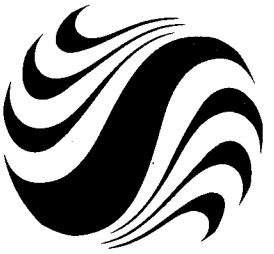
McMicken Dam
Fissure Risk Zone
Remediation Project
Dam Breach Alternatives



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Flood Control District of Maricopa County
2801 West Durango Street
Phoenix AZ 85009

Reference: **McMicken Dam Fissure Risk Zone Remediation Project**
Contract FCD 2002C011, Work Assignment 1
Dam Breach Alternatives

Dear Bobbie:

Transmitted herewith are eight copies of the Dam Breach Alternatives Report for the above referenced project. The report presents the results of an alternatives analysis for breach of the south end of the dam within the hazard zone and design of a 100-year flood control facility.

Should you have any questions, please do not hesitate in contacting the undersigned.

Sincerely,

STANTEC CONSULTING INC.

Chuck Gopperton, PE
Project Engineer
cgopperton@stantec.com

C: Addressee (8)

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McMicken Dam Fissure Risk Zone Remediation Project

Work Assignment 1A

Dam Breach Alternatives

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Purpose and Scope

The purpose of this task was to analyze alternatives for breaching McMicken Dam within the fissure hazard risk zone. The goal is to present alternatives for comparison to repair or replacement alternatives for the dam. A secondary goal is to present alternatives that remove the dam from the fissure hazard risk zone. The purpose of this report is to present the alternatives analysis and recommendations.

Alternatives

Alternatives to be considered will segment the dam outside of the fissure hazard risk zone and breach and remove the portion of the dam within the fissure hazard risk zone. All alternatives reduce the flood protection from PMF to a 100 year level. Three alternatives were considered as follows:

6A – Breach the dam
6B – Breach the dam and divert the runoff north
6C – Breach the dam and capture the runoff in a basin

Alternative 6A

Description

Three breach locations are considered for this alternative. Those locations are based on natural drainage divides of the contributing watershed. The dam centerline stations at the drainage divides are 77+00, 87+00 and 107+00. For each of these locations the dam is breached and partially removed to the southern end of dam. A "new end of dam segment" is constructed to the natural drainage divide. The new dam is constructed using material borrowed from the existing dam embankment. The plans are shown in Plates 1, 2 and 3.

For comparison with the other two alternatives, only the third option, breach at approximately station 107+00, is considered. Breach and construction of the new end of dam segment at station 110+00 removes the dam from the fissure hazard risk zone.

Function

For each breach location, runoff from the 100-year storm is captured by the existing McMicken Dam low flow channel and when this channel is full, the water flows out through a breach in the remaining embankment. The flow continues in the existing washes, east to the Beardsley Canal and then south along the canal within the North Inlet Channel, where it outfalls to White Tanks FRS No. 3 (FRS #3).

Opportunities

The main opportunities attributed to Alternative 6A are:

- A portion of the right of way within the fissure hazard risk zone may be sold or used for other purposes besides flood control.
- Runoff released into the existing washes will benefit the environment and may be counted as mitigation area.

Constraints

The main constraints attributed to Alternative 6A are:

- Peak flows and runoff volumes are increased downstream. The North Inlet Channel from Olive Avenue south to FRS #3 will need to be upsized to convey the higher flows.
- A new 100-year floodplain will be created from the low flow channel to Olive Avenue.
- The total runoff volume to FRS #3 is increased. The effect of this increase in volume has not been analyzed, however it is assumed that it will have a significant impact on the dam and will increase the frequency and duration of spillway operation.
- The total storage volume for McMicken Dam is reduced. It is assumed that the effect of this reduction will be negligible; however, this must be verified by analysis.
- Areas downstream of the breached section will have a reduced level of flood protection. Acceptance of this alternative will require public involvement and may not be obtained.
- The schedule for implementing this alternative will be lengthened substantially to provide time for additional hydrology and hydraulic studies, designs and for public involvement and agency approvals.

Alternative 6B

Description

The dam is breached and removed from Station 110+00 south to Station 40+00. A "new end of dam segment" is constructed outside of the moderate fissure hazard risk zone at approximately station 110+00. The new dam is constructed using material borrowed from the existing dam embankment. A diversion channel is constructed to divert runoff north into McMicken Dam. The plan is shown in Plate 4.

Function

100-year runoff is diverted by a channel and conveyed north into McMicken Dam. Some runoff will enter the existing low flow channel and then will flow out through the breach.

Opportunities

The main opportunities attributed to Alternative 6B are:

- The dam is removed from the fissure hazard risk zone, significantly improving the safety of McMicken Dam.
- A portion of the right of way within the fissure hazard risk zone may be sold or used for other purposes besides flood control.
- Runoff released into the existing washes will benefit the environment and may be counted as mitigation area.

Constraints

The main constraints attributed to Alternative 6B are:

- Runoff volumes are slightly increased downstream.

- A new 100-year floodplain will be created from the Low flow channel to Olive Avenue.
- The total runoff volume to FRS #3 is increased slightly, however the effect of this increase in volume is assumed to be negligible. This must be verified by analysis.
- The total storage volume for McMicken Dam is reduced. It is assumed that the effect of this reduction will be minimal; however, this must be verified by analysis.
- Areas downstream of the breached section will have a reduced level of flood protection. Acceptance of this alternative will require public involvement and may not be obtained.
- The schedule for implementing this alternative will be lengthened substantially to provide time for additional hydrology and hydraulic studies, designs and for public involvement and agency approvals.

Alternative 6C

Description

The dam is breached and partially removed from Station 110+00 south to Station 40+00. A "new end of dam segment" is constructed outside of the moderate fissure hazard risk zone at approximately station 110+00. The new dam is constructed using material borrowed from the existing dam embankment. A basin is constructed by enlarging the existing low flow channel and utilizing the existing dam embankment as above ground storage and freeboard. The plan is shown in Plate 5.

Function

100-year runoff is captured by the detention basin. Outlet pipe(s) drain the basin and discharge into the existing washes. The runoff discharged from the basin then flows east to the Beardsley Canal and then south along the canal within the North Inlet Channel, where it outfalls to FRS #3.

Opportunities

The main opportunities attributed to Alternative 6C are:

- The dam is removed from the fissure hazard risk zone, significantly improving the safety of McMicken Dam.
- A portion of the right of way within the fissure hazard risk zone may be sold or used for other purposes besides flood control.
- Runoff released into the existing washes will benefit the environment and may be counted as mitigation area.

Constraints

The main constraints attributed to Alternative 6C are:

- A new 100-year floodplain will be created from the low flow channel to Olive Avenue.
- The total runoff volume to FRS #3 is increased. The effect of this increase in volume has not been analyzed. It may require improvements to the dam.

- The total storage volume for McMicken Dam is reduced. It is assumed that the effect of this reduction will be negligible; however, this must be verified by analysis.
- Areas downstream of the breached section will have a reduced level of flood protection. Acceptance of this alternative will require public involvement and may not be obtained.
- The schedule for implementing this alternative will be lengthened substantially to provide time for additional hydrology and hydraulic studies, designs and for public involvement and agency approvals.

Design

Hydrology

General

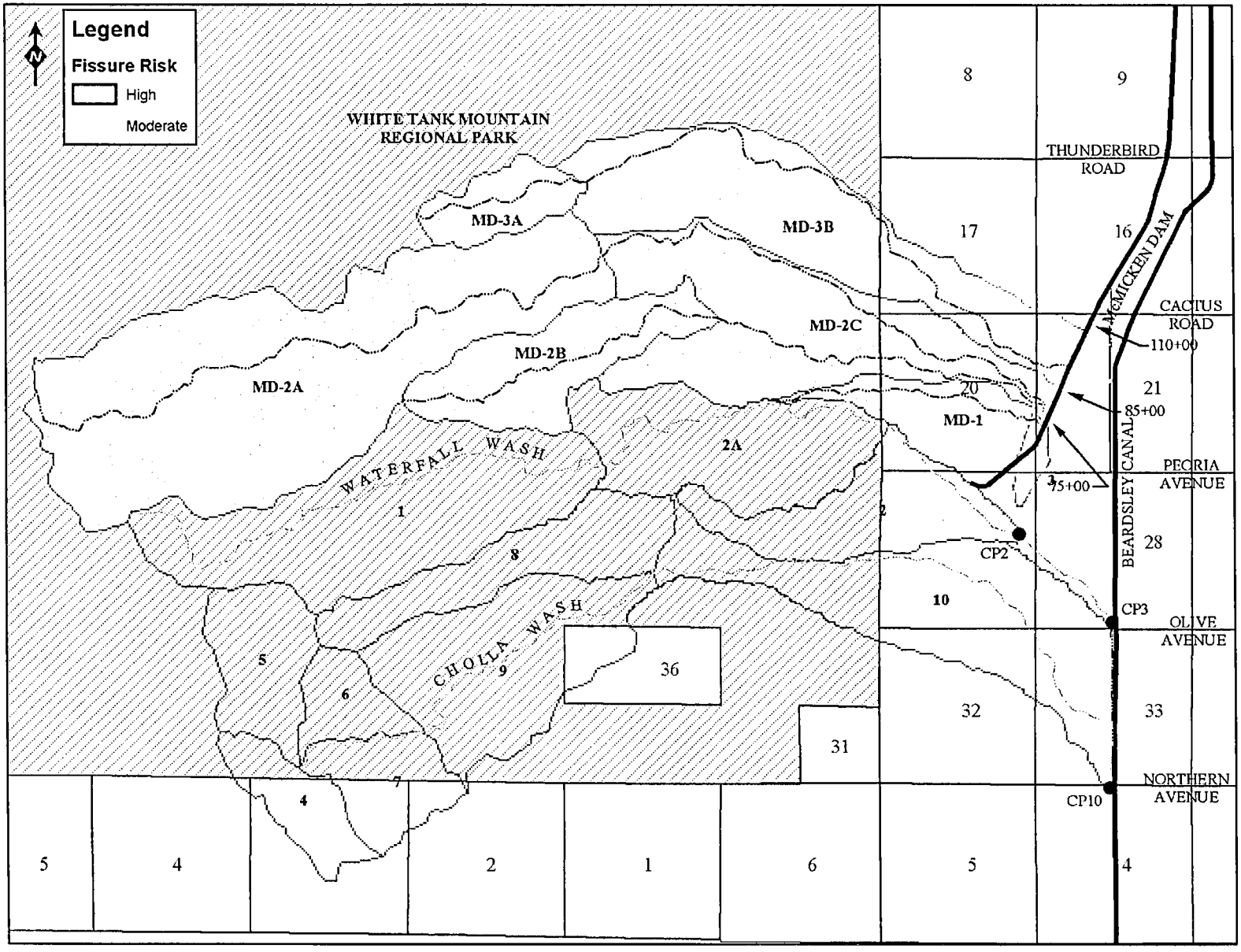
The study watershed considered for this Work Assignment is approximately 20 square miles in size and is composed of two unique "subwatersheds" which currently function independently of each other. One of the subwatersheds is approximately 9 square miles in size and is a portion of the McMicken Dam watershed. The limits of this area are set by the limits of the fissure hazard risk zones and are shown in Figure 1. The remaining 11 square mile watershed is a portion of the White Tank Flood Retarding Structure No. 3 (FRS#3) watershed. The limits for this area are also shown in Figure 1. The FRS #3 area is included in this analysis in order to evaluate potential impacts of the dam breach alternatives on this structure as well as the facilities that convey flow to FRS #3.

