size, form, color, and texture of the plant material from the west side near Las Sendas to the desert landscape on the east side of the basin.
   - Scatter vegetation along both sides of the O&M road to break the view of the line of the road alignment.
   - Place shrubs, ground covers, rocks, and boulders in an irregular pattern along the sides and top of the basin side slopes.
   - Consider views from McDowell Road, 76th Street, and the Las Sendas development to the basin in the placement and organization of plant material.
   - Install temporary irrigation system to establish plant material.
4. Structural Components
   - Use materials, shapes, and colors that blend in with the surroundings for any side weirs, spillways, dissipaters, and inlets required as determined during final design.
   - Use boulders native to the vicinity as a structural component.



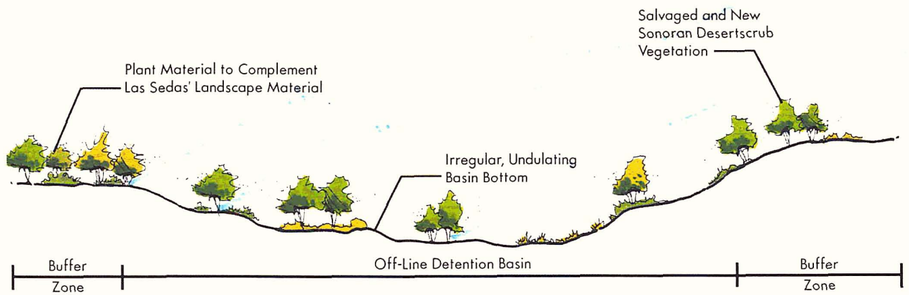
Sossaman Basin Location

View of the Sossaman Basin Site



Conceptual Sketch

Plan



Section

Oak Street Basin

Landscape Design Theme: to create an organic appearing landform whose shape, side slopes, and bottom surface are undulating and irregular with large berms/islands/peninsulas to break up the form of the basin and is revegetated to restore the visual character and habitat value as close as possible to the original site conditions.

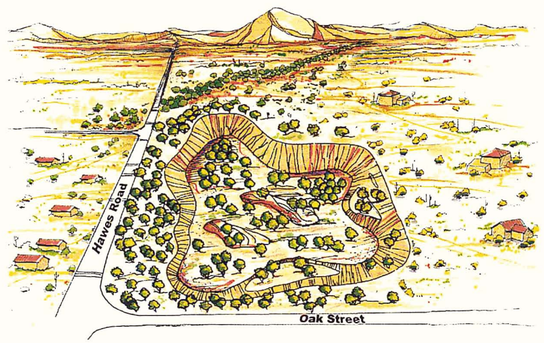
Consider the City on Mesa's *Site Development Design Standards* (Section 11-15-1 through Section 11-15-5) in addition to the design guidelines provided below.

Basin Criteria:

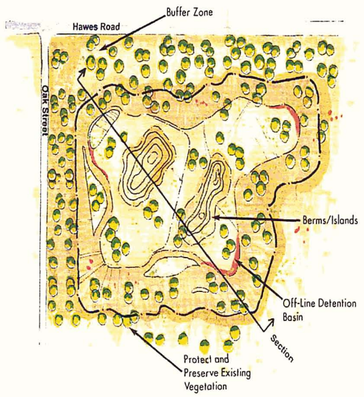
1. Perimeter
   - Provide a 30 to 50-foot landscaped buffer zone around the basin that includes the operation and maintenance (O&M) road.
   - Meander the O&M road to mimic the organic basin configuration.
   - Surface O&M road with native inert material.
   - Supplement the existing vegetation in the buffer zone to increase screening of the basin from Hawes Road and Oak Street as well as from the adjacent residences.
   - Design fencing around basin to blend with surrounding setting in terms of color, material, and form.
2. Configuration
   - Create overall basin form that appears more organic and less geometric.
   - Warp and vary side slope ratios from 3:1 to 8:1 and round top of side slopes. Leave natural rock outcrops in basin side slopes.
   - Provide irregular basin bottom slope and large berms/islands or side peninsulas that undulate the floor of the basin and follow the natural topography of the site.
   - Avoid disturbance to saguaros that cannot be transplanted, mature ironwoods (because of the slow growth), and to the existing unnamed wash and associated xeroriparian vegetation.
3. Vegetation
   - Use plant material from the plant list in the City of Mesa's *Uplands Development Standards* (Ordinance 3693), but select specific species to respond to the context of this basin.
   - Place shrubs, ground covers, rocks, and boulders in an irregular pattern along the sides and top of the basin side slopes.
   - Install temporary irrigation system to establish plant material.
   - Restore density and variety of vegetation to the existing site conditions.
   - Salvage and re-establish indigenous vegetation where possible.
   - Consider views from Hawes Road, Oak Street, and adjacent residences to the basin in the placement of plant material.
   - Salvage surface soil (6-8 inches) from the basin area and replace in the landscaped areas. Maximum stockpile height for surface soil should be 6 to 8 feet.
4. Structural Components
   - Use materials, shapes, and colors that blend in with the surroundings for any side weirs, spillways, dissipaters, and inlets required as determined during final design. Use of boulders native to the vicinity is preferred as a structural component.

