BOARD OF SUPERVISORS AGENDA ITEM REPORT

Requested Board Meeting Date: May 18, 2021

Title: Regional Flood Control District Technical Policies

Introduction/Background:

In 2006, the Flood Control District (District) began using Technical Policies to clarify sections of the Floodplain Management Ordinance (Ordinance). These efforts were well received by consultants and permittees because they reduced regulatory uncertainty and ensured consistent interpretation of the regulations.

Discussion:

Changes to the Arizona Revised Statutes in 2015 limited the District's flexibility in revising Technical Policies. Since they are considered Substantive Policy Statements, they must now follow a process similar to a rulemaking. The District wishes to make updates to numerous Technical Policies and adopt three new policies. These revisions have gone through substantial stakeholder review including review by the development community, environmental community, and the Arizona Department of Water Resources. The District's Flood Control District Advisory Committee has reviewed the proposed revisions and have recommended approval.

Conclusion:

These proposed policies and revisions improve on the current versions to provide more options for compliance, to clarify ambiguous provisions of the Ordinance, and provide guidance to staff and the public to ensure consistent and equitable implementation for floodplain modeling and development.

Recommendation:

The District recommends that the Board of Directors approve the proposed revisions to the existing Technical Policies, and the adoption of three new Technical Policies.

Fiscal Impact:

N/A

Board of Supervisor District:

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☒ All

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Contact: Eric Shepp, Floodplain Administrator Telephone: 520-724-4610

Department Director Signature/Date: 4/23/21

Deputy County Administrator Signature/Date: 4/27/2021

County Administrator Signature/Date: 4/28/21

PIMA COUNTY
FLOOD CONTROL

MEMORANDUM

DATE: April 23, 2021

TO: C. H. Huckelberry
County Administrator

FROM: Suzanne Shields, P.E.
Director

SUBJECT: Regional Flood Control District Technical Policies Revisions

The Regional Flood Control District's (District) Technical Policies revisions have been in review and discussion for over a year with a large delay in progress due to the Big Horn Fire. The District recommends that the policies be approved by the Board of Supervisors acting as the Flood Control District Board of Directors (Board) so they can be used in floodplain permitting and flood hazard mapping. Although the policies are technically "guidance" policies, they still require Board approval.

There has been extensive stakeholder engagement throughout the process and comments have been received by many stakeholders representing the development community, environmental community, and the Arizona Department of Water Resources. The District exceeded their outreach effort, engaging directly with relevant stakeholders to ensure that their interests were heard and that responses were provided, with changes made as appropriate.

The rulemaking process includes posting a notice on the District's website with draft language, receiving and responding to comments in writing, and posting a final version on the website. All of this information including comments and District responses can be found at: https://webcms.pima.gov/government/flood_control/.

BACKGROUND

Beginning in 2006, the District began the use of Technical Policies to clarify ambiguities in the Floodplain Management Ordinance. These policies, considered Substantive Policy Statements, cover a wide and varied set of topics from construction standards and modeling parameters to implementation procedures and processes. The overall impact of the Technical Policies has been profound and include faster permitting timeframes, administrative efficiencies and clear direction to applicants and the public, which has reduced claims that the District is regulating in an arbitrary fashion. In fact, these Technical Policies have been well received by the community as they provide clear guidance that facilitates obtaining permits from the District. The construction details that are provided in some of the policies reduce soft costs, allowing for the permitting of improvements more quickly and inexpensively.

In 2015, the Arizona Legislature modified the statutes that govern flood control districts to consider Substantive Policy Statements that could be used as the basis for licensing decisions as rules, meaning that the Substantive Policy Statements have to follow a similar process as rulemaking. Since then, the District has not modified any existing Technical Policies or used new ones.

CURRENT AGENDA ITEM

This Board agenda item consists of revisions to numerous existing Technical Policies, as we well as the creation of three new Technical Policies. The vast majority of the changes are to provide additional clarification or to increase regulatory flexibility by providing more options for compliance. These changes were identified during implementation and underscore why changes to Substantive Policy Statements should be kept at the administrative level; they can evolve and adapt easily over time as new issues or information arises. There was considerable support amongst the stakeholders for approval of the changes to the existing policies.

Among the new Technical Policies, TECH-024, the policy regarding avoidance and minimization of the disturbance or regulated riparian habitat, generated the most stakeholder interest. The District realized that many stakeholders considered the District's riparian habitat regulations as primarily a habitat mitigation program, even though the regulations state that the District should review any project's effectiveness at avoiding and minimizing riparian habitat disturbance as the highest priority with the intent being to avoid the need for mitigation. As such, the District developed TECH-024 to establish guidelines regarding riparian habitat avoidance and minimization so that applicants could understand what effective avoidance and minimization means, and so District staff can consistently and equitably apply the guidance.

Please let me know if you have any questions or need additional information.

SS/tj

Attachments

c: Carmine DeBonis, Jr., Deputy County Administrator – Public Works
Eric Shepp, P.E., Deputy Director – Regional Flood Control District
Andy Dinauer, P.E., Deputy Director – Regional Flood Control District