Existing Conditions

Hydrologic parameters for the FRS #3 portion of the study area have been developed by others, but were updated as part of Work Assignment 2. A discussion of those parameters, are provided in the report for that Work Assignment. Hydrologic parameters for the McMicken Dam portion of the study watershed were initially prepared as part of Work Assignment 1. Those parameters were prepared independently of the work conducted for the FRS #3 areas and were primarily focused on estimating runoff for the Probable Maximum Flood (PMF). Therefore, the original parameters for the McMicken Dam portion of the study area were revised as part of this Work Assignment to be more representative of the runoff characteristics associated with the 100-year event and to be consistent with the FRS #3 area hydrologic parameters.

Runoff exiting the breached portion of McMicken Dam would be intercepted by the Beardsley Canal and would then be directed south along the canal alignment where it would combine with runoff from Waterfall and Cholla Washes, ultimately being conveyed to FRS #3. Currently, the 100-year peak discharges along the Beardsley Canal are estimated at the Olive and Northern Avenue crossings to be 2,434 and 6,945 cfs, respectively. These locations are identified on Figure 1 as CP3 and CP10, respectively. The drainage areas at these locations are 4.9 and 10.9 square miles, respectively.

Figure 1
Watershed Map



Alternatives

For Alternative 6A, three breach locations were considered. Those locations are based on natural drainage divides of the contributing watershed. The dam centerline stations at the drainage divides are approximately 77+00, 87+00 and 107+00. For each of these breach locations a new dam extension is constructed. The runoff contributing to the breach area is estimated, routed through the existing low flow channel and then routed downstream to combine with runoff from Waterfall Wash. The three breach locations are shown in Plates 1 through 3, respectively. The peak discharges and runoff volumes for each breach location are listed in Table 1. HEC-1 operation CC1-O represents the controlled outflow from the existing low flow channel. For these alternatives, it was assumed that the existing dam would be removed to the natural grade. A small outlet channel is graded from the low flow channel to an existing wash. This outlet channel serves as the controlled outlet for the low flow channel which is considered to function as a detention basin.

Table 1 - Summary of 100-Year Peak Discharges and Runoff Volumes for Alternative 6A

HEC-1 ID	Station 77+00		Station 87+00		Station 107+00	
	Peak Discharge cfs	Runoff Volume acre-ft	Peak Discharge cfs	Runoff Volume acre-ft	Peak Discharge cfs	Runoff Volume acre-ft
CC1-I	1,224	54	3,036	563	4,645	715
CC1-O	104	54	2,513	563	2,811	715
CP3	2,395	381	3,154	904	3,161	1,048
CP10	6,920	756	6,953	1,145	6,925	1,267

For this analysis, both the 6 and 24-hour storms were modeled. The values listed in Table 1 are for the controlling storm. For the breach option at station 77+00, the low flow channel has a storage capacity of approximately 126 acre-ft. The 100-year runoff volume for this area is 54 acre-feet. Although the low flow channel could store the entire inflow volume, a small outlet is modeled to drain the basin. The resulting peak discharge at Olive Avenue is 2, 400 cfs, slightly less than existing conditions. The decrease in discharge is due to the increase in the areal reduction of the point rainfall depth associated with the addition of the contributing area from the breached portion of McMicken Dam combined with the significant attenuation that can be achieved by routing the runoff through the conveyance channel. In other words, the peak discharge from Waterfall Wash and the breached portion of McMicken Dam are non-coincident and the increase in areal reduction is sufficient to result in a decrease in the peak discharge. For the breach options at Stations 87+00 and 107+00, the low flow channel storage capacity is approximately 210 and 420 acre-feet, respectively. However, the inflow volumes are approximately 360 and 715 acre-feet, respectively. The resulting peak discharge at Olive Avenue would increase from 2,434 cfs to approximately 3,200 cfs.

For Alternative 6B, McMicken Dam would be breached and a new end of dam segment would be constructed at Station 110+00. Runoff contributing to the breach at Station 77+00 would be routed through the existing low flow channel and then routed downstream to combine with runoff from Waterfall Wash. All other runoff contributing to the breach location would be intercepted by a diversion channel and conveyed back into

the dam. A new dam extension would be constructed and would be located outside of the moderate fissure hazard risk zone as shown in Plate 4. The diversion channel is approximately 6,100 feet in length with a bottom width varying from 150 to 230 feet. The channel is sized to convey the 100-year flow. The 100-year peak discharge and runoff volume from the breach area that is diverted back into McMicken Dam is approximately 4,300 cfs and 680 acre-feet. The runoff allowed to continue downstream past the breach is nearly identical in magnitude to that estimated for Alternative 6A at Station 77+00. This area was allowed to continue downstream as opposed to intercepting the runoff in the diversion channel given that the results from Alternative 6A show that this volume does not significantly impact the FRS #3 facilities.

For Alternative 6C, McMicken Dam would be breached at Station 110+00. Runoff contributing to this area would be routed through an engineered detention basin. The basin is sized such that the existing condition peak discharges at Olive and Northern Avenues are not increased. The proposed layout is shown in Plate 5. The maximum storage capacity is approximately 600 acre-feet and is almost entirely below grade to be considered a non-jurisdictional structure. The basin is graded such that it does not extend beyond the existing drainage easement, which results in a linear basin similar to the conveyance corridor. To maximize the efficiency of this linear basin, the basin floor is graded to three separate 2 barrel 48-inch diameter pipe outlets. The peak inflow to the basin is approximately 4,645 cfs and 715 acre-feet. The resulting peak discharge at Olive and Northern Avenues is approximately 2,545 and 6,761 cfs, respectively.

Effect on McMicken Dam

For Alternative A, a new end of dam segment would be located at natural drainage divides. Three locations were investigated. Segmentation of the dam at those locations would remove approximately 0.6, 7 and 9 square miles of the watershed from McMicken Dam, respectively. For Alternatives B and C a new end of dam segment would be located at approximately station 110+00. Segmentation of the dam at this location will remove approximately 9 square miles of the watershed from McMicken Dam.

For alternatives A and C, the runoff volume into McMicken Dam during the PMF is reduced. For Alternative A, the runoff volume into McMicken Dam is reduced by approximately 300, 3,900 and 5,200 acre-feet for the three breach locations, respectively. For Alternative C, the runoff volume into McMicken Dam is reduced by approximately 5,200 acre-feet. For alternative B, the 100-year flood is diverted into the dam. Runoff in excess of the 100-year event would overtop the diversion channel and thus would not be diverted into McMicken Dam. During the PMF, this runoff is reduced by approximately 4,200 acre-feet. The estimated total runoff volume for the spillway design flood is 44,000 acre-feet. The alternatives reduce the total volume of runoff into the dam by as much as 9 percent.

Segmentation of the dam also reduces the total storage capacity in the McMicken Dam reservoir. The capacity of the reservoir to the top of the dam is approximately 36,000 acre-feet. For Alternative A, the total storage capacity is reduced by approximately 750, 1,000 and 1,750 acre-feet for each breach location, respectively. For Alternatives B and C, the total storage capacity is reduced by approximately 1,750 acre-feet. This is a reduction of up to approximately five percent of the total storage to the top of the dam.

An inflow hydrograph and hydraulic routing analysis of the revised watershed for the dam has not been conducted. However, in light of the significant reduction in runoff to the dam, it is assumed that segmenting the dam will not have a significant effect on operation of the dam.