Oak Street Basin Location

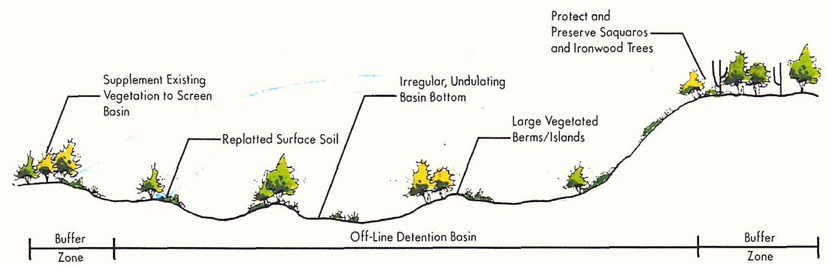
View of the Oak Street Basin Site



Conceptual Sketch



Plan



Section

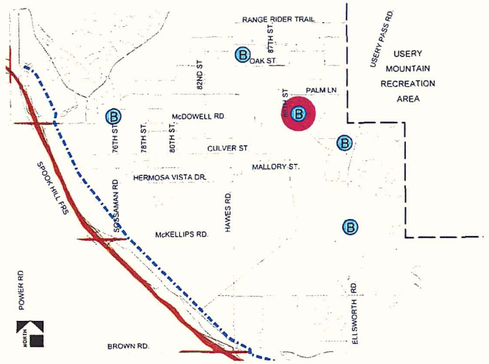
88th Street Basin

Landscape Design Theme: to create an organic appearing landform whose shape, side slopes, and bottom surface are undulating and irregular with stepped benches following the existing topography and is revegetated to restore the visual character as close as possible to the original site conditions.

Consider the City on Mesa's *Site Development Design Standards* (Section 11-15-1 through Section 11-15-5) in addition to the design guidelines provided below.

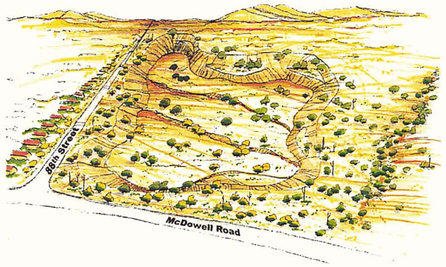
Basin Criteria:

1. Perimeter
   - Provide a 30 to 50-foot landscaped buffer zone around the basin that includes the operation and maintenance (O&M) road.
   - Meander the O&M road to mimic the organic basin configuration.
   - O&M road surface to be of native inert material.
   - Supplement the existing plant material in the buffer zone to increase screening of the basin from 88th Street and McDowell Road as well as from the adjacent residences.
2. Configuration
   - Provide irregular basin bottom slope with a series of stepped benches that follow the existing topography.
   - Create an overall basin form that appears more organic and less geometric.
   - Warp and vary side slope ratios from 3:1 to 8:1 and round top of side slopes.
   - Avoid disturbance to saguaros that cannot be transplanted and mature ironwoods (because of the slow growth).
3. Vegetation
   - Use plant material from the plant list in the City of Mesa's *Uplands Development Standards* (Ordinance 3693), but select specific species to respond to the context of this basin.
   - Place shrubs, ground covers, rocks, and boulders in an irregular pattern along the sides and top of the basin side slopes.
   - Install temporary irrigation system to establish plant material.
   - Restore density and variety of vegetation to the existing site conditions.
   - Salvage and re-establish indigenous vegetation where possible.
   - Consider views from 88th Street, McDowell Road, and adjacent residences to the basin in the placement of plant material.
4. Structural Components
   - Use materials, shapes, and colors that blend in with the surroundings for any side weirs, spillways, dissipaters, and inlets required as determined during final design.
   - Use of boulders native to the vicinity is preferred as a structural component.

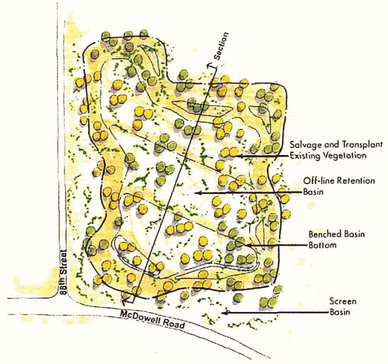


88th Street Basin Location

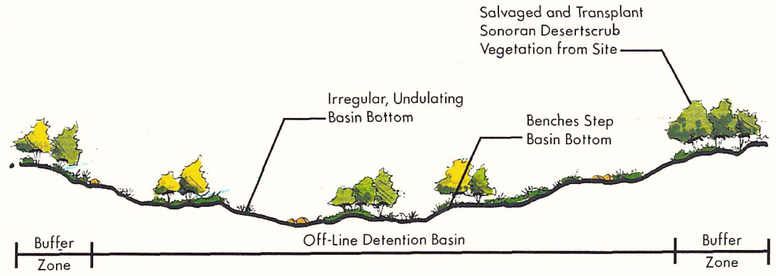
View of the 88th Street Basin Site



Conceptual Sketch



Plan



Section

Ellsworth Basin

Landscape Design Theme: to create an organic appearing landform whose shape and side slopes are undulating and irregular with island/berms forming channels in the basin following the existing topography to preserve as much existing vegetation and mimic a natural braided wash.