2021 New and Revised RFCD Technical Policy Public Comments and District Response

Technical Policy Number(s)	Commenter Name	Commenter Organization	Comment	District Response
TECH 005	Brian Cosson	ADWR	Is there a distinction on how these types of development are regulated within a Regulatory Floodplain versus Floodway? Or are these types of development prohibited in a Floodway.	Section A deals with the construction of fences and walls in floodways. No revision was deemed necessary in response to this comment.
TECH 005	Mark Masek	Pima County Development Services	Placing rebar 4" o.c. at the bottom of a wall, would meet the intent of the code without regulating the 4" maximum height.	The District has revised the language of the policy and the relevant figure.
TECH 005	Brian Jones	RFCD	Reference needed to pool enclosure details	Addressed
TECH 005	Brian Jones	RFCD	Fence/wall permitting matrix needs to be updated to match policy revisions	
TECH 005	Brian Jones	RFCD	Policy conflicts with the fence matrix RE floodway and woven wire fences/solid walls	Floodway section of policy and matrix updated to resolve conflict regarding woven wire fence and walls over minor regulatory washes.
TECH 006, TECH 007, TECH 014	Brian Cosson	ADWR	For TECH 006-Tech-005 uses the term Regulatory Floodplain and this Tech Policy refers to the Floodway Fringe Area. Is there a difference? For TECH 007-Suggest keep the terms consistent unless there are distinctions between Regulatory Floodplain, Floodway Fringe and Regulatory Wash (See A3 and A4) For TECH 014-Refers to Floodway Fringe Area. See previous comments.	All references to the floodway fringe have been changed to regulatory floodplain
TECH007	Shawn Cote	SAHBA	With respect to A.4: "Is this prohibited? Or is it allowed IF Sealed scour and pier design is submitted by Engineer? (See Section B.1.b)"	It is correct that A.4 and B.1.b are contradictory. Language in B.1.b revised to match the intent of the policy, which is to categorically prohibit the use of piers within an erosion hazard area.
TECH 011	Brian Cosson	ADWR	There is a February 2020 FEMA Policy on Accessory Structures and Agricultural Structures. See attached. This FEMA policy will likely require changes in the State Model, especially when it comes to defining the low cost and size criteria FEMA is suggesting. Although I understand the rationale with not requiring a FPUP for accessory structures less than 200 square feet, FEMA does not have this same rationale. They expect all development to be reviewed for compliance. Consider still requiring a FPUP but not a building permit. I suspect we will need to talk this thru.	Response: This policy does not establish the 200 square foot standard, it merely clarifies the intent of the standard. Structures under 200 square feet are not exempt from compliance, merely from permitting. This exemption is provided in the Ordinance and changing the value to a lesser number would require a revision of the Ordinance. No revision was deemed necessary in response to this comment.
TECH 014	Shawn Cote	SAHBA	With respect to 3) "In my experience this can be argued however the scour depth will be deeper"	The Ordinance requires orientation parallel to flow, with some exceptions, including submittal and approval of an engineering analysis. Language revised to make it more clear that deviations from the policy are allowed but may require engineering analysis/design.
TECH 014	Shawn Cote	SAHBA	With respect to 6a) "Note: If the stem wall retains more than 4-ft, a structural review will be required"	Noted. The District always advises applicants that when the stem wall retains more than 4 feet that a structural engineer must design and seal the wall construction details. Language revised to make it more clear that DSD structural review will occur.
TECH 014	Shawn Cote	SAHBA	General comment: "Is an Engineering Analysis allowed for structures 40-ft or less is it results in more shallow scour protection than is required in Table 014?"	Yes. The use of Tech 014 is permissive (may be used), not mandatory (must be used). The policy provides off-the-shelf designs that applicants may use if desired. Applicants may provide engineering that designs adequate erosion protection. However, if an elevation method provided by Tech 014 is used, it must be used in its entirety as designed and presented in the policy. All but very minor modifications of the standard details would require an engineering analysis. Language revised to make it more clear that deviations from the policy are allowed but may require engineering analysis/design.
TECH 022	Brian Cosson	ADWR	Last paragraph, Page 1. Suggest not using the term "State Standards" because this can be misinterpreted as an actual State Standard that ADWR has adopted. Maybe replace "State Standards" with "ARS freeboard requirements"?	Revised as suggested.
TECH 022	Brian Cosson	ADWR	Page 2, II. (Flood Opening Use). Crawlspaces are another enclosed area that flood openings are commonly used.	Crawl spaces added to the types of enclosed spaces where flood openings are commonly used.

2021 New and Revised RFCD Technical Policy Public Comments and District Response

Technical Policy Number(s)	Commenter Name	Commenter Organization	Comment	District Response
TECH 022	Brian Cosson	ADWR	Page 4, B(2). Could this jeopardize the 1 square inch of opening for every square foot of enclosure or does PCRFCD already take these requirements into account when approving the plan set? If the latter, maybe make mention of this in the Tech Policy.	Section V.B.3 states that the area taken up by louvres must be subtracted from the total flood opening size. The District places the responsibility of calculating the open area of flood openings on the surveyor completing the Elevation Certificate. Revisions were made to Sections V and VI to clarify the surveyor/engineer responsbility.
TECH 022	FEMA Technical Bulletin 1	NFIP	Section 8.1 of NFIP Technical Bulletin 1 states: "Every enclosed area is required to have at least two flood openings on exterior walls. Flood openings should be installed in at least two sides of each enclosed area."	The District policy has been revised to include this language. See Section III.D of the policy.
TECH 022	FEMA Technical Bulletin 1	NFIP	Section 8.3.2 of NFIP Technical Bulletin 1 states: "The interior grade or floor along the lowest side of the building must be at or above the exterior grade across the entire length of the lowest side, and there must be positive surface drainage away from the building; otherwise, the enclosure will be considered a basement as defined by the NFIP. "	The District policy has been revised to include this language. See Section III.F of the policy.
TECH 024	Jonathan Lutz	Tucson Audubon Society	Under the “minimize” recommendations for each development type we suggest adding methods to reduce the spread of invasive species – techniques and avoidance suggestions. Specifically off-site soils, whether used as fill or on equipment used for the project, are a significant invasive species vector. Additionally, riparian habitats, due to their increased moisture levels, are particularly susceptible to rapid invasion and efforts to prevent incidental spread are from primary vectors are warranted.	The policy has been modified to address invasive species vectors.
TECH 024	Priscilla Storm	Diamond Ventures	On the surface, it seems like this is a change from the current process and expands and extends upon the current level of PCRFCD involvement and review in projects. Is this correct?	Partially correct. The District should be involved in processes that authorize new uses or entitlements on property for which the District regulations are applicable (e.g. regulatory floodplains, erosion hazard area, and regulated riparian habitat). Today, these processes occasionally but not consistently include the District. Perhaps that is why you think this new involvement. There have been incidences where uses or entitlements were authorized without District involvement, but, due to our code, intended uses were severely curtailed. The goal here is avoid those difficult situations where an applicant receives a no after a yes. There is time and money involved in all of that.
TECH 024	Priscilla Storm	Diamond Ventures	The industry now has certainty with the requirement to prepare a Riparian Mitigation Plan if greater than 1/3 of an acre is disturbed, showing avoidance, minimization, on-site, off-site and in lieu mitigation. If Technical Policy #024 were to be adopted as introduced, it seems to add significant uncertainty post rezoning approval, with multiple additional opportunities for PCRFCD to provide input and change what the property owner/developer must do to comply. And creates an open ended standard which at PCRFCD discretion, could replace the current procedures for a Riparian Mitigation Plan. Is this the intent, or a potential outcome?	Addressed: The language has been changed to reflect that the use of this policy will only be applied one time for a site at the upstream most part of the development process.
TECH 024	Priscilla Storm	Diamond Ventures	If, per our conversation, one of the primary goals of this policy is to encourage hydrology earlier in the land planning process, it would seem this policy should focus on Comp Plan and Rezoning Applications and not every incremental step in the process. Why is it necessary to have this Policy apply to rezoning time extensions, variances, special use permits, plat note waivers, etc. The perception is that PCRFCD can now weigh in and increase requirements at any point in the process up construction is initiated. This seems to add uncertainty for the Owner.	There is some value in identifying where a potentially more intensive use might be incompatible with the Floodplain Ordinance. Our continued involvement in these processes is to avoid an applicant getting the entitlement and then finding out that it can't be implemented. Language changed to remove time extension, which was an already authorized entitlement.