Effect on North Inlet Channel

Breach of the dam without any other improvements (Alternative 6A) will cause the greatest impact to the North Inlet Channel. The peak flow rates will increase and require that improvements be made to the channel. The flow will break out over the Beardsley Canal near Olive Avenue as previously documented in other studies and that flow would need to be captured and conveyed safely downstream. It is assumed that the East Conveyance Channel as described in the White Tanks FRS #3, North Inlet Channel Pre-Design Study Report would need to be constructed to convey this additional flow downstream. Alternatives 6B and 6C would be designed such that there is no increase in peak flow into the North Inlet Channel.

Effect on White Tanks FRS No. 3

All of the alternatives have some impact on FRS #3. During any flood event, additional water will drain into the dam. The greatest impact would be to breach the dam and not improve the basin (Alternative 6A). For the 100-year flood, as much as 715 acre-feet of runoff will reach FRS #3. This will require significant improvements be made to the dam to pass this additional volume of water.

Alternative 6C improves this situation by storing more runoff and delaying the outflow to the North Inlet Channel. The proposed basin is designed to drain in 72 hours. While the 100-year flood runoff volume reaching FRS #3 is the same, it will be delayed such that the impact on FRS #3 may be reduced. This may still require improvements be made to the dam to pass this additional volume of water.

Alternative 6B diverts a minimum of the 100-year flood runoff north to McMicken Dam so that there is very little runoff flowing to FRS #3 during the 100-year flood. Only that small drainage area east and south of the diversion channel will flow to FRS #3. Total runoff for this area during the 100-year flood is around 50 acre-feet. This runoff is intercepted by the existing low flow channel and then slowly released so that the impact to FRS #3 is assumed to be minimal.

Under larger events, greater than the 100-year flood, it is likely that flows from the fissure hazard risk zone watershed will overtop the diversion channel, overtop the existing low flow channel or detention basin, continue easterly and overtop and possibly breach the Beardsley Canal. Once they have overtopped and breached the canal, they may continue easterly and subsequent flow may not reach FRS #3. Detailed analysis of these breaches and breakouts and estimation of the flood hydrograph and volume of water from the watershed which will reach FRS #3 is required before the actual impact on FRS #3 can be determined for larger flood events.

Sediment Transport

Streams in this watershed can carry significant sediment loads. Field investigation has shown that existing channel beds are armored with cobbles and boulders; however, there is evidence of active bank erosion. Sediment is deposited in flatter areas and consists of coarse sand and fine gravel. It is likely that during larger floods (25-year and greater), significant quantities of coarse gravel, cobbles and boulders would be transported. The Corps used a design value of 0.2 acre-foot/sq. mile/year for design of McMicken Dam. However, this value is for the entire watershed and may not be characteristic of this project watershed. Investigation of sedimentation rates given in the Maricopa County Drainage Design Manual indicates that a rate of 0.3 might be more appropriate. It may also be appropriate to apply a safety factor to this value and assume

for design purposes a value of 0.6. Using these values, it can be expected that up to 5 acre-feet of sediment or more will be deposited on an annualized basis in the low flow channel or in the diversion channel. Sediment basins are recommended in the diversion channel to capture this sediment and allow easy removal.

Scour countermeasures are also required to prevent damage to the diversion channel. Riprap or gabions are recommended since the material is readily available. Riprap should be placed points of inflow and at the end of the diversion channel to prevent erosion and head cutting. Sufficient freeboard should be provided for the diversion channel to allow for sediment accumulations that may not be cleaned out prior to the 100-year flood.

Riprap or other erosion protection may be required along the toe of the new end of dam segment.

Riprap or gabions are also required at the outlet of the low flow culverts.

Design Components

New End of Dam Segment

The new end of dam segment will be designed to completely retain the McMicken Dam reservoir north of Station 110+00. The dam will be constructed to a minimum elevation of 1363 for the entire length. Plate 6 shows the proposed dam segment plan and typical details.

It will be located outside of the fissure hazard risk zone. The probability of the fissure hazard risk zone migrating northerly such that the new end of dam segment may eventually be within the active fissure zone is very low. Therefore, it was not considered necessary to construct this dam segment with double cutoffs or a geomembrane liner on the foundation to defend against fissure induced piping or erosion.

The proposed dam extension has the following design features:

- Full removal of the Holocene soils (assumed to be 8 feet in average thickness), which are considered to have a high potential for collapse on wetting and a high potential for erosion.
- Installation of an upstream cutoff extending 15 feet into the underlying cemented Pleistocene soils. The depth of 15 feet was selected to allow comparison of alternatives. A geotechnical investigation will need to be completed prior to determining the design depth of the cutoffs, and to determine the depth of Holocene soil removal. The intent of the cutoff is to protect against erosion of earth fissures that could occur when the dam impounds water. The erosion could result in the loss of the foundation for the dam and, ultimately, failure of the dam and releases of water downstream. The required depth of penetration by the cutoff also will be dependent on studies of flow through fissure cracks that is presently being conducted by the District. It is assumed the 2-foot wide cutoff can be excavated with a trenching machine and will be backfilled with a flowable backfill material. The cutoff also includes an 80-mil thick HDPE geomembrane and a 20-ounce nonwoven geotextile.
- The new embankment has a 2½H:1V upstream slope, a 2H:1V downstream slope and a crest width of 12 feet. It is assumed that the embankment can be constructed using native soils, including the excavated Holocene soils.

- Protection against embankment piping will be provided by an 80-mil thick HDPE geomembrane and a 20-ounce nonwoven geotextile placed on the upstream side of the embankment.

It is possible that additional measures may be required for the embankment design to prevent failure caused by fissure induced erosion or piping.

Dam Breach

The existing dam will be breached by excavating the embankment down to the existing ground level at one or more locations such that 100-year flood runoff can pass through the breach and enter the existing channel and continue downstream. The embankment will be removed and a portion of the material may be used to construct the new end of dam segment. For alternative 6C, a portion of the embankment will remain and will provide additional detention basin volume and freeboard during the 100-year flood. The remaining embankment will be lowered such that it is a non-jurisdictional structure. The height of this remnant structure may remain as high as six feet and still be non-jurisdictional. For purposes of this analysis, it was assumed that no more than three feet of water would be allowed to pond against this embankment. This reduces the risk of failure due to an earth fissure and provides freeboard. A risk assessment may be conducted which may show that additional depth of ponding might result in an acceptably low risk due to fissure induced dam failure.

Low Flow Channel

The low flow channel is retained for all alternatives and functions as a detention facility to reduce the impact of flood flows downstream of the breached dam. The channel may also be enlarged to provide a borrow site for material needed to construct the new end of dam segment and for anticipated future embankment raises needed for the remainder of McMicken Dam north of the fissure hazard risk zone. Low flow culverts are required to drain the channel for alternative 6C.

Diversion Channel

A diversion channel is proposed in Alternative 6B to divert 100-year flood runoff north into the dam reservoir. Flows in excess of the 100-year flood could overtop the channel and continue east. The diversion channel would divert only those flows from the two largest drainage basins, basins MD2 and MD3. Flows from basin MD1 would be captured in the existing low flow channel and routed through the breaches.

The channel is designed as a trapezoidal earth channel, with subcritical flow and low velocities to reduce the amount of erosion. Material excavated from the channel would be placed in a berm on the east side to provide additional freeboard. The height of the berm in the vicinity of the larger washes should be raised so if a wave is generated, or if sediment is clogging the channel, it won't overtop. Sediment basins would be constructed, below grade, at each large confluence. These will provide some energy dissipation and will allow the water to pond, drop the sediment load and then turn 90 degrees.

Detention Basin

For Alternative 6C, a detention basin is constructed by enlarging the existing low flow channel and utilizing a portion of the existing dam embankment as above ground storage and freeboard. The basin functions to capture the flood flow and release it at a slow enough rate such that the peak flows in the North Inlet Channel are not increased.

The draw down time is assumed to be a maximum of 3 days. This is required for health and safety reasons and so that the basin will be able to capture multiple storms. The maximum height of the embankment is reduced to no more than six feet such that the structure will not be classified as a dam by ADWR. Maximum depth of water impounded above the natural ground behind the remnant structure is about 3 feet. This provides freeboard for the 100-year flood. The basin is constructed to utilize the existing low flow channel south of the new end of dam segment. The low flow channel provides some storage capacity and also conveys flow into the basin. Additional capacity for storage is added by excavation of a deeper basin section near the north end of the low flow channel. Some of the excavated material may be used to construct the new dam segment. Outlet pipe(s) are constructed to release flows into the existing washes.

Land Acquisition

New flood plains will be created for all breach alternatives considered and this will require acquisition of new right of way. Flood runoff will be discharged from the existing low flow channel into the washes east of the breached dam. Flows will continue east to the Beardsley Canal and then south along the canal to the North Inlet Channel at Olive Avenue. The dimensions of these new floodplains were not determined by hydraulic analysis, however, a rough estimate of the potential length of channels and width of right of way was made. Up to approximately 60 acres of additional land would be required for the floodplains. This land must be acquired from the Arizona State Land Department.

Approximately 35 acres of new right of way must be acquired for Alternative 6B for the diversion channel. This land must be acquired from the Arizona State Land Department.

No additional right of way is needed for the new end of dam segment or for the detention basin.

Some existing right of way within the McMicken Dam impoundment may be disposed of for all alternatives. However, some of this land may be un-developable because of 100-year floodplains at each major wash. Other land may be of limited use due to the presence of earth fissures. No estimate was made of the amount of land that might be disposed.