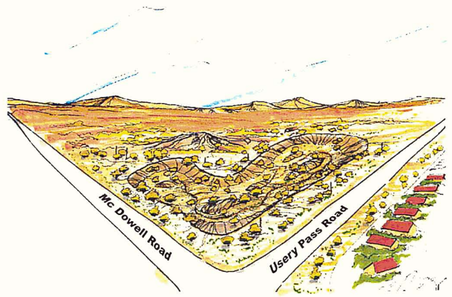
Consider the City on Mesa's *Site Development Design Standards* (Section 11-15-1 through Section 11-15-5) in addition to the design guidelines provided below.

Basin Criteria:

1. Perimeter
   - Provide a 30 to 50-foot landscaped buffer zone around the basin that includes the operation and maintenance (O&M) road.
   - Meander the O&M road to mimic the organic basin configuration.
   - O&M road surface to be of native inert material.
2. Configuration
   - Avoid disturbance to saguaros that cannot be transplanted as well as mature ironwoods (because of the slow growth).
   - Create large berms/islands in the bottom of the basin, following the natural contours of the site to mimic a series of braided channels.
   - Basin bottom slope is irregular with an undulating floor that follows the natural topography of the site.
   - Create an overall basin form that appears more organic and less geometric.
   - Warp and vary side slope ratios from 3:1 to 8:1 and round top of side slopes. Leave natural rock outcrops in basin side slopes.
3. Vegetation
   - Use plant material from the plant list in the City of Mesa's *Uplands Development Standards* (Ordinance 3693), but select specific species to respond to the context of this basin.
   - Place shrubs, ground covers, rocks, and boulders in an irregular pattern along the sides and top of the basin side slopes.
   - Install temporary irrigation system to establish plant material.
   - Restore density and variety of vegetation to the existing site conditions.
   - Salvage and re-establish indigenous vegetation where possible.
   - Consider views from Usery Pass Road, McDowell Road, and adjacent residences to the basin in the placement of plant material.
   - Scatter vegetation along both sides of the O&M road to break the view of the line of the road alignment.
4. Structural Components
   - Any side weirs, spillways, dissipaters, and inlets required as determined during final design should use materials, shapes, scale, and colors that blend with the surroundings.
   - Use of boulders native to the vicinity is preferred as a structural component.

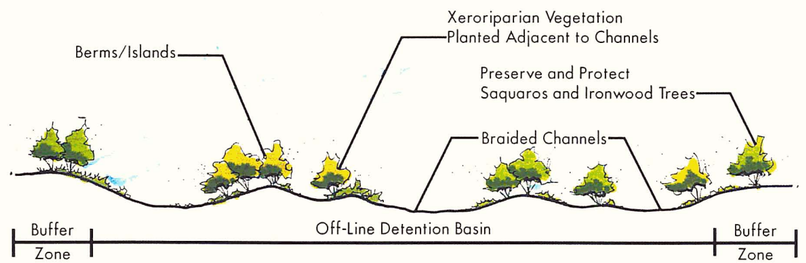
Ellsworth Basin Location

View of the Ellsworth Basin Site



Conceptual Sketch

Plan



Section

Boulder Mountain Elementary School Basin

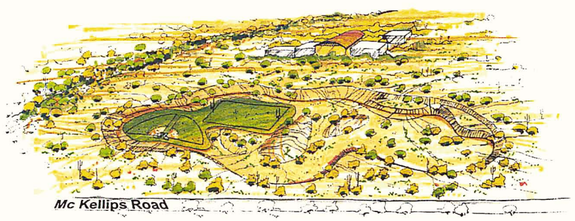
Landscape Design Theme: to create an organic-appearing landform that has a multi-use recreation function, and preserves the adjacent unnamed wash and associated vegetation. Due to the undulated shape of the basin, additional right-of-way acquisition was necessary in order to obtain a rectangular parcel. Consider the City on Mesa's *Site Development Design Standards* (Section 11-15-1 through Section 11-15-5) in addition to the design guidelines provided below.

Basin Criteria:

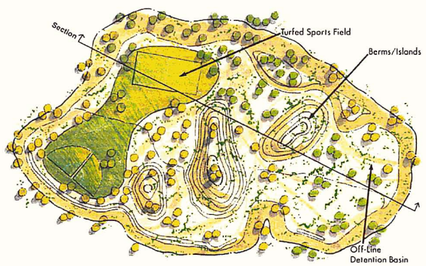
1. Perimeter
   - Provide a 30 to 50-foot landscaped buffer zone around the basin that includes the operation and maintenance (O&M) road.
   - Meander the O&M road to mimic the organic basin configuration.
   - O&M road surface to be of native inert material.
2. Configuration
   - Avoid disturbance to saguaros that cannot be transplanted as well as mature ironwoods (because of the slow growth).
   - Create large berms/islands in the bottom of the basin, following the natural contours of the site to mimic a series of braided channels.
   - Basin bottom slope is irregular with an undulating floor that follows the natural topography of the site.
   - Create an overall basin form that appears more organic and less geometric.
   - Warp and vary side slope ratios from 3:1 to 8:1 and round top of side slopes. Leave natural rock outcrops in basin side slopes.
   - Incorporate large berms in the bottom of the basin to mimic the existing landforms present in the naturally landscaped portion of the basin. Design these berms to provide the opportunity for recreational use of mountain bikes.
3. Vegetation
   - Views from McKellips Road and adjacent residences to the basin should be considered in the placement of plant material.
   - In the desert portion of the basin, place vegetation to allow for mountain bike use and incorporation of informal trails.
   - Use plant material from the plant list in the City of Mesa's *Uplands Development Standards* (Ordinance 3693), but select specific species to respond to the context of this basin. Install turf in the sports field area.
   - Place shrubs, ground covers, rocks, and boulders in an irregular pattern along the sides and top of the basin side slopes.
   - Install temporary irrigation system to establish plant material.
   - Salvage and re-establish indigenous vegetation where possible.
   - Scatter vegetation along both sides of the O&M road to break the view of the line of the road alignment.
4. Structural Components
   - Any required side weirs, spillways, dissipaters, and inlets should use materials, shapes, scale, and colors that blend with the surroundings.
   - Use of boulders native to the vicinity is preferred as a structural component.