2021 New and Revised RFCD Technical Policy Public Comments and District Response

Technical Policy Number(s)	Commenter Name	Commenter Organization	Comment	District Response
TECH 024	Priscilla Storm	Diamond Ventures	Overall, the Policy uses the term 'riparian habitat' which I assume the draft policy intends to apply equally to IRAs as Xeroriparian D. Applying a higher than current standard across all classes of habitat, all sizes of projects and across all predevelopment steps pre-site disturbance is a concern, if that is what this will do. Given the concepts introduced in this Technical Policy, it would seem that limiting any final approved PCRFCD Technical Policy #-24 to Important Riparian Areas and Hydromesoriparian Areas and excluding Xeroriparian classes of regulated riparian habitat has merit, as does to applying this policy only to Comp Plan Amendments and initial Rezoning requests that come after the adoption of the Policy.	The Ordinance, as written, applies to all riparian habitat. QUESTION: Is there a way to add a justification that below a certain TVV (i.e.Xero D TVV) is justification, though mitigation would still be required. Added new Section F.13 for staff review.
TECH 024	Priscilla Storm	Diamond Ventures	In Section B., Tech Policy 24 begins with the statement…"Unless projects were subject to rezoning or other entitlement processes that utilized this policy, projects that are required to use the development review process shall follow the criteria listed below." I need some help quantifying the potential impact on our entitled land if Tech Policy 24 is adopted in the current draft.	The current language applyies this Policy at the time of platting or development plan if the policy was not applied at the time of rezoning. Section B has been modified to exempt application of this policy for Specific Plans approved prior to the adoption of the policy.
TECH 024	Priscilla Storm	Diamond Ventures	Section C. 2. And C.3. I would ask you to consider that Tech 24 Policy only apply to New Major Comp Plan Amendments and not Minor Comp Plan Amendments and New Applications for Rezoning or Specific Plans and not Modifications of Conditions of Zoning or Modifications of Conditions of Specific Plan Approval.	Language revised to strike applicability to modifications to rezoning conditions and to specific plan conditions.
TECH 024	Chris Poirier	Pima County Development Services	In the Purpose Section: "Consider that the ORDINANCE is the regulatory document and policy should only provide clarification thereof. This document in its current state is a substantive change to the ORDIANCE that undisputedly allows for disturbance. This document can be written to provide guidance to minimize arguments, but the "We start with a NO and you can try to work us down," approach is not reasonable. If you wish to start with the NO, then I strongly advise you to tackle the ORDIANCE."	Section 16.30.040.A.1 states, "A. Submittals. Permit applications shall include: 1. Evidence that *no reasonably practicable alternative exists to the proposed impact* on mapped habitat and evidence that the impact has been minimized to the maximum extent practicable." [emphasis added] Section 16.30.040.B of the Ordinance states, "Conditions may be placed on the permit that, to the extent reasonably practicable, require *preservation of* , or mitigate the impact on, riparian habitat. If mitigation is required, compliance with an approved habitat mitigation plan shall be made a condition of the permit. [emphasis added] Further, Section 16.30.050.A states, "If an applicant demonstrates to the satisfaction of the District that alteration of regulated riparian habitat areas cannot reasonably be avoided, a mitigation plan shall be submitted to the District . . ." Further, 16.30.060 Review process. states, "The application and any proposed mitigation plan shall be evaluated by their effectiveness in: A. Avoiding the impact; B. Minimizing the impact; C. Rectifying the impact; D. Reducing or eliminating the impact over time; and E. Compensating for the impact" These provisions of the Ordinance make it clear that avoidance of disturbance is the first and highest priority, and mitigation is a subsequent requirement when avoidance is not reasonable. No revision was deemed necessary in response to this comment.
TECH 024	Chris Poirier	Pima County Development Services	Background paragraph 2: "I have witnessed many successful riparian mitigation plans get approved by the BOS and successfully administered by RFCD. Do you have quantifiable data that this is an unsuccessful program? What is the problem being addressed?"	Chapter 16.30 is a riparian habitat <u>protection</u> ordinance, and mitigation is the last resort. While the mitigation requirements work well, avoiding the disturbance in the first place hasn't been as effective as it could be. Applicants try to use a wide array of reasons why avoidance of regulated riparian habitat is not reasonably practicable, yet no standard exists in the Ordinance for what is reasonably practicable. The purpose of this policy is to provide direction on this matter. No revision was deemed necessary in response to this comment.