Floodplains

Additional floodplains are created by breaching the dam and allowing flood flow to return to existing washes east of the dam. No analysis was done on the effect of allowing these flows to return to these watercourses. The watercourses may be allowed to remain natural; however, since the low flow channel remains in place and alters the natural flow of water through the area, the flow regime for these channels will not be natural. All of the upstream flow will likely be discharged into several of the largest channels. For the basin alternative (6C) it is likely that only one or two channels will be utilized to discharge flows from the basin. This is likely to cause increased erosion in these channels and will probably require that they be stabilized to reduce the amount of sediment transport and prevent lateral migration. No hydraulic analysis or design was performed for these channels.

A floodplain exists along the Beardsley Canal. A dike was constructed to protect the canal from flood flows and a channel has formed at the base of this dike. Once the dam is breached, additional runoff will reach the dike and flow in this channel. This floodplain will increase in size. The additional flow may require some stabilizing measures, such as placement of riprap or gabions to prevent erosion, or excavation to provide more

capacity in the channel. It may also require periodic maintenance to remove accumulated sediment. No hydraulic analysis or design was performed for this channel.

Environmental Impact

Breaching the dam has a positive impact on the environment for all alternatives by allowing runoff which previously was diverted into Trilby Basin to continue downstream in existing washes. These washes were cutoff by the construction of McMicken Dam and currently they convey very little runoff east of the dam.

Alternative 6B has a negative environmental impact on the existing washes tributary to the low flow channel. Construction of the diversion channel will divert the flow from these channels. The effect will be to dry up these washes for some distance downstream until runoff can again accumulate in the channels.

Alternative 6C has a negative environmental impact on the existing washes tributary to the low flow channel. Enlargement of the low flow channel to create a detention basin will remove a portion of some of these channels. However, the enlarged basin will likely increase the area of waters of the US and this will help to mitigate the impact. As described for Alternative 6A, the breach of the dam will have a positive impact on the washes downstream of the dam because the basin will drain into these washes instead of being diverted into Trilby Basin.

Fissure Hazard Risk Zone Remediation

None of the alternatives include a specific repair or require a specific element be constructed to protect against fissures within the breached area. However, all the alternatives greatly reduce the risk of fissure induced flooding. Specific measures to mitigate the risk are:

- Removal of the dam from the risk zone eliminates the possibility of catastrophic dam failure
- Breaching the dam and low flow channel within the fissure hazard risk zone greatly reduces the amount of flood water impounded and the length of time that water is impounded
- Diversion of the 100-year flood into McMicken Dam reduces the amount of water impounded within the fissure hazard risk zone
- Limiting the impoundment depth above ground, limits the amount of pressure on a potential fissure which could cause it to erode and fail
- A smaller volume of flood water impounded may be insufficient to cause failure of a fissure
- A potential failure involving a smaller flood impoundment will likely cause less flood damage

In light of all the factors listed above, the annualized risk of failure due to earth fissures is very low and protective measures for the potential fissures is assumed to be unnecessary.

Cost

The cost to implement each alternative is estimated to assist with alternative evaluation.

For purposes of this analysis, cost estimates are provided for the following conditions and assumptions:

- For alternative 6A, additional capacity is required in the North Inlet Channel to convey the flows to FRS #3. Costs for these improvements are derived from the White Tanks FRS #3, North Inlet Channel, Pre-Design Study Report by Wood Patel & Associates, July 2002 and are included in the estimate. Since the peak flow reaching Olive Avenue is increased, the construction cost and right of way required for this channel is increased by a factor of 25% over that estimated by Wood Patel.
- No costs are estimated for remediation of FRS #3 since the impact of the alternatives is unknown. However, if a dam breach alternative is considered further, the impacts must be analyzed and the additional cost should be factored into the decision.
- No costs are estimated for improvements to floodplains created between the low flow channel and the Beardsley Canal, or along the Beardsley Canal. However, if a dam breach alternative is considered further, these impacts must be analyzed and the additional cost should be factored into the decision.
- The end of dam segment is assumed to be an earthen dam with limited protection against earth fissures and cracking. For regulatory acceptance, it may be required to provide full fissure protection for this embankment. This would increase the cost.
- Diversion channel is assumed to be an un-lined, trapezoidal earth channel.
- Life cycle O&M costs are not included.
- Landscaping and aesthetic treatment costs are not included.
- Mitigation costs include Hydroseeding of the disturbed areas of the low flow channel, detention basin and diversion channel and enhanced re-vegetation of the breached dam area.
- Minimal costs are estimated for haul away of excess material. An assumption is made that the material can be placed on the existing dam to provide additional freeboard. No other stockpile or disposal site was identified in this analysis. If a suitable disposal or stockpile site is not located close to the project site, the cost to haul away and stockpile or dispose of excess material could greatly exceed these estimates.
- Costs for new right of way acquisition are added where they were specifically identified and quantified. A rough estimate of the cost for new right of way for the new floodplains which are created is provided, however, no hydraulic analysis of these floodplains was done.

Table 2 – Cost Summary

Item	Alt 6A	Alt 6B	Alt 6C
Construction	$2,905,000	$2,326,000	$6,805,000
Mobilization, Engineering and Permits	$765,000	$615,000	$1,779,000
Contingency	$581,000	$465,000	$1,361,000
Right of Way	$1,680,000	$1,500,000	$600,000
Total	$5,931,000	$4,906,000	$10,545,000

Recommendations

- Alternative 6A - Breaching the dam without providing any diversion, detention or other mitigation is not recommended. It is assumed that the cost to convey the flood water downstream will be excessive and the effect on FRS #3, while unknown, would likely require significant costly improvements to the dam and outlet works.
- Alternative 6B or 6C may be technically feasible; however, analysis of the effects on FRS #3 and on McMicken Dam must be completed to validate this assumption.
- Public involvement is required for any of these alternatives. Acceptance and approval must be obtained from major stakeholders such as the Maricopa Water District, Luke Air Force Base, Arizona Department of Transportation and any large landowners. Regulatory acceptance must be obtained from Arizona Department of Water Resources.
- The schedule for analysis, design, permitting and construction for any of these alternatives will be longer than that anticipated for any of the dam repair, or relocation alternatives.
- A quantitative risk assessment should be undertaken to document the change in risk that would be made if any of these alternatives were chosen.

Cost Estimate

Flood Control District of Maricopa County
McMicken Dam FRZR Project

Alternative 6A - Breach Dam (Station 107+00)
Reconnaissance Level Design

Engineers Estimate
Prepared August 15, 2003

DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
Excavation, Remove Existing Dam	175000	CY	$2.00	$350,000
Construct New Dam Segment	1	LS	$465,000.00	$465,000
Haul away excess material to stockpile	86000	CY	$2.00	$172,000
Riprap, Dumped	1100	CY	$35.00	$38,500
Filter Fabric	1100	SY	$2.00	$2,200
Environmental Mitigation	553000	SF	$0.23	$127,190
Construct North Inlet Channel Improvements (East side)	1	LS	$1,750,000	$1,750,000
			CONSTRUCTION SUBTOTAL	**$2,905,000**
Design and Construction Engineering	15%	LS	$435,750	$435,750
Construction Staking and As-Builts	2%	LS	$58,100	$58,100
Construction water & dust control	1%	LS	$29,050	$29,050
Construction inspection, testing, quality control	5%	LS	$145,250	$145,250
NPDES/SWPPP Permit	1	LS	$10,000	$10,000
Mobilization	3%	LS	$87,150	$87,150
			MOBILIZATION, PERMITS AND ENGINEERING SUBTOTAL	**$765,000**
	20%		**CONTINGENCY**	**$581,000**
Right of Way, New Floodplains	60	AC	$20,000	$1,200,000
Right of Way, East Side Channel	24	AC	$20,000	$480,000
			TOTAL	**$5,931,000**

Note: totals rounded to the nearest $1,000

Flood Control District of Maricopa County
McMicken Dam FRZR Project

Alternative 6B - 100-Year Diversion Channel
Reconnaissance Level Design

Engineers Estimate
Prepared August 8, 2003

DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
Excavation, Remove Existing Dam	175200	CY	$2.00	$350,400
Excavation, Channel	219200	CY	$2.00	$438,400
Embankment, Channel Berm	11200	CY	$4.00	$44,800
Construct New Dam Segment	1	LS	$465,000.00	$465,000
Haul away excess material to stockpile	279000	CY	$2.00	$558,000
Riprap, Dumped	7168	CY	$35.00	$250,880
Filter Fabric	7170	SY	$2.00	$14,340
Hydroseed	1530000	SF	$0.05	$76,500
Environmental Mitigation	553000	SF	$0.23	$127,190
			CONSTRUCTION SUBTOTAL	**$2,326,000**
Design and Construction Engineering	15%	LS	$348,900	$348,900
Construction Staking and As-Builts	2%	LS	$46,520	$46,520
Construction water & dust control	1%	LS	$23,260	$23,260
Construction inspection, testing, quality control	5%	LS	$116,300	$116,300
NPDES/SWPPP Permit	1	LS	$10,000	$10,000
Mobilization	3%	LS	$69,780	$69,780
			MOBILIZATION, PERMITS AND ENGINEERING SUBTOTAL	**$615,000**
	20%		**CONTINGENCY**	**$465,000**
Right of Way, New Floodplains	40	AC	$20,000	$800,000
Right of Way, Diversion Channel	35	AC	$20,000	$700,000
			TOTAL	**$4,906,000**