School Basin Location

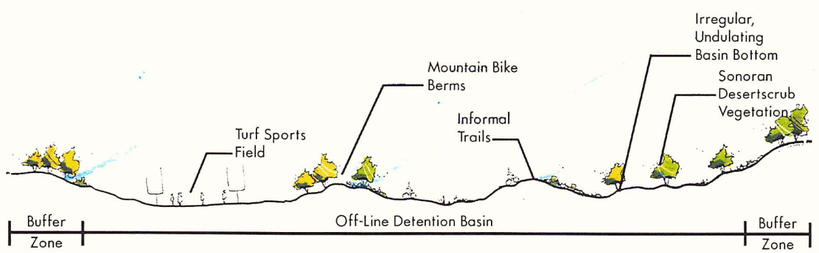
View of the School Basin Site



Conceptual Sketch



Plan



Section

PART 9 SEDIMENTATION AND GEOLOGIC FEATURES

Sediment yield was computed for existing and future conditions. Sediment impacts of the various alternatives and the recommended alternative were evaluated. The following documents were produced in support of the ADMP:

- *Existing Conditions Sedimentation Analysis Report*, March 2002
- Technical Memorandum Regarding Future Conditions Sediment Yield and Sedimentation Engineering Review of the Recommended Alternative, April 4, 2002

The complete versions of these documents are included under separate cover in the Technical Appendices to the ADMP report.

The following is a summary of the important aspects and findings of the sedimentation analyses for the ADMP.

Future Conditions Sediment Yield

The recommended alternative was limited to the watersheds contributing directly to the Spook Hill FRS. Therefore, the future conditions analysis focused on those subwatersheds. The *Existing Conditions Sedimentation Analysis* (JEF, 2000) recommended the use of the average results of PSIAC, MUSLE, and Flaxman (1974) methods for determination of sediment yield in the Spook Hill ADMP study area.

For the future conditions analysis, watershed land use and runoff response are affected by future development within the watershed. However, much of the Spook Hill FRS area is already developed under the existing conditions. Moreover, much of the Spook Hill FRS watershed is located within preserve areas that are unlikely to experience future development. Therefore, the watershed was examined and adjustments to land use parameters and runoff parameters were made to the PSIAC, MUSLE, and Flaxman (1974) calculations performed for the existing conditions for the subbasins affected by future development.

The results of the future conditions sediment yield calculations for the three methods are shown in Table 6. The data show that overall future conditions sediment yields are not drastically affected by future development. This is due largely to the relatively small overall changes in land use in the future condition in the Spook Hill FRS watershed.

Table 6 - Summary of Future Conditions Average Annual Sediment Yield to the Spook Hill FRS

Method	Existing (ac-ft/sq.mi./yr)	Future (ac-ft/sq.mi./yr)	Difference (%)
PSIAC	0.22	0.21	-4.5
MUSLE	0.070	0.068	-2.9
Flaxman	0.137	0.137	0.0
Average	0.142	0.138	-2.8

However, consideration of complete development of pure natural desert to medium density residential (MDR), for example, shows a larger difference. Table 7 shows an example assuming total conversion of desert to MDR. The 2-year peak discharges for Flaxman were not adjusted because 2-year discharges were not computed for the ADMP. However, if a 50 % reduction in the 2-year peak discharge is assumed, the Flaxman results decrease sediment yield by about 30 percent.

Table 7 - Difference in Sediment Yield for Complete Conversion of Desert to Medium Density Residential Using Basin 400 as an Example

Method	Existing (ac-ft/sq.mi./yr)	Future (ac-ft/sq.mi./yr)	Difference (%)
PSIAC	0.15	0.12	-20
MUSLE	0.016	0.011	-34
Flaxman	0.056	0.056	0*
Average	0.074	0.062	-16

*Note: Flaxman with assumed 50% reduction in Q2 yields a 30% reduction.

In summary, overall sediment yield changes in the Spook Hill FRS watershed are not dramatically affected by future land use changes because the degree of additional development is also not that great. Therefore, the planning level sediment yield values reported in the Existing Conditions Sedimentation Analysis (JEF, 2000) were recommended for use in the evaluation of the sedimentation impacts of the recommended alternative.