2021 New and Revised RFCD Technical Policy Public Comments and District Response

Technical Policy Number(s)	Commenter Name	Commenter Organization	Comment	District Response
TECH 024	Chris Poirier	Pima County Development Services	Background paragraph 3: "Prospers need to be considered holistically. It is full of policies that support the continuation of the CLS. The IRA element of the CLS has forever allowed mitigation. CLS rules have been expanded to allow for off-site mitigation. This effort to effectively eliminate or severely limit riparian disturbance will negatively impact goals of the CLS. Additionally, it limits the overall efficient use of land outside CLS protections. Prospers pushes for lot yields and densities where appropriate (under current rules). Even 4.9 Element includes GOALS 2 & 3 (note the protection of uplands and healthy development patterns). Goals 2 & 3 support minimizing impacts but clearly recognize a balance. This effort removes any balance."	Pima Prospers contains the following statements: "Important Riparian Areas are critical elements of the Sonoran Desert where biological diversity is at its highest. These areas are valued for their higher water availability, vegetation density, and biological productivity. They are also the backbone to preserving landscape connectivity." Under Conservation Guidelines, Policy 3.b states, "b. Every effort should be made to protect, restore and enhance the structure and functions of IRA, including their hydrological, geomorphological and biological functions;" These statements are interpreted to mean that Regulated Riparian Habitat is the highest value habitat and thus is the highest priority for protection by avoidance. Furthermore, there is a presumed flood hazard associated with riparian habitat, compounding the primacy of riparian habitat protection. No revision was deemed necessary in response to this comment.
TECH 024	Chris Poirier	Pima County Development Services	If you could consider more clarity of historic disturbance? We are trying to push redevelopment hard, so any alignment with that concept would be helpful and mutually beneficial (allow development here, less pressure on virgin desert elsewhere)	Added language in support of redevelopment and infill projects within RRH areas disturbed prior to the effective date of the maps
TECH 024	Chris Poirier	Pima County Development Services	Section F, paragraph 1: "If these are worth publishing then why shouldn't they eliminate a requirement? This statement needs to be flipped around. If the following are met then WE WILL ACCEPT disturbance. In its current format it appears disingenuous. "	The intent of this paragraph is to state that there are justifiable reasons for disturbing regulated riparian habitat, but those justifications do not eliminate the requirement for mitigation when more than 1/3 of an acre of habitat is disturbed. This is a requirement of the Ordinance. Language amended to clarify.
TECH 024	Chris Poirier	Pima County Development Services	Section F, final paragraph: "Lot yields matter. Prospers introduced minimum RACs. Aesthetics matter. There is a public process where neighbors have a statutory right to participate in. Conflicts with requirements matter. Personal preference matters. Someone is seeking to develop a property with a vision. It should not be immediately discounted. "	Addressed: This language has been removed from the policy.
TECH 024	Chris Poirier	Pima County Development Services	Section G: "Significant rule changes should occur with an ordinance. RFCD is a partner of the process, and all departments need to balance our goals and objectives when evaluating land use requests. This pre-empts meaningful and collaborative design. When approached by any level of development it's easy to start with a "stay out of the flood way and stay out of (or mitigate) erosion hazard setbacks. " This now places riparian areas almost on the same level. The public process needs to drive the design. Please also consider the CLS and NPPP code requirements that this document will negatively impact. "	The District maintains that this is a clarification of Chapter 16.30 of the Ordinance regarding riparian habitat protection. The first priority of first avoiding riparian habitat has not be adequately applied due to the lack of clarity. The CLS and NPPP all consider riparian habitat protection as the first priority.
TECH 024	Shawn Cote	SAHBA	In Purpose section: If changing the rules, should be done during the planning stage.	This is not a new rule, but will add planning and keep permitting in the language.
TECH 024	Shawn Cote	SAHBA	In Background section: Change "is" to "may be"	Accepted
TECH 024	Shawn Cote	SAHBA	In Background section: Add "along with other factors"	Accepted
TECH 024	Shawn Cote	SAHBA	In Policy Section, first paragaph: Various suggested language changes	Accepted with the exception that the word "public" was left in the text because the public has a right to be involved in entitlement processes.
TECH 024	Shawn Cote	SAHBA	Definitions 2: Language change to add "for single lot development"	Addressed: This definition is not intended to include single-lot permits. A new definition is provided to cover single-lot development
TECH 024	Shawn Cote	SAHBA	Definitions 3: Language change to limit the actions considered in the scope of "Entitlement review"	Not accepted: One of the goals of this policy is to make sure RH disturbance is considered as part of any of the processes noted in the language, though not more than one for the same site.
TECH 024	Shawn Cote	SAHBA	Section A.1.: language change from "shall" to "should"	Response: Shall with the justified language is the same as should.
TECH 024	Shawn Cote	SAHBA	Section A.1.: Question about where the construction staging area would be documented.	Addressed: Revised wording to provide more detail.
TECH 024	Shawn Cote	SAHBA	Section A.1.: language change	Response: Shall with the justified language is the same as should.
TECH 024	Shawn Cote	SAHBA	Section B: language change	Addressed: Revised language to clarify that this policy will not be applied when this policy has already been applied for the same site under a previous process.

2021 New and Revised RFCD Technical Policy Public Comments and District Response

Technical Policy Number(s)	Commenter Name	Commenter Organization	Comment	District Response
TECH 024	Shawn Cote	SAHBA	Section B.1: language change	Response: "Shall" with the justified language is the same as should.
TECH 024	Shawn Cote	SAHBA	Section B.1.a: language change	Addressed: language revised in the spirit of the proposed language change, including adding "pursuant to 18.07.080" instead of quoting 18.07.080.
TECH 024	Shawn Cote	SAHBA	Section B.1.b: language change	Addressed: language revised in the spirit of the proposed language change, including adding "pursuant to 18.07.080" instead of quoting 18.07.080.
TECH 024	Shawn Cote	SAHBA	Section B.1.c and d: language change	Not accepted. The requirement of the Ordinance is to avoid/mitigate distrubance of all habitat.
TECH 024	Shawn Cote	SAHBA	Section B.1.e: language change	Accepted
TECH 024	Shawn Cote	SAHBA	Section B.2: language change	Not accepted. The requirement of the Ordinance is to avoid all habitat.
TECH 024	Shawn Cote	SAHBA	Section C.1: language change	Addressed. The spirit of the requested changes has been incorporated into the revised language.
TECH 024	Shawn Cote	SAHBA	Section C.2: language change	Accepted change to include specific project types. Rejected change limiting habitat type. The Ordinance and the policy applies to all habitat types.
TECH 024	Shawn Cote	SAHBA	Section C.3: language change	Accepted change to include specific project types. Rejected change limiting habitat type. The Ordinance and the policy applies to all habitat types.
TECH 024	Shawn Cote	SAHBA	Section C.2-5: language change and comment about review of projects that have already been looked at under another process.	Revised language in Section B to say that this policy will not apply to processes already started when policy is approved, but may be applied to downstream processes when this policy was not previously considered. Rejected language changes limiting scope to only certain types of regulatory riparian habitat. The Ordinance requires avoidance/mitigation of all regulated riparian habitat.
TECH 024	Shawn Cote	SAHBA	Section C.5: recommended striking this item	Not accepted. The District notes that this is authority the District wants to preserve. Note that the language says "may" not "shall".
TECH 024	Shawn Cote	SAHBA	Section E: requested complete removal of this section	Not accepted. When these uses increase disturbance the District wants to weigh in.
TECH 024	Shawn Cote	SAHBA	Section F, first paragraph	Not accepted. Justification for disturbance doesn't eliminate the rquirement for mitigation
TECH 024	Shawn Cote	SAHBA	Section F.1	Accepted
TECH 024	Shawn Cote	SAHBA	Section F.3: request to strike in its entirety.	Kept concept but revised language to address the comment. "The purpose of the proposed improvement relative to existing improvements and uses. For example, a detached garage may be more appropriate to keep near an SFR than a barn."
TECH 024	Shawn Cote	SAHBA	Section F.4	Addressed: Added language to allow disturbance in areas that remain disturbed with no habitat regrowth.
TECH 024	Shawn Cote	SAHBA	Section F.7	Accepted with the exception of "or other"
TECH 024	Shawn Cote	SAHBA	Section F.8	Accept strike-out, revise language to make it more clear that it refers to disturbance in the access, not the buildable area.
TECH 024	Shawn Cote	SAHBA	Section F.11	Accepted: Removed "on a case by case basis."
TECH 024	Shawn Cote	SAHBA	Section F.12 (new F.12 proposed)	Not accepted. There is an existing process to correct the maps.
TECH 024	Shawn Cote	SAHBA	Section F.13 (new list item proposed as F.13)	Accepted
TECH 024	Shawn Cote	SAHBA	Paragraph after F.13	Addressed: This paragraph has been removed.
TECH 024	Shawn Cote	SAHBA	Section G	Not accepted. The point of this section is to assist property owners in not reaching the threshold at which mitigation is required.
TECH 024	Shawn Cote	SAHBA	Letter comment #1: Any proposed expansion or increased costs associated with Tech Policy #024 must be considered against other community priorities including facilitating economic development, promoting infill development, and encouraging homeownership.	Response: This policy a clarification of the rules, not an expansion of the rules. The goal is for better site planning to allow for the desired economic development while effectively avoiding/minimizing disturbance to riparian habitat.