Note: totals rounded to the nearest $1,000

Flood Control District of Maricopa County
McMicken Dam FRZR Project

Alternative 6C - 100-Year Detention Basin
Reconnaissance Level Design

Engineers Estimate
Prepared August 18, 2003

DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
Excavation, Remove Existing Dam	112700	CY	$2.00	$225,400
Excavation, Basin	1411000	CY	$2.00	$2,822,000
Construct New Dam Segment	1	LS	$465,000.00	$465,000
Haul away excess material to stockpile	1421000	CY	$2.00	$2,842,000
Pipe, 48 inch RGRCP, Class III	600	LF	$90.00	$54,000
Headwall, 48 inch	12	EA	$2,500.00	$30,000
Riprap, Dumped	1111	CY	$35.00	$38,885
Filter Fabric	1670	SY	$2.00	$3,340
Hydroseed	4521000	SF	$0.05	$226,050
Environmental Mitigation	429000	SF	$0.23	$98,670
			CONSTRUCTION SUBTOTAL	**$6,805,000**
Design and Construction Engineering	15%	LS	$1,020,750	$1,020,750
Construction Staking and As-Builts	2%	LS	$136,100	$136,100
Construction water & dust control	1%	LS	$68,050	$68,050
Construction inspection, testing, quality control	5%	LS	$340,250	$340,250
NPDES/SWPPP Permit	1	LS	$10,000	$10,000
Mobilization	3%	LS	$204,150	$204,150
			MOBILIZATION, PERMITS AND ENGINEERING SUBTOTAL	**$1,779,000**
	20%		**CONTINGENCY**	**$1,361,000**
Right of Way, New Floodplains	30	AC	$20,000	$600,000
			TOTAL	**$10,545,000**

Note: totals rounded to the nearest $1,000

Flood Control District of Maricopa County
McMicken Dam FRZR Project

Alternative 6A - Breach Dam (Station 107+00) **Engineers Estimate Details**
Reconnaissance Level Design **Prepared August 15, 2003**
Prepared by: cvg Checked by: Revisions/Comments

Excavation, Remove Existing Dam

Length	Bot width	Top width	Avg Height	Avg area	Excavation	
6,500	85.00	12.00	15.00	727.50	175,200	
				Total excavation	175,200	cubic yards

Excess material to be hauled away to stockpile

Total excavation		175,200	
Borrow needed for new dam		89,500	deleted shrinkage
	Total haul away	86,000	cubic yards for recompaction of dam embankment material

Riprap, Dumped

	location	number	length	width	thickness	quant riprap
D50 = 18"	Breach	1	100	50	3	556
D50 = 18"	Breach	1	100	50	3	556
					total	1,112

Filter Fabric filter fabric to be placed under riprap

location	length	width	number	Area (sf)	
Breach	100	50	1	5000	
Breach	100	50	1	5000	
		Total		10000	sf
				1120	sy

Environmental Mitigation mitigate existing dam area

location	length	width	number	Area		
existing dam	6500	85	1	552500		deleted hydroseed
		Total		553000	square feet	added mitigation

Flood Control District of Maricopa County
McMicken Dam FRZR Project

Alternative 6A - Breach Dam (Station 107+00) | **Engineers Estimate Details**
Reconnaissance Level Design | **Prepared August 15, 2003**
Prepared by: cvg | Checked by: | Revisions/Comments

Improvements to North Inlet Channel 600 cfs on east side of canal

Total construction cost from WPA report for Alt 4	$ 2,517,205.00
subtract cost of riprap/slope protection on west side	$ (809,144.00)
subtract cost for 4 - 10 x 6 RCB on west side at Olive	$ (131,626.00)
subtact cost for maintenance road on west side	$ (72,100.00)
subtract excavation on west side of canal from Olive to Cholla	$ 11,606.00
subtract excavation on west side of canal from Northern to FRS#3	$ (59,033.00)
subtract for landscaping on west side from Northern to FRS #3	$ (3,742.00)
subtract for aesthetic treatment on west side from olive to cholla	$ (8,694.00)
subtract for aesthetic treatment on west side from cholla to northern	$ (10,253.00)
subtract for aesthetic treatment on west side from northern to FRS#3	$ (31,003.00)
subtract for aesthetic treatment on west side north of olive	$ (3,246.00)
subtract for aesthetic treatment on west side north of olive	$ (5,265.00)
Lump sum construction cost	$ 1,394,705.00

Since flow to be carried on the east side may exceed 600 cfs, apply a factor to increase this cost

assume	25%	additional cost to upsize the channel and siphons for the additional flow	
		additional cost	$ 348,676.25
		total cost	$ 1,743,381.25
		round to	$ 1,750,000.00

Right of way requirement for east side channel

		per WPA report	19.00 acres
assume	25%	additional width for upsized channel and siphons for the additional flow	
		additional acreage	4.75 acres
		total acreage	23.75 acres
		round to	24.00 acres

Flood Control District of Maricopa County
McMicken Dam FRZR Project

Alternative 6B - 100-Year Diversion Channel | **Engineers Estimate Details**
Reconnaissance Level Design | **Prepared August 8, 2003**
Prepared by: cvg | Checked by: | Revisions/Comments

Excavation, Remove Existing Dam

Length	Bot width	Top width	Avg Height	Avg area	Excavation	
6,500	85.00	12.00	15.00	727.50	175,200	cubic yards

Excavation, Channel — excavation to construct diversion channel

	Length	Bot width	Top width	Avg depth	Avg area	side slope	Excavation	
channel reach 1	3,100	230.00	269.20	4.90	1,223.04	4 :1	140,500	
channel reach 2	2,000	150.00	190.00	5.00	850.00	4 :1	63,000	
sediment basin	100	100.00	148.00	6.00	744.00	4 :1	2,800	
sediment basin	100	100.00	148.00	6.00	744.00	4 :1	2,800	
sediment basin	100	100.00	148.00	6.00	744.00	4 :1	2,800	
outfall	200	230.00	262.00	4.00	984.00	4 :1	7,300	
note: depth is avg to top of ground						Total excavation	219,200	cubic yards

Embankment, Channel Berm — compacted berm along channel

	Length	Bot width	Top width	Avg height	Avg area	side slope	Fill	
channel reach 1	3,100	32.80	16.00	2.10	51.24	4 :1	5,900	
channel reach 2	2,000	32.80	16.00	2.10	51.24	4 :1	3,800	
sediment basin	300	40.80	32.80	1.00	36.80	4 :1	500	
sediment basin	300	40.80	32.80	1.00	36.80	4 :1	500	
sediment basin	300	40.80	32.80	1.00	36.80	4 :1	500	
						Total excavation	11,200	cubic yards

Excess material to be hauled away to stockpile

Total excavation			394,400	
fill			11,200	
Borrow needed for new dam			89,500	
shrinkage of compacted fill	15%		15,105	
		Total haul away	279,000	cubic yards

Riprap, Dumped

	location	number	length	width	thickness	quant riprap
D50 = 18"	sediment basin	1	50	100	3	556
D50 = 18"	sediment basin	1	50	100	3	556

Flood Control District of Maricopa County
McMicken Dam FRZR Project

Alternative 6B - 100-Year Diversion Channel — **Engineers Estimate Details**
Reconnaissance Level Design — **Prepared August 8, 2003**
Prepared by: cvg — Checked by: — Revisions/Comments

D50 = 18"	sediment basin	1	50	100	3	556
D50 = 18"	channel confluence	1	50	230	3	1,278
D50 = 18"	channel confluence	1	50	150	3	833
D50 = 18"	channel confluence	1	50	150	3	833
D50 = 18"	outfall	1	100	230	3	2,556
					total	7,168

Filter Fabric — filter fabric to be placed under riprap

location	length	width	number	Area (sf)	
sediment basin	50	100	1	5000	
sediment basin	50	100	1	5000	
sediment basin	50	100	1	5000	
channel confluence	50	230	1	11500	
channel confluence	50	150	1	7500	
channel confluence	50	150	1	7500	
outfall	100	230	1	23000	
	Total			64,500	sf
				7170	sy

Hydroseed — mitigate areas disturbed

location	length	width	number	Area	
channel reach 1	3100	269	1	833900	
channel reach 2	2100	190	1	399000	
berm reach 1	3100	33	1	102300	
berm reach 2	2100	33	1	69300	
sediment basin	148	148	3	65712	
sediment basin berms	300	41	3	36900	
outfall	100	230	1	23000	
existing dam					changed to mitigation
	Total			1530000	square feet

Environmental Mitigation — mitigate existing dam area

location	length	width	number	Area
existing dam	6500	85	1	552500

		Total		553000	square feet

Right of Way

location	length	width	number	Area	
channel reach 1	3100	269	1	833900	
channel reach 2	2100	190	1	399000	
berm reach 1	3100	33	1	102300	
berm reach 2	2100	33	1	69300	
sediment basin	148	148	3	65712	
sediment basin berms	200	41	3	24600	
		Total		1494900	square feet
				34.32	acres
			round to	35.00	acres

Flood Control District of Maricopa County
McMicken Dam FRZR Project

Alternative 6C - 100-Year Detention Basin | **Engineers Estimate Details**
Reconnaissance Level Design | **Prepared August 18, 2003**
Prepared by: cvg | Checked by: | Revisions/Comments

Excavation, Remove Existing Dam

	Length	Bot width	Top width	Avg Height	Avg area	Excavation
	6,500	66	12	12	468.00	112,700