Sediment yield/delivery effects of the recommended alternative

The recommended alternative will have two important impacts on sediment delivery to the FRS. First, the location of the delivery of sediment to the FRS will be altered from the existing condition. That is, rather than being distributed relatively evenly along the FRS (except at the outlet of the Signal Butte Floodway), sediment delivery with the proposed project conditions will be concentrated at the outlets of the conveyance systems along McDowell, Hermosa Vista, and McKellips Roads. Second, the sediment entering the pipe and channel systems will be delivered 20 to 50% more efficiently than the existing natural system.

Figure 5 shows a comparison of drainage areas at various points with and without the recommended alternative. These areas were used with the recommended average annual sediment yield to compute average annual sediment delivery to the FRS with one exception – the detention basins.

Estimation of Sediment Delivery to Detention Basins

The proposed detention basins are designed as offline detention facilities. Bypass flows were taken from the recommended alternative HEC-1 models. Only suspended sediments were assumed to be able to enter the detention basins. Suspended sediments were assumed to represent 70 % of the total sediment yield based on MUSLE estimates, field measurements of sediment yield at the Spook Hill Floodway sediment basin (JEF, 2000), and similar analyses at Bailey Tank on Bailey Draw in the North Peoria ADMP study (JEF, 2001). SCS design notes for the Spook Hill Floodway also reported a 70 % suspended load design assumption for sizing the sediment basin (SCS, 1992).

The following equations were developed (JEF, 2002) to estimate the quantity of sediment delivered to each of the proposed detention basins. The equations are based on USGS Region 13 regression equations, a triangular hydrograph, constant suspended sediment concentrations throughout the hydrograph, and Equation 3.2 in ADWR (1985) for calculation of average annual volumes from T-year estimates.

For a 2-year bypass basin: $Vol_{ss}(\text{mean annual}) = Vol_{ss100}$ [0.0367]

For a 10-year bypass basin: $Vol_{ss}(\text{mean annual}) = Vol_{ss100}$ [0.0105]

And for a 25-year bypass basin: $Vol_{ss}(\text{mean annual}) = Vol_{ss100}$ [0.0031]

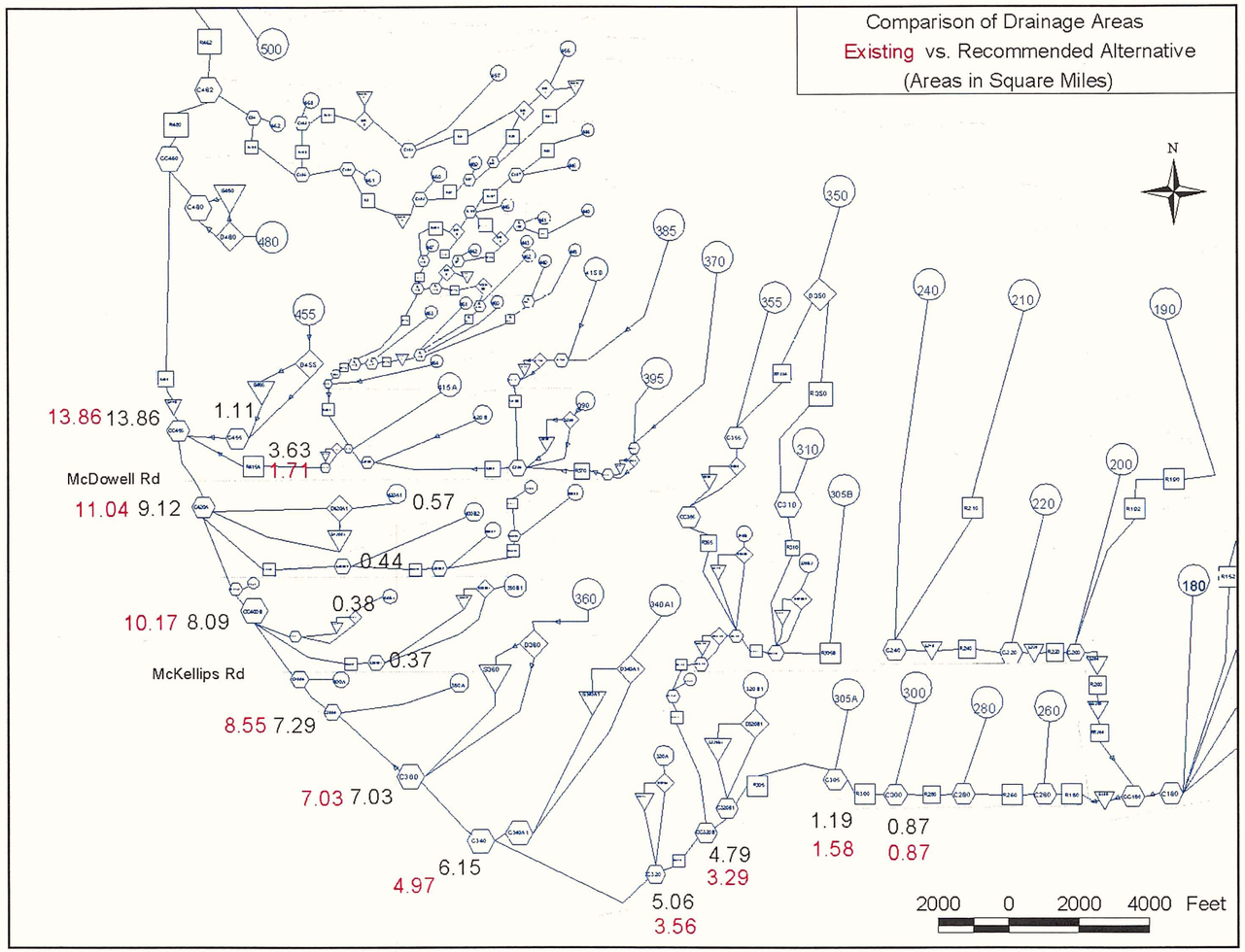


Figure 5

Table 8 shows the percentage of the basin detention volume relative to the accumulated sediment inflow for the 50 year design life. The estimates suggest that only minimal sediment maintenance of these basins will be required during their design life.