2021 New and Revised RFCD Technical Policy Public Comments and District Response

Technical Policy Number(s)	Commenter Name	Commenter Organization	Comment	District Response
TECH 024	Shawn Cote	SAHBA	Letter comment #2: As a Guideline, the Policy should be drafted for guidance, not regulation, i.e. the “shalls” should be replaced with “should” or “may”.	Response: Stating "shall, unless justified," equals should.
TECH 024	Shawn Cote	SAHBA	Letter comment #3: The Policy should be implemented only at the time of Plan Amendments and Rezoning Applications and not applied at any other stage of the development process.	Response: The purpose of the policy is to apply the rules at any stage of development, but not more than one.
TECH 024	Shawn Cote	SAHBA	Letter comment #4: The Policy should focus on the most biologically resource intense Important Riparian Areas and Hydromesoriparian Areas and not be applicable to Xeroriparian Areas and uplands outside of the floodways.	Response: The Ordinance requires protection of all habitat.
TECH 024	Shawn Cote	SAHBA	Letter comment #5: Avoidance of regulated riparian areas is a consideration in land planning, but it is not always the sole priority. The policy should be rewritten to include and acknowledge the other variables that must be taken into consideration, including private property rights and taxpayer land use preferences.	Response: We agree it's not the sole priority. The goal is to establish performance standard for what avoidance means in the Ordinance, which has previously been unclear.
TECH 026	Brian Cosson	ADWR	Top of Page 3, Letter A, first paragraph. Add “elevation” after “regulatory flood”	Revised as suggested.
TECH 026	Brian Jones	RFCD	C.2 refers only to the 2019 revision of the western portion of the Lee Moore watershed, not to the2018 revision to the eastern portion	Language revised to refer to the 2018 study
TECH 108	Brian Cosson	ADWR	Bottom of Page 2 first paragraph. Suggest adding commercial structures.	Revised as suggested.
TECH 108	Brian Cosson	ADWR	Page 3, second to last paragraph. Not sure what “the common wall between the existing structure and the proposed addition may be substantially modified”	Requested clarification on this comment. Upon discussion, ADWR understands what the policy language intends and has no issue with the language as originally proposed.
TECH 108	Brian Cosson	ADWR	Page 4, 1.2.1 suggest adding ”3 foot opening” in front of the word "doorway:.	Revised to say "three foot maximum width opening doorway"
TECH 108	Brian Cosson	ADWR	Tech Policy 022 is titled Flood Openings. This Tech Policy mentions flood vents. Might want to keep the terminology consistent.	Revised as suggested except where the change would lead to awkward wording, i.e. "the garage may be flood-opened" is awkward compared to "the garage may be flood-vented"
TECH 108	Brian Jones	RFCD	The District historically has not included attached porches and similar improvements as part of the 50% rule in shallow sheetflow floodplains.	Revised language in Section 2.3 to exempt attached porches and similar improvements from the 50% rule in shallow sheetflow floodplains.
TECH 108	Brian Jones	RFCD	The District learned that a "Determination of Eligibility" for historical structures has essentially the same restrictions and protections as a fully designated historical structure, the later of which is a time-consuming and expensive process. Suggest allowing a Determination of Eligibility as acceptable documenation for historical structure exemption from nonconforming use rules	Updated Section 1.2.3 to include Determination of Eligibility
TECH 108	Brian Jones	RFCD	DSD is implementing a new SolarAPP permit application process. Language should be revised to address agreement with DSD.	Section 2.1.1 edited to address SolarAPP process.
TECH 108	Brian Jones	RFCD	Reference to 16.26.060 in Section 3.3.1 should be to 16.12.060	Fixed
No comments were receieved for TECH 015, 018 or 110				
Latest revision of this public comment response document on 1/28/2021.				

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT
TECHNICAL POLICY

POLICY NO.: Technical Policy, TECH-005 **EFFECTIVE DATE: November 5, 2007**
REVISED: 5/18/21

POLICY TITLE: Construction Standards for Fences and Walls within Regulatory Floodplains

PURPOSE: To clarify 16.20.020.C.5 by establishing guidelines regarding the design and construction of fencing and walls that may be approvable without providing an engineering study demonstrating no adverse impact (i.e. encroachment criteria have been met).

BACKGROUND:

Due to the typical amount of area enclosed and location on or near property boundaries, fences (wire, wrought iron, woven wire, chain-link, wood, sheet steel, etc.) and walls (masonry, block, etc.), hereafter collectively called fences/walls, have the potential to significantly impact flood flows to the adverse impact of adjacent properties and the floodplain in general. In addition to their impact to floodplains, the structural failure of fences/walls not designed to pass floods or withstand flood forces have caused structures to flood that otherwise may not have flooded. Floodplain Management Ordinance provision 16.20.020.C states that an applicant proposing new development may be required to provide an engineering report prepared by an Arizona-registered civil engineer outlining the effects that the development will have on the flow of flood waters through the area being developed and through surrounding areas. If an engineering study reasonably demonstrates that there is no adverse impact (i.e. meets encroachment criteria), a Floodplain Use Permit (FPUP) may be issued for the new development. In many cases, fences and walls can be reasonably assured to have a negligible impact on flood waters through the use of certain construction and design standards without the need for an engineering analysis.