Excavation, Basin assume basin has 4:1 side slopes, top of basin at 1346.00

	Length	Bot width	Top width	Avg depth	Avg area	Excavation
basin, north end	2,400	828	900	9	7,776.00	691,200
basin, central	1,500	628	700	9	5,976.00	332,000
basin, south end	2,300	530	570	5	2,750.00	234,300
daylight, north end	2,400	450		8	1,800.00	160,000
daylight, central	1,500	350		4	700.00	38,900
daylight, south end	2,300	285		12	1,710.00	145,700
existing low flow channel	6,200	200	216	4	832.00	(191,100)
					Total excavation	1,411,000 cubic yards

Excess material to be hauled away to stockpile

Total excavation			1,523,700
Borrow needed for new dam			89,500
shrinkage of compacted fill	15%		13,425
		Total haul away	1,421,000 cubic yards

Riprap, Dumped

	location	number	length	width	thickness	quant riprap
D50 = 12"	culvert inlet and outlets	12	50	25	2	1,111
					total	1,111

Flood Control District of Maricopa County
McMicken Dam FRZR Project

Alternative 6C - 100-Year Detention Basin | **Engineers Estimate Details**
Reconnaissance Level Design | **Prepared August 18, 2003**
Prepared by: cvg | Checked by: | Revisions/Comments

Filter Fabric

filter fabric to be placed under riprap

location	length	width	number	Area (sf)	
culvert inlet and outlet	50	25	12	15000	
		Total		15,000	sf
				1670	sy

Hydroseed

mitigate areas disturbed

location	length	width	number	Area	
detention basin	2,400	900	1	2160000	
detention basin	1,500	700	1	1050000	
detention basin	2,300	570	1	1311000	
		Total		4521000	square feet

Environmental Mitigation

location	length	width	number	Area	
existing dam	6500	66	1	429000	
		Total		429000	square feet

Pipe, 48 inch RGRCP, Class III

Length 100 ft | 6 each | total 600 ft

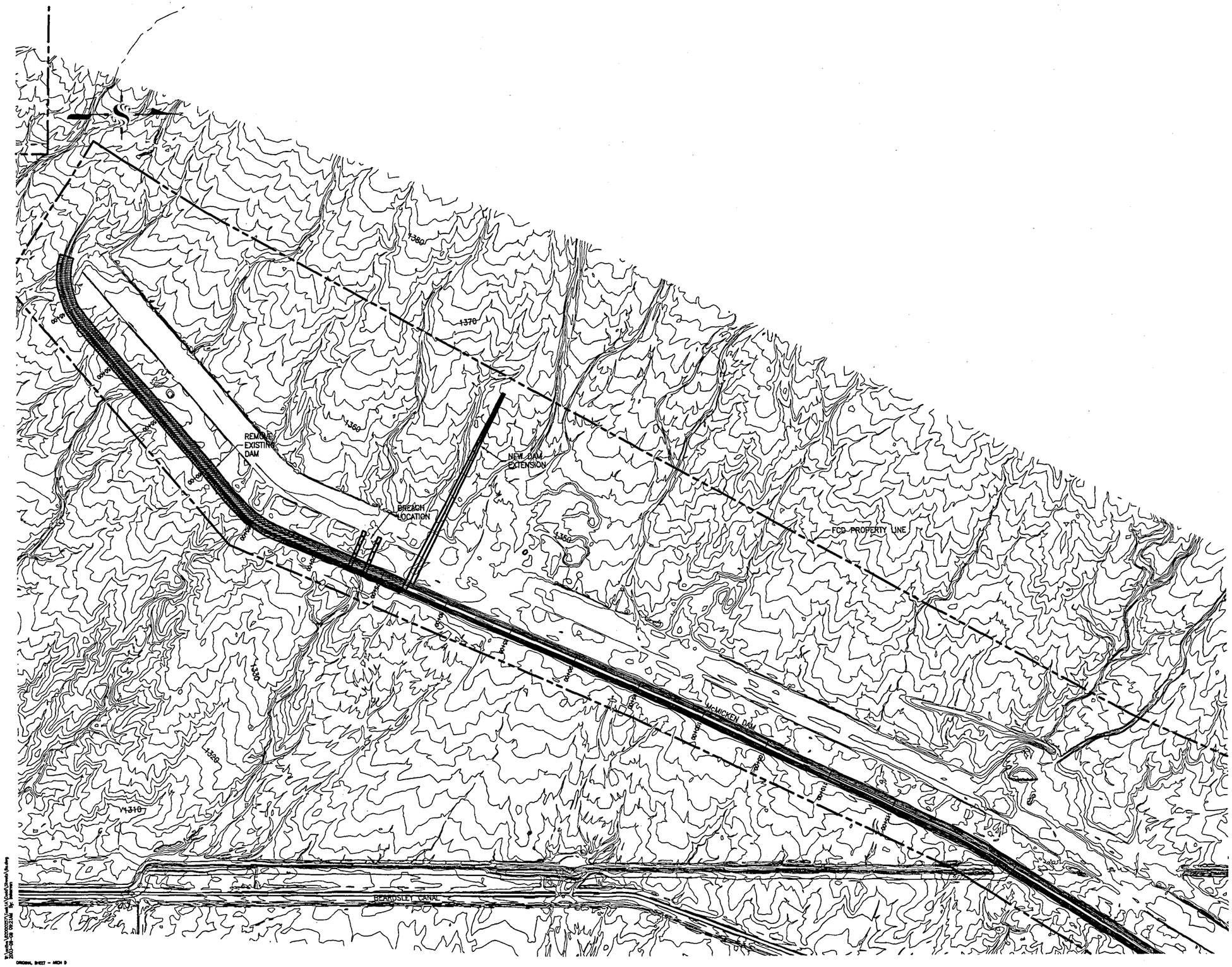
Headwall, 48 inch 12 ea

Flood Control District of Maricopa County
McMicken Dam FRZR Project
Cost Estimates for Alternative 6

Estimated Structure/Modification Length (ft): 1800

			Estimated Unit Cost (2002)								Alternative 6		
	Earthwork	UNIT		Sectional Area/Length	UNIT	Estimated Cost ($)	Sectional Area/Length	UNIT	Estimated Cost ($)	Sectional Area/Length	UNIT	Estimated Cost ($)
A	Clear and Grub Sloped Surface	SY	$ 0.10		LF	$ -		LF	$ -	160	LF	$ 3,200
B	Excavation of Trenches (15 feet hard dig)	LF	$ 3.50		No.	$ -		No.	$ -	1	No.	$ 6,300
C	Provide and Place Flowable Fill	CY	$ 35.00		SF	$ -		SF	$ -	30	SF	$ 70,000
D	Mass Excavation	CY	$ 0.75		SF	$ -		SF	$ -	790	SF	$ 39,500
E	Mass Excavation of Slopes	CY	$ 0.90		SF	$ -		SF	$ -	100	SF	$ 6,000
F	Grading of Slopes	SY	$ 0.63		LF	$ -		LF	$ -	80	LF	$ 10,080
G	Random Compacted Backfill	CY	$ 1.25		SF	$ -		SF	$ -	0	SF	$ -
H	Fill and Compact Fine Grained Buttress Material (over liner)	CY	$ 2.75		SF	$ -		SF	$ -	240	SF	$ 44,000
I	Fill and Compact Fine Grained Buttress Material (mass)	CY	$ 2.00		SF	$ -		SF	$ -	1120	SF	$ 149,333
J	Excavate Downstream Slope to 1:1	CY	$ 1.25		SF	$ -		SF	$ -	0	SF	$ -
K	RCC Section Downstream	CY	$ 45.00		SF	$ -		SF	$ -	0	SF	$ -
K.1	Cement (10% by weight)	TON	$ -		TON	$ -		TON	$ -	0	TON	$ -
L	Soil Cement Structure	CY	$ 35.00		SF	$ -		SF	$ -	0	SF	$ -
L.1	Cement (7% by weight)	TON	$ -		TON	$ -		TON	$ -	0	TON	$ -
	Non-Structural Embankment Fill	CY	$ 1.00		SF	$ -		SF	$ -	0	SF	$ -
	Upstream Diversion Structure (Stanley)	Lump	$ -		Lump	$ -		Lump	$ -		Lump	$ -
	Liner Materials	**UNIT**	**Estimated Unit Cost (2002)**									
M	80 mil HDPE, 20 oz. NW Geotextile Supply and Install (v)	SF	$ 2.00		LF	$ -		LF	$ -	15	LF	$ 54,000
	80 mil HDPE, 20 oz. NW Geotextile Supply and Install (h)	SF	$ 0.80		LF	$ -		LF	$ -	59	LF	$ 61,000
	CONSTRUCTION SUBTOTAL:					$ -			$ -			$ 463,413
	Environmental Mitigation	AC	$ 10,000.00		AC	$ -		AC	$ -	15	AC	$ 150,000
	Design and Construction Engineering	LS	15%			$ -			$ -			$ 69,512
	Construction Staking and As-Builts	LS	2%			$ -			$ -			$ 9,268
	Construction water & dust control	LS	1%			$ -			$ -			$ 4,634
	Construction inspection & testing	LS	5%			$ -			$ -			$ 23,171
	Mobilization	LS	3%			$ -			$ -			$ 13,902
	MOBILIZATION, PERMITS AND ENGINEERING SUBTOTAL:					$ -			$ -			$ 270,487
	CONTINGENCY		20%			$ -			$ -			$ 92,083
	TOTAL					$ -			$ -	Alternative 6		$ 826,583