Table 8 - Average Annual Sediment Inflow to Recommended Detention Basins

Basin	D. A. (sq.mi.)	Bypass Frequency	Average Annual Sediment (ac-ft)	Accumulated Sediment Volume in 50 years (ac-ft)	Basin Storage Volume (ac-ft)	50 year Sediment Volume as Percent of Basin Storage Volume
I	0.86	2-yr	0.016	0.822	32	2.6
J	0.87	2-yr	0.017	0.832	32	2.6
L	1.94	2-yr	0.037	1.855	55	3.4
H	2.25	25-yr	0.004	0.184	4.6	4.0
O	1.17	10-yr	0.006	0.320	18	1.8

Sediment Transport Issues For the Design of the Recommended Alternative

The design philosophy of the recommended alternative was to collect and pass sediment through the system to the FRS to the extent possible. This strategy will localize sediment maintenance to fewer discrete locations along the FRS. However, it will also mean that sedimentation basins may be required at the outlets of the primary conveyance systems within the FRS pool area. Otherwise, the low flow channel in the FRS may become blocked, resulting in ponded water along the FRS that will not able to positively drain into the Spook Hill Floodway. The data in Tables 13 and 14 could be used as a guideline for planning such sedimentation basins. Also, in order to realize this design objective, catch basins and collector ditches along roadways and around the detention basins will require design that facilitates sediment transport continuity without excessive local erosion of these facilities.

Another consequence of a sediment throughflow approach is that of potential abrasion of system conveyance facilities. That is, sand and fine gravels that enter channels or storm drains flowing at relatively high velocities will abrade linings if not properly designed, protected, and maintained.

Abrasion resistant alternatives may include combinations of any of the following:

- High strength concrete (minimum 5,000 psi 28 day strength)
- Substitution or addition of silica sand into aggregate mix.
- Addition of steel fibers into concrete mix for added strength, internal curing crack prevention, and abrasion resistance.
- Thickened invert of culverts, boxes, and other culvert linings to provide sacrificial layering

It is recommended that at a minimum, high strength concrete and a sacrificial layer of material be provided with any abrasion mitigation designs. It is also recommended that the final selection of an abrasion resistant material be based on a value engineering assessment that must consider the anticipated facility design life, maintenance accessibility, capital and maintenance cost, and consequence of failure.

Shallow Bedrock

Figure 6 shows potholing prioritization based on examination of existing geologic information and engineering judgment of potential geologic controls on construction of the recommended alternative. In particular, much of the Spook Hill FRS watershed is comprised of a landform called a pediment. A pediment is a broad sloping bedrock surface thinly mantled by alluvium. Of concern to the recommended drainage alternative for the ADMP is the depth (or lack thereof) of that alluvial mantle. In general, the areas of the watershed upstream of or near the numerous inselbergs, or rocky hill islands, on the pediment are likely to have relatively shallow bedrock. Moreover, locations further upslope or in close proximity to an inselberg are more likely to contain shallow bedrock.

Field observations and soil surveys indicate that the depth of alluvium is probably between 3 to 10 feet in these areas. Consequently, any channel, storm drain, or detention basin that will require more than 6 to 8 feet of excavation may encounter bedrock. However, the bedrock nearest to the surface is likely to be relatively weathered granite which may not require extraordinary excavation measures if significant depths of removal are not required. On the other hand, the potential uncertainties suggest potholing is warranted before final design in order to ascertain excavation costs associated with implementation of the recommended alternative and the need to explore alternative construction methods or materials.

Conclusions

The future conditions are not drastically different from the existing conditions according to the Wood/Patel HEC-1 modeling. Therefore, at a planning level, the results of the *Existing Conditions Sedimentation Analysis* (JEF, 2000) remain largely valid.

The recommended alternative will have an impact on the quantity and location of sediment delivered to the Spook Hill FRS. Planning level estimates of those locations and quantities were computed. Sedimentation basins at the ends of the proposed conveyance facilities at McDowell, Hermosa Vista, and McKellips Roads should be considered in the final design.

The recommended detention basins will also accumulate fine-grained suspended sediments from the flows diverted to them. Bypass frequency estimates of basin inflows were used to estimate the quantities of sediment entering the basins. The results suggest that only minimal sediment maintenance will be required in these basins during their design life.