An FPUP is required for construction of any fence/wall within a regulatory floodplain in order to ensure compliance with the Ordinance. Depending on the nature of the flood hazard at the site and the proposed characteristics of the fence/wall, the District may accept certain fence/wall configurations without requiring an engineering study. As a basic starting point, the fence/wall types allowed for each flood hazard area can be found on the attached table titled: *FLOODPLAIN MANAGEMENT PRACTICES FOR FENCES / WALLS*.

In 2020, this policy was revised to add additional clarity, consistency and address rule changes or clarifications from local, state and federal agencies. New sections were added related to floodways, pool enclosures and wrought iron fences.

POLICY:

As a matter of good floodplain management practices, it is *preferable* that all fences and walls within floodprone areas be elevated at or above the Base Flood Elevation (BFE). The minimum standard is that fences/walls may not adversely impact adjacent properties. This policy dictates when elevating or creating openings in a fence or wall is required and also establishes when the standard design criteria presented in this policy may be used in lieu of an engineering analysis or an engineered design. The allowed fence/wall configurations are summarized for each type of flood hazard area on the attached Table titled: *FLOODPLAIN MANAGEMENT PRACTICES FOR FENCES / WALLS*, effective January 13, 1994, and revised December 11, 2018. Designs that meet the standards outlined below may be approved by the District without an engineering study unless uncertain, unusual, or high hazard conditions exist.

Fences and walls within regulatory Flow Corridors are further subject to the provisions of *Technical Policy 026: Regulation of Single-Lot Development within Flow Corridors*, which modifies some of the requirements within this policy.

A. Fences/Walls within Floodways

The FEMA guidance document titled *Certification Requirements for Simple Floodway Encroachments* states, ". . . nothing that offers any resistance to the flow of floodwaters may be placed in a regulatory floodway unless compensatory action is taken to restore the lost conveyance." As such:

1. Walls and solid fences are not allowed in a floodway
2. Open, pipe rail, wrought iron and woven wire fence are allowed over the channel of a minor regulatory watercourse when constructed as detailed in B.6 and Figure 005-1.
3. Except as provided in A.3, any fence or wall proposed within a floodway area must:
    a. meet the requirements in Sections B through J of this policy, and
    b. be justified by an engineering analysis prepared by an Arizona registered civil engineer that:
        i. Addresses debris loading on the fence/wall, and
        ii. Addresses compensatory conveyance of flood flows, and
        iii. Demonstrates that the improvements cause no rise in the base flood elevation.
4. The Ordinance establishes that the primary channel of any regulatory watercourse is considered to be a floodway, however the District may waive the requirements above when all of the following conditions are met:
    a. Sections B through J of this policy are met,
    b. the floodway is designated such solely under Section 16.08.350.C of the Ordinance, expressly that the floodway is the primary channel of a minor regulatory watercourse with a discharge less than 2,000 cfs, and
    c. the portion of the fence within the channel is solely 3 or 4 strand barbed or barbless wire.

B. All Fences/Walls

The requirements in this section apply to all fences and walls.

1. The FPUP application must be accompanied by a site plan of the property, to a measurable scale, which meets all of the requirements of 16.20.020, including showing all existing and proposed development, existing and proposed grading, topography, and floodplain/erosion hazard setback delineations.
2. The site plan must also show the proposed fence/wall location in relation to the property boundaries, as well as a dimensioned elevation view detail showing the height of the bottom of the fence/wall above natural grade and/or flood openings or a reference to one of the standard details in this Policy, if applicable. The site plan must indicate the location and size of any required flood openings, and demonstrate that these flood openings are aligned with similar flood openings on adjacent properties (if existing).
3. Approval of the FPUP shall require the signing of a covenant stipulating that all flood openings will be kept free of debris at all times and remain open for the passage of floodwaters and/or that fences/walls will be elevated and kept free of debris, as applicable. The property owner must also acknowledge that if the fence/wall poses a flood hazard at any time in the future, the fence/wall shall be modified at the owner's expense to eliminate the hazard.
4. Fences/walls that are intended to contain livestock are not allowed in the channel of a regulatory wash.
5. Single strands of wire may be placed below the bottom of a fence/wall at six inch intervals, except within the channel of a regulatory wash.
    a. The lowest strand shall be at least six inches above natural grade (natural grade is not to be altered).
    b. The highest strand shall be at least six inches below the bottom of the fence.

    c. For example, if the fence is elevated one foot above grade, a single strand is allowed below the bottom of the fence. One additional strand is allowed for each additional 6 inches that the fence is elevated.
6. For any type of fence other than a fence that meets the definition of open fencing in Section D, if the fence is across a regulatory wash, the bottom of the fence shall be elevated at or above the Base Flood Elevation (BFE). In floodplains such as sheetflow floodplains where the BFE is a depth of flow, the point of measurement for the bottom of the fence across the channel shall be the highest bank of the wash (see Figure 005-1).
    a. Vertical support posts are not allowed within the channel.
    b. Nothing is allowed below the bottom of the fence within the channel, except as provided in B.7 and B.8.
7. Trash racks or any kind of mesh screening are not allowed within the channel of a regulatory wash unless the following conditions are met:
    a. The trash rack or screening is offset at least 25 feet from any property boundary for washes with a base flood discharge of less than 2000 cubic feet per second (cfs),
    b. The trash rack or screening is offset at least 50 feet from any property boundary for washes with a base flood discharge of 2000 cfs to less than 5000 cfs,
    c. Trash racks or screens are not allowed on washes with a discharge of 5000 cfs or more.
8. Flap gates, flip gates, or similar type designs are prohibited within regulatory washes unless a design by an Arizona registered civil engineer is approved by the District. Flap gates are commonly desired as a solution to allow the passage of floodwaters while preventing unwanted entry of wildlife or exit of domestic pets through the open space required by this policy. However, they often fail to perform as intended and as a result, divert, obstruct or retard flow.
9. Natural flow paths must be preserved and design considerations must be made to accommodate flow based on the type of fence/wall being constructed.
10. The requirements of Technical Policy 026 shall be applied to fences and walls within Flow Corridors.