Plates



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Legend

Notes

Revision	By	Appd.	MM.DD.YY

Issued	By	Appd.	MM.DD.YY

File Name: mrkn.dwg	bge	CG	MCD	05.27.03
	Dwn.	Chkd.	Dsgn.	MM.DD.YY

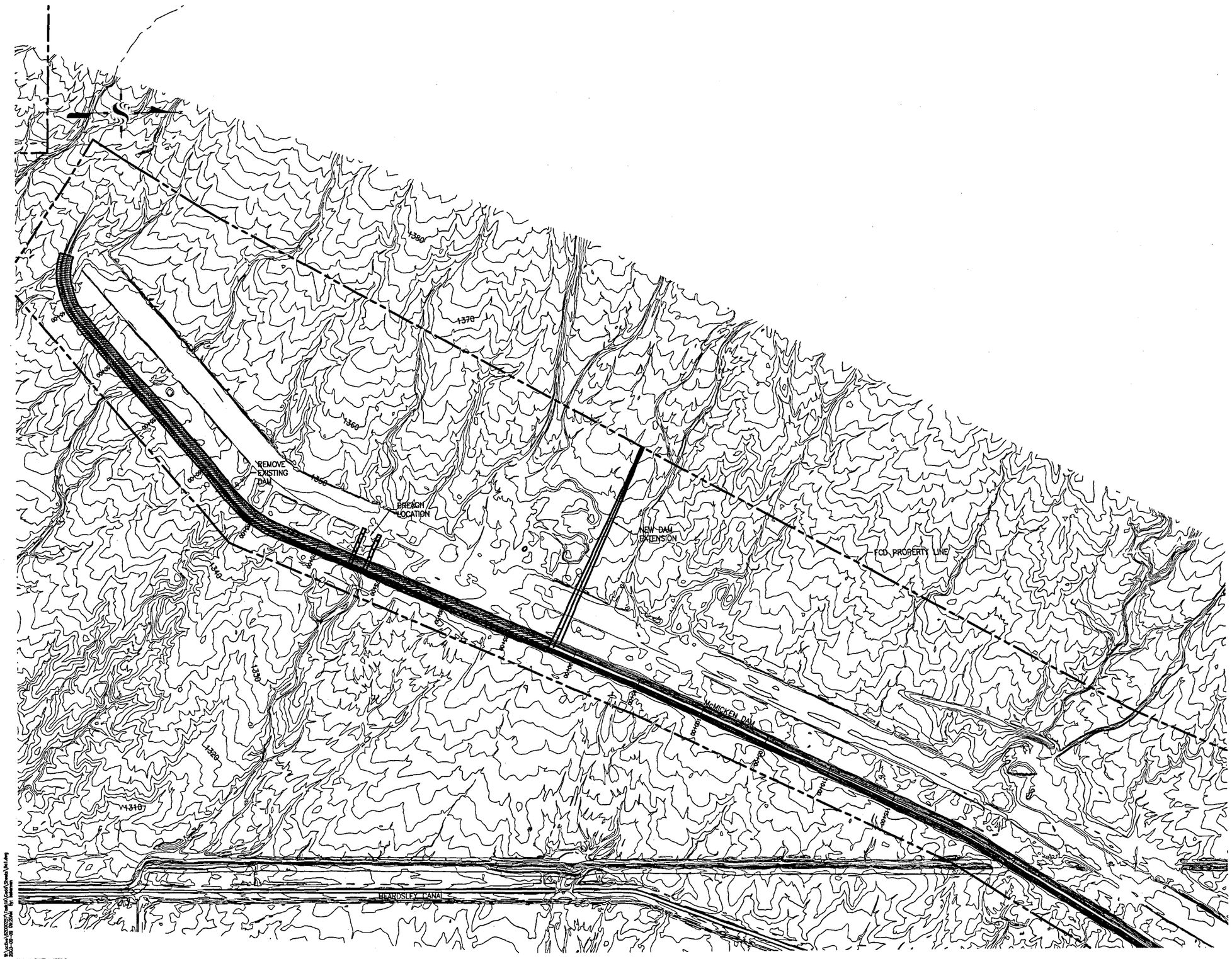
Permit-Seal

Client/Project
Flood Control District of Maricopa County

McMicken Dam FRZR
Task 1A

Title
Plate 1
McMicken Dam
Alternative Site Plan 6A-1

Project No.	Scale	
82000257	1"=300'	
Drawing No.	Sheet	Revision
	1 of 1	0



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Notes

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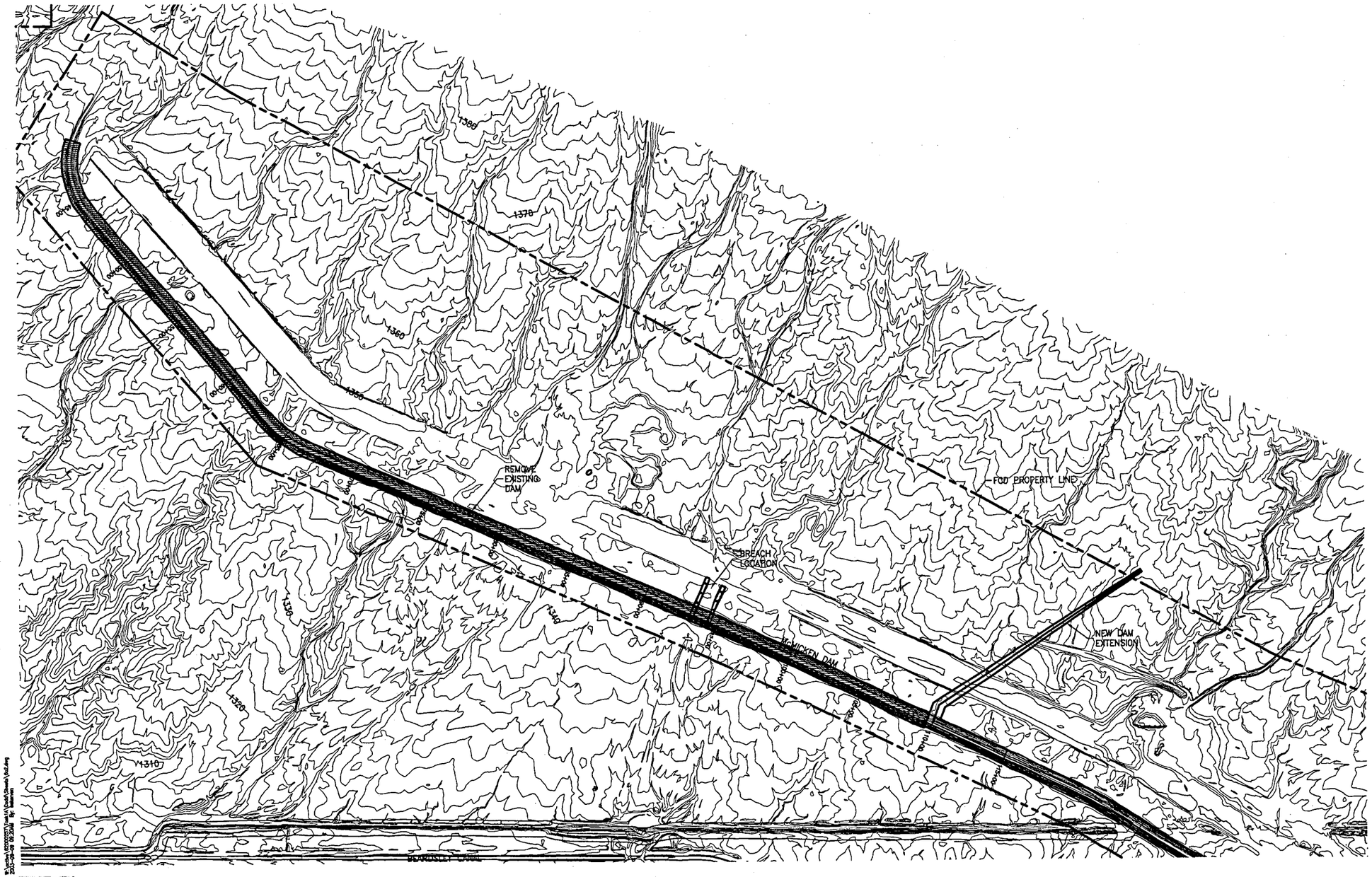
Permit-Seal

Client/Project
Flood Control District of Maricopa County

McMicken Dam FRZR
Task 1A

Title
Plate 2
McMicken Dam
Alternative Site Plan 6A-2

Project No.	Scale	
82000257	1"=300'	
Drawing No.	Sheet	Revision
	1 of 1	0



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Legend

Notes

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Permit-Seal

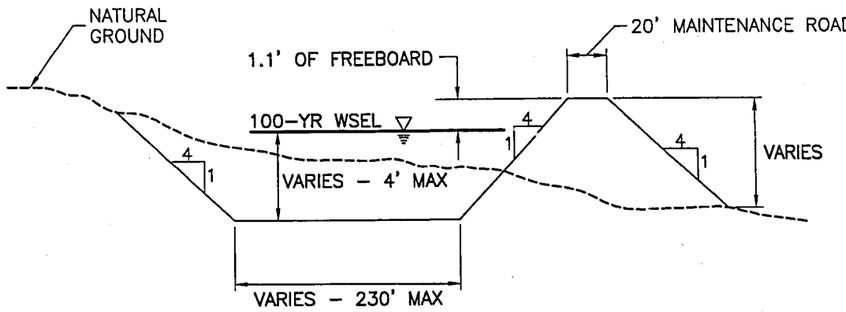
Client/Project
Flood Control District of Maricopa County