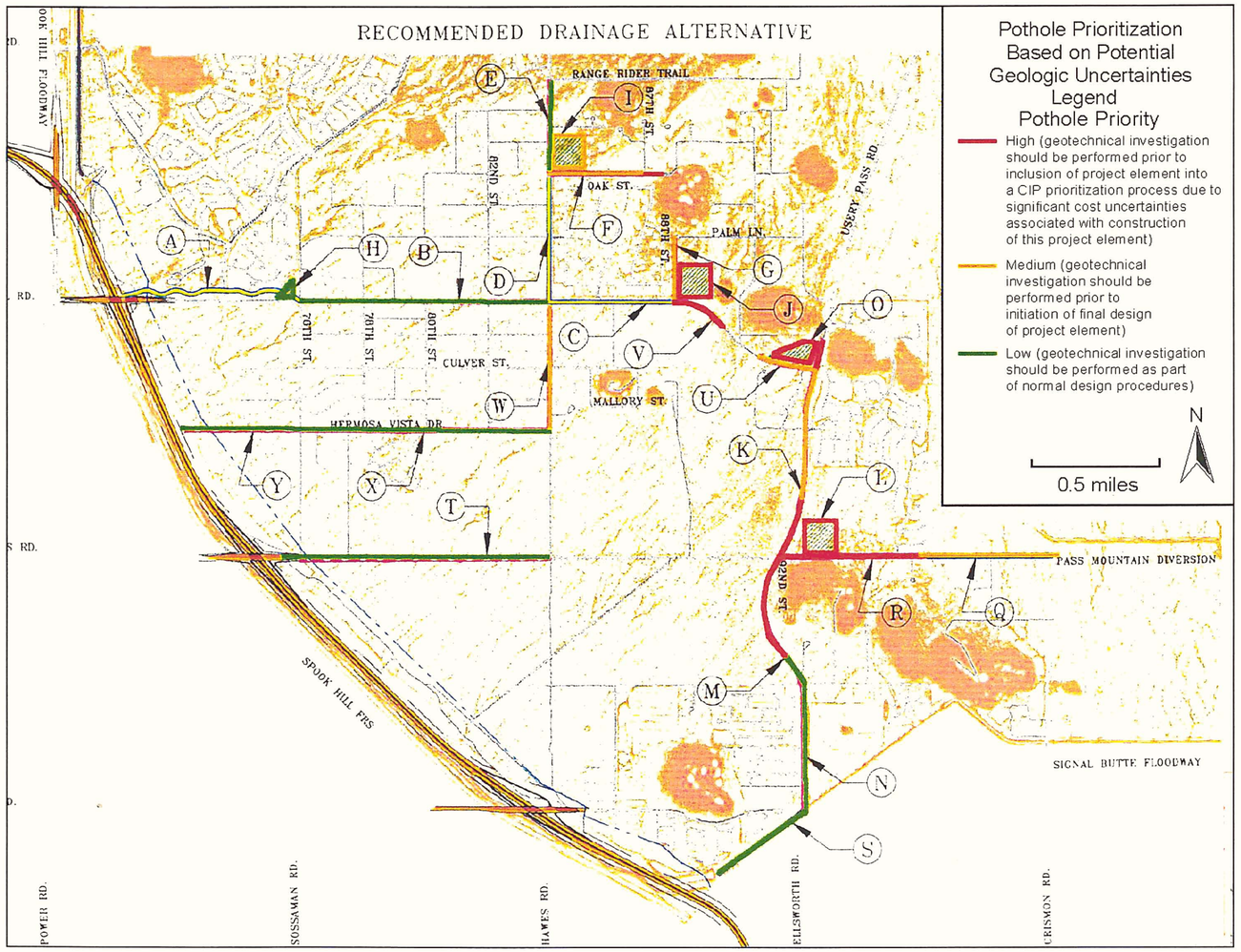


Figure 6

PART 10 IMPLEMENTATION PLAN

Potential Obstacles

The single most important ingredient to the successful implementation of the Recommended Plan is the early acquisition of the right-of-way for the detention basins. The project area is experiencing rapid development and, understandably, many of those who currently own undeveloped parcels are very eager to sell to a developer and make a profit. During the latter weeks of the ADMP process, it became apparent that one of the recommended detention basins locations (northeast of the intersection of McDowell Road and 88th Street) was soon to be developed as single family homes on 1 acre lots. This basin location had been identified in the first few months of the ADMP process as a key location which should be acquired; however, neither the District nor the City of Mesa had funding at their disposal to proceed with acquisition since they did not have an adopted plan.

Although the decision was made to proceed with the plan as approved, the project team did perform some preliminary investigation of an alternate basin location northeast of the intersection of Hawes Road and Culver Street which appears to satisfy the requirements of the Recommended Plan. It is, therefore, imperative that land acquisition be the highest priority since the loss of any other basin sites could be crippling to the proper operation of the Recommended Drainage Plan.

Another important ingredient is to promote the awareness of the ADMP and the Recommended Plan. The District and the City of Mesa should actively promote the plan and make homeowners and developers aware of the intent of the plan and the features which remain to be implemented.