C. Special Considerations for Pool Enclosures

For below-ground pools and above-ground pools less than four feet tall, Building Code safety requirements dictate that pool barriers are required and that the barrier shall not allow the passage of a 4-inch diameter sphere. This often conflicts with District requirements for opening sizes. In addition, the pool code requires the bottom of a pool enclosure fence to be no more than two inches above grade when grade is earth, as opposed to a hardscape surface such as block or concrete. The bottom of a pool enclosure may be four inches above grade when grade is hardscaped, such as concrete. However, when properly spaced rebar is placed in wall openings, the top of a wall opening may be more than four inches above grade when grade is a hardscape surface. Pool safety guidelines also restrict the use of horizontal bars since they may be used as steps to scale the fence/wall. When a pool enclosure is proposed within a regulatory floodplain and this policy requires that flood openings or elevating the bottom of the fence are necessary, the following shall apply (see also Figure 005-3):

1. When a solid fence or block wall with openings is acceptable and the District determines that the top of flood openings must be higher than four inches above grade, the standard details for the wall openings shall be modified as follows.
    a. Openings shall be constructed with rebar placed in the openings.
    b. The rebar shall be oriented vertically so as to not offer a step to get over the wall.
    c. The rebar shall be spaced four inches apart, on center.
    d. The District may require more openings or larger openings in order to compensate for the less than optimal rebar orientation and spacing.
2. When a block wall is acceptable and the District determines that the top of the flood openings are allowed to be four inches above grade, the top of the opening shall be exactly four inches above natural grade in order to keep the bottom of the fence as high as possible within the limits of the pool safety requirements.
    a. As a result, the area below the fence must be hardscape and cannot be dirt or loose rock.

b. A concrete footer, block, or concrete slab is acceptable under the fence to meet the 4 inch opening requirement. It is recommended that applicants verify the acceptability of any other materials with Development Services.
c. The District may restrict the use of rebar or other materials within the flood openings.
d. The District may require more openings or larger openings in order to compensate for the less than optimal flood opening size.

3. The District may require an alteration of the size or configuration of the fence to offset the reduced capacity to pass flows through the fence/wall caused by the pool enclosure safety requirements.
4. The District may require flow-through fencing or wrought iron to be used in lieu of a solid fence or block wall.

D. Open Fences

Open fences, which includes most pipe rail fences and 3 or 4 strand barbed/barbless wire fences, are subject to District approval and are generally considered to be the preferred fencing type within a floodplain. To qualify as open fencing, the fencing cannot occupy more than 10% of the flow area obstructed by the fence. With respect to open fences, the following standards must be met:

1. Meets the provisions of Sections A and B of this policy.
2. Fence posts or vertical wires or stays shall be placed no closer than 6 feet apart for stranded wire fence
3. Fence posts shall be placed no closer than 8 feet apart for pipe rail type fence
4. Fence posts may not be placed in the primary channel of a regulatory wash
5. Not allowed in the primary channel if the purpose of the fence is to contain livestock
6. All fencing across the channel of a major regulatory watercourse (having a base flood discharge of 2,000 cfs or greater) must be supported by an engineering analysis as detailed in Section A of this policy.
7. The only fencing type allowed across the channel of a minor regulatory watercourse (having a base flood discharge of less than 2,000 cfs) is 3 or 4 strand barbed or barbless wire. All other provisions of this Section must be met.

An engineering analysis demonstrating no adverse impact may be provided to the District for approval in lieu of meeting the standards above.

E. Wrought Iron Fences

Wrought iron fences are subject to District approval. Since the bars of wrought iron fences are typically in a vertical orientation, they are prone to catching debris carried by floodwaters. In terms of the degree of floodplain impact, wrought iron fences are in between open fences and woven wire fences. In order to construct a wrought iron fence, the following standards must be met:

1. Meet the provisions of Sections A and B of this policy.
2. Elevate the bottom of the wrought iron fence at or above the BFE, **or**
3. If not elevated at or above the BFE, setbacks from property lines for wrought iron fence aligned perpendicular to the direction of flow are as follows:
    a. At least 5 feet where flow depths are 1 foot or less
    b. At least 10 feet where flow depths are greater than 1 foot but less than 3 feet.
    c. At least 15 feet where low depths are 3 feet or greater.
4. If not elevated at or above the BFE, setbacks from property lines for wrought iron fence aligned parallel to the direction of flow are as follows:
    a. Zero (0) feet where flow depths are 1 foot or less
    b. At least 5 feet where flow depths are greater than 1 foot but less than 3 feet.
    c. At least 10 feet where flow depths are 3 feet or greater.
5. Any portion of a wrought iron fence not meeting the above setback requirements shall be elevated such that the lowest part of the fence is elevated at or above the BFE.

An engineering analysis demonstrating no adverse impact may be provided to the District for approval in lieu of meeting the standards above.

F. Woven Wire Fences

Woven wire fence, which includes chain-link fence, field fence, and chicken wire fence, are subject to District approval and can be deceptively hazardous in floodplains. While they are not solid obstructions to flow like a wall, they easily catch debris carried by floodwaters. As such they may divert and obstruct flow just like a wall. Hydrodynamic pressure on the trapped debris also applies forces to fences that they are not designed to withstand, causing them to fail in a hazardous manner. In order to construct a woven wire fence, the following standards must be met:

1. Meet the provisions of Sections A and B of this policy.
2. Elevate the bottom of the woven wire fence at or above the BFE, **or**
3. If not elevated at or above the BFE, woven wire fence aligned perpendicular to the direction of flow shall be set back as follows:
    a. At least 20 feet from the upstream property boundary and at least 10 feet from the downstream property boundary where flow depths are 1 foot or less
    b. At least 30 feet from the upstream property boundary and at least 15 feet from the downstream property boundary where flow depths are greater than 1 foot but less than 3 feet.
    c. At least 40 feet from the upstream property boundary and at least 20 feet from the downstream property boundary where low depths are 3 feet or greater..
4. If not elevated at or above the BFE, woven wire fence aligned parallel to the direction of flow shall be set back from any property boundary as follows:
    a. At least 5 feet where flow depths are 1 foot or less
    b. At least 10 feet where flow depths are greater than 1 foot but less than 3 feet.
    c. At least 15 feet where flow depths are 3 feet or greater.