McMicken Dam FRZR
Task 1A

Title
Plate 3
McMicken Dam
Alternative Site Plan 6A-3

Project No.	Scale	
82000257	1"=300'	
Drawing No.	Sheet	Revision
	1 of 1	0

DIVERSION CHANNEL TYPICAL SECTION



NOT TO SCALE

Stantec Consulting Inc.
8211 South 48th Street
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85044
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Notes

Revision	By	Appd.	MM.DD.YY

Issued	By	Appd.	MM.DD.YY

File Name: mlisa.dwg	bge	CD	MCG	05.27.03
	Dsn.	Chkd.	Dept.	MM.DD.YY

Permit-Seal

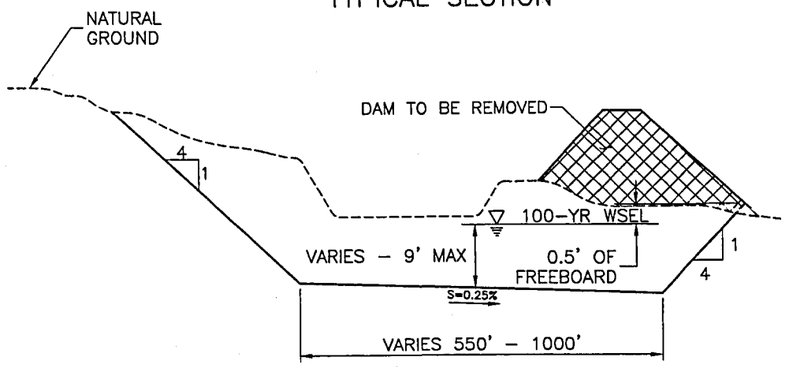
Client/Project
Flood Control District of Maricopa County

McMicken Dam FRZR
Task 1A

Title
Plate 4
McMicken Dam
Alternative Site Plan 6B

Project No.	Scale	
82000257	1"=300'	
Drawing No.	Sheet	Revision
	1 of 1	0

BASIN TYPICAL SECTION



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Notes

Revision	By	Appd.	MM.DD.YY

Issued	By	Appd.	MM.DD.YY

File Name: mike.dwg	bge	CC	MCG	05.27.03
	Dsn.	Chkd.	Dsgn.	MM.DD.YY

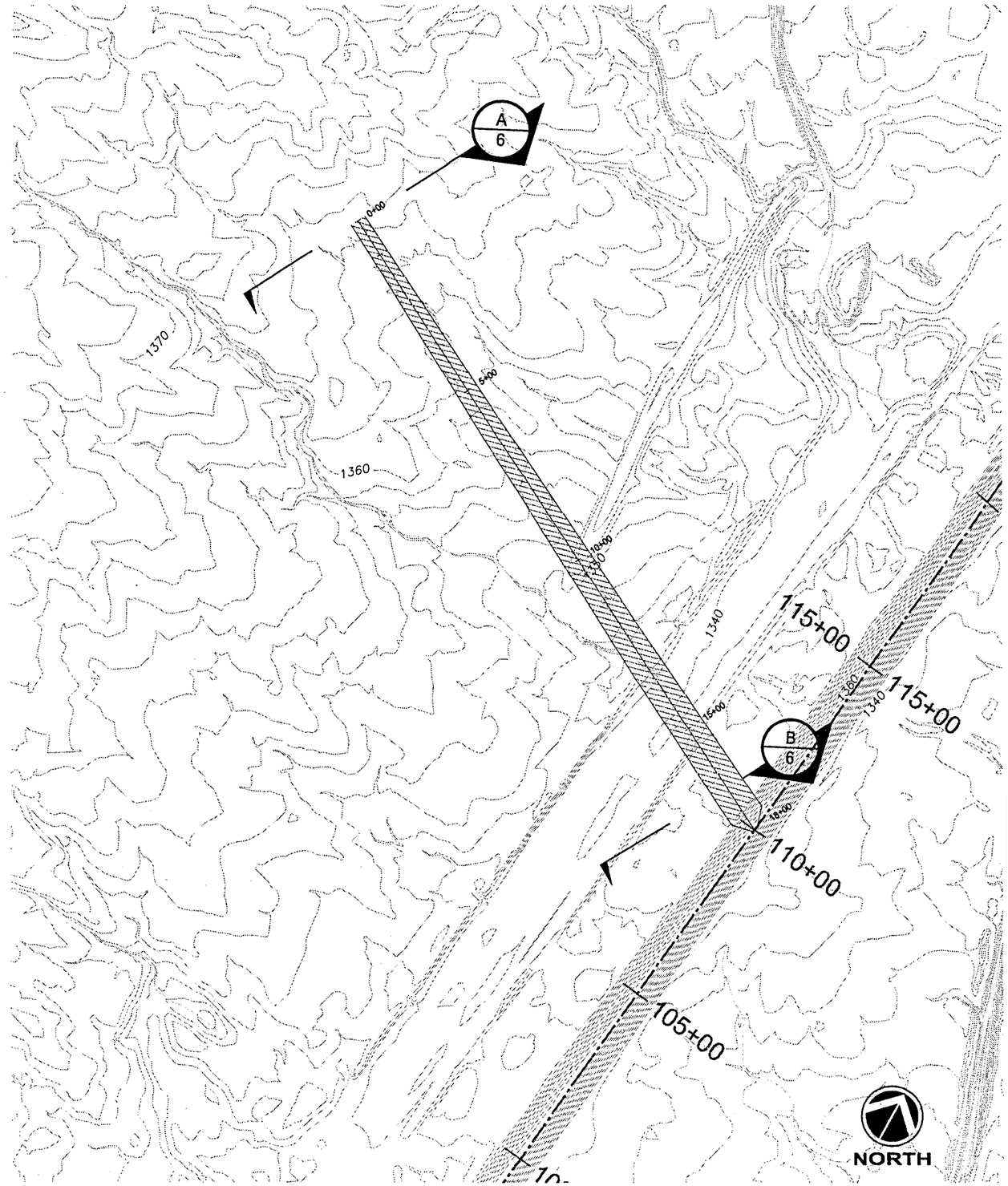
Permit-Seal

Client/Project
Flood Control District of Maricopa County

McMicken Dam FRZR
Task 1A

Title
Plate 5
McMicken Dam
Alternative Site Plan 6C

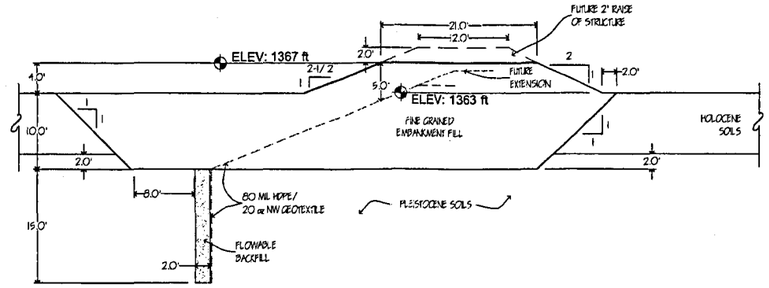
Project No.	Scale	
82000257	1"=300'	
Drawing No.	Sheet	Revision
	1 of 1	0



ALTERNATIVE 6

0 150 300 600

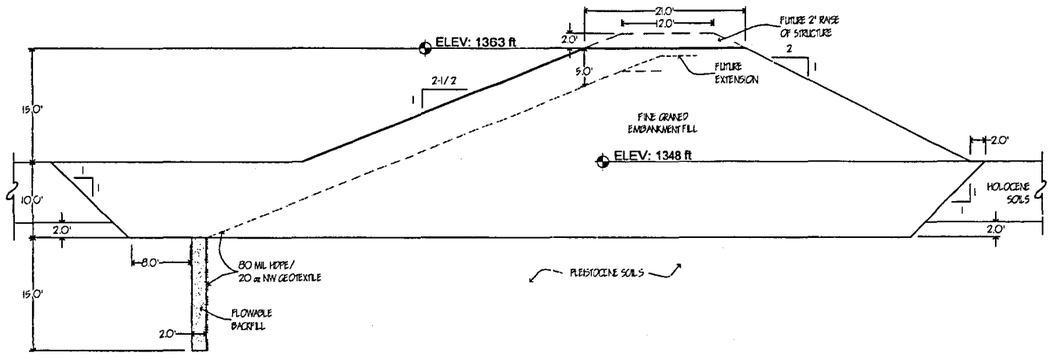
SCALE: 1" = 300'



SECTION A - STATION 0+00

0 10 20 40

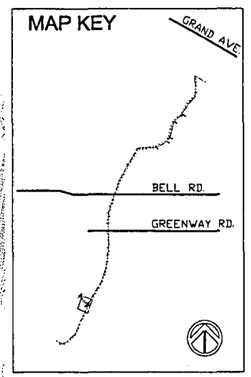
SCALE: 1" = 20'



SECTION B - STATION 16+80

0 10 20 40

SCALE: 1" = 20'



NOTE: Refer to Table 7 for cost estimates

JOB NO.	2-117-001066
DESIGN:	LAH
DRAWN:	GWH/EHS
DATE:	8/2003
SCALE:	AS SHOWN

ALTERNATIVE 6
DAM EXTENSION

McMICKEN DAM FRZR PROJECT
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2002CO11, WORK ASSIGNMENT NO. 1

PLATE 6

amec