Critical Success Factors

Successfully implementing the Recommended Drainage Alternative from the Spook Hill Area Drainage Master Plan will require adherence to several critical success factors:

1. **Adopt the Recommended Plan** The Recommended Plan must be adopted by both the District's Board of Directors (Maricopa County Board of Supervisors) and the Mesa City Council.
2. **Get the Funding** Adequate funding must be allocated for the construction of the plan elements. The District and the City of Mesa should ensure that the plan elements are entered into their respective Capitol Improvement Programs (CIP) so that the funds can be allocated.
3. **Buy the Right-of-Way** The right-of-way for the detention basins must be acquired immediately before the rapid development renders the land unavailable for flood control use.
4. **Start the Process** All stakeholders should agree to begin the implementation process.
5. **Educate the Community** The District and the City of Mesa should immediately begin the process of educating the public about the plan and this will entail educating their own personnel, particularly the review personnel in their land development departments.
6. **Start the Final Design Phase** The Recommended Plan included as part of this report is conceptual (15%) in nature and will require a significant amount of additional design work to yield a set of construction documents. The stakeholders should agree to begin the final design process as soon as possible based on the agreed upon phasing priorities shown on the following page in Table 9.

Funding Sources

Primary funding for the final design and construction of the elements of the Recommended Plan will come from the Flood Control District of Maricopa County and the City of Mesa. The distribution of funds will be established in an Inter-Governmental Agreement (IGA) between the District and the City of Mesa. Each agency will then allocate funding for the individual elements of the plan per a phasing plan jointly developed by the Flood Control District and the City of Mesa.

Since many of the potential developers will reap the benefits of the recommended Plan, both in increased safety and decreased drainage infrastructure cost, both the District and the City of Mesa should pursue participation agreements with new developers in which they would assist with the funding and/or the construction of the plan elements that are within or adjacent to their proposed development.

The following tables will provide a breakdown of the anticipated costs associated with each phase of the project's construction. The Flood Control District of Maricopa County, together with the City of Mesa, has developed a prioritization or "phasing" schedule for the Recommended Alternative and, based on this schedule, the construction costs were distributed to determine the total cost for each phase (see Table 9). In addition, the anticipated annual and 50 year life-cycle maintenance costs were distributed according to the same schedule (see Table 10).

Table 9 - Phasing Cost Breakdown for Recommended Alternative

Priority	Phase Elements	Raw Const. Cost	Contingencies Const.	Engin.	Const. Admin.	Construction Cost	Land Acquisition	Total Cost
1	Land Acquisition for Detention Basins (H,I,J,O,L)						$5,514,696	**$5,514,696**
2	Las Sendas Channel,McDowell Rd., & 76th St. Basin (A,B,H)	$2,390,187	$597,547	$167,313	$143,411	$3,298,458		**$3,298,458**
3	Hawes Rd. & Hermosa Vista Systems (W,X,Y)	$2,520,391	$630,098	$176,427	$151,223	$3,478,140		**$3,478,140**
4	Oak St Basin, Oak St. & Hawes Rd. Storm Drains (D,E,F,I)	$1,922,409	$480,602	$134,569	$115,345	$2,652,924		**$2,652,924**
5	88th St. & McDowell Storm Drains & 88th St. Basin (C,G,J,V)	$2,111,501	$527,875	$147,805	$126,690	$2,913,871		**$2,913,871**
6	E. McKellips, School Basin, Lower Ellsworth (L,M,N,Q,R)	$6,191,160	$1,547,790	$433,381	$371,470	$8,543,801		**$8,543,801**
7	Upper Ellsworth and Ellsworth Basin (K,O)	$2,573,686	$643,422	$180,158	$154,421	$3,551,687		**$3,551,687**
8	McKellips Road Storm Drain (T)	$1,338,984	$334,746	$93,729	$80,339	$1,847,798		**$1,847,798**
		$19,048,318	$4,762,080	$1,333,382	$1,142,899	**$26,286,679**		**$31,801,375**

Table 10 - Phased Maintenance Cost Breakdown for Recommended Alternative

Phase	Phase Elements	Annual Maintenance Cost Lined Channels	Unlined Channels	Storm Drains	Detention Basins	Total Annual Maint. Cost*	Total 50 yr. Life Cycle Cost
1	Land Acquisition for Detention Basins (H,I,J,O,L)	$0	$0	$0	$0	$0	**$0**
2	Las Sendas Channel,McDowell Rd., & 76th St. Basin (A,B,H)	$0	$0	$2,677	$1,220	$3,897	**$194,850**
3	Hawes Rd. & Hermosa Vista Systems (W,X,Y)	$0	$324	$4,103	$0	$4,427	**$221,350**
4	Oak St Basin, Oak St. & Hawes Rd. Storm Drains (D,E,F,I)	$48	$552	$1,227	$4,411	$6,238	**$311,900**
5	88th St. & McDowell Storm Drains & 88th St. Basin (C,G,J,V)	$0	$1,019	$1,423	$4,834	$7,276	**$363,800**
6	E. McKellips, School Basin, Lower Ellsworth (L,M,N,Q,R)	$0	$2,156	$2,743	$15,111	$20,010	**$1,000,500**
7	Upper Ellsworth and Ellsworth Basin (K,O)	$0	$690	$2,308	$4,130	$7,128	**$356,400**
8	McKellips Road Storm Drain (T)	$0	$0	$2,423	$0	$2,423	**$121,150**
		$48	$4,741	$16,904	$29,706	**$51,399**	**$2,569,950**

*Note: The City of Mesa spends approx. $4,300/acre for O&M; the numbers used in Table 10 are based on historic District expenditures.