An engineering analysis demonstrating no adverse impact may be provided to the District for approval in lieu of meeting the standards above.

G. Solid Fences and Walls without Flood Openings (50 Feet or More from Property Boundaries)

Subject to District approval, with consideration for natural drainage, in order to construct a solid fence or wall without flood openings and without an engineering study, the following standards must be met:

1. Meet the provisions of Sections A and B of this policy.
2. The fence/wall shall be offset from all property boundaries by a minimum of 50 feet.
3. The total flow obstruction shall not exceed 50% of the extent of the floodplain impacting the property as measured perpendicular to the direction of flow, considered cumulatively with all other manmade obstructions to flow on the property (i.e. structures, fill, other fences/walls, elevated driveways, etc.).
4. For properties smaller than 1 acre, less than 50% of the total area of the property subject to flooding is enclosed or obstructed.
5. For properties larger than 1 acre, no more than 22,000 square feet of the subject property is enclosed.
6. The fence/wall shall not be placed at grade across a drainage path.

H. Solid Fences and Walls with Flood Openings (25-50 Feet from Property Boundaries)

Subject to District approval, with consideration for natural drainage, in order to construct a solid fence or wall within 25-50 feet of a property boundary without an engineering study, the following standards must be met (see also Figures 005-2 and 005-3):

1. Meet the provisions of Sections A and B of this policy.

2. The solid fence or wall must be offset from all property boundaries by a minimum of 25 feet.
3. The solid fence or wall must contain flood openings that comprise at least 50% of the total fence/wall length. The bottom of flood openings shall be at natural grade, and utilize one of the following standards:
    a. Alternating panels of solid fence/wall and panels of wrought iron fence, subject to the following minimum standards (see also Figure 005-2):
        i. At least 50% of the linear length of the wall shall be wrought iron panels,
        ii. Wrought iron panels shall be relatively evenly distributed along the entire length of the wall, though may be concentrated where more flow is expected,
        iii. The bottom horizontal member of the wrought iron fence panel must be at least six inches above grade (or four inches above grade if the fence/wall is a pool enclosure),
        iv. The solid portions of the wrought iron fence located below BFE shall occupy 20% or less of the flow area for an assumed 2 foot flow depth, **or**
    b. A solid fence/wall with flood openings, subject to the following minimum standards (see also Figure 005-3):
        i. The bottom of all openings shall be at natural grade.
        ii. The top of all openings shall be at or above the BFE. If pet containment within the fence/wall is desired, flood openings may be fitted with horizontal bars (3/8 inch max diameter) spaced no closer than 6 inches vertically (to be replaced with vertically oriented bars with 4 inches of horizontal spacing if fence/wall is a pool enclosure). (See Figure 005-3 Details B or C)
        iii. Where the BFE is six inches or less, flood openings shall be a minimum of one full course of block high or a minimum of 8 inches, whichever is greater, above natural grade and be a minimum of two blocks wide or a minimum of 32 inches, whichever is greater.
        iv. Where BFE flood depths are greater than six inches, flood openings shall be a minimum of two full courses of block high or a minimum of 16 inches) above natural grade, or to the BFE, whichever is greater, and be a minimum of two blocks wide or a minimum of 32 inches, whichever is greater.
4. Where the solid fence or wall crosses existing drainage paths only wrought iron or open type fences are allowed. The bottom of the fence crossing the drainage path shall be elevated above the defined drainage path to the height of the bank of the defined drainage path or above the BFE, whichever is higher. There shall be no vertical posts within the defined drainage path.
5. For the purpose of facilitating passage of flood flow through adjacent lots, the flood openings on one property shall be generally aligned with the flood openings (if existing) on adjacent properties.

The pertinent hydraulic features of this acceptable fence/wall are summarized on Figures 005-2 and 005-3, and are for hydraulic design purposes only; structural design of the fence/wall is the responsibility of the applicant.

I. Solid Fences and Elevated Walls (Within 25 Feet of Property Boundaries)

Subject to District approval, with consideration for natural drainage, in order to construct a fence/wall within 25 feet of any property boundary without an engineering study, the following standards must be met.

1. Meet the provisions of Sections A and B of this policy.
2. Any portion of the fence/wall within 25 feet of a property boundary must be elevated at or above the BFE;
3. Vertical posts/pillars supporting the fence/wall shall be:
    a. Spaced no closer than 8 feet apart (measured from center to center),
    b. If masonry, no more than 16 inches wide
    c. If solid fence, no more than 6 inches wide.
4. If masonry, submittal of a sealed report or design by a structural engineer is required demonstrating that the wall is structurally sound. This report does not need to address the impact to or from

floodwaters, but is necessary to demonstrate that the structural design for the large openings is sufficient to maintain the structural integrity of the wall.

5. Where the solid fence/wall crosses existing drainage paths or regulatory washes only wrought iron or open type fences are allowed. The bottom of the wrought iron fence crossing the defined drainage path shall be elevated above the defined drainage path to the height of the bank of the defined drainage path or above the BFE, whichever is higher. There shall be no vertical posts within the drainage path or wash channel.

J. Solid Fences and Walls that Do Not Satisfy the Standards of this Policy

Proposed fences/walls that do not meet the standards described above shall require the submittal of an engineering report for District approval that addresses the following (at a minimum):

1. The study must demonstrate that the fence/wall does not adversely impact any adjacent property by showing that:
    a. The fence/wall does not increase the BFE by more than 0.1 feet, as measured at property boundaries,
    b. The fence/wall does not increase the base flood velocity by more than 1 foot per second or 10%, whichever is less, as measured at property boundaries,
    c. The fence/wall does not increase the potential for erosion on any adjacent property, and
    d. The fence/wall does not divert flow, meaning that flood waters enter and exit the subject property in substantially the same location and under identical flow conditions after the fence/wall is constructed as it did before the fence/wall was constructed
2. The site plan must include a detail of the fence/wall design, a detail of any flood openings and the total number and location of the flood openings.
3. The site plan must be sealed by the engineer of record
4. The FPUP will be conditioned upon the requirement that an as-built certification letter from an Arizona-registered civil engineer be provided to the District upon completion of the work, confirming that the fence/wall was constructed in accordance with the FPUP, the engineering study, and the site plan.

APPROVED BY:

_____ _____

Suzanne Shields, P.E. **Date**
Director and Chief Engineer

Original Policy Approved: 11/5/07
Date(s) Revised: 11/2/15, 11/17/20, 5/18/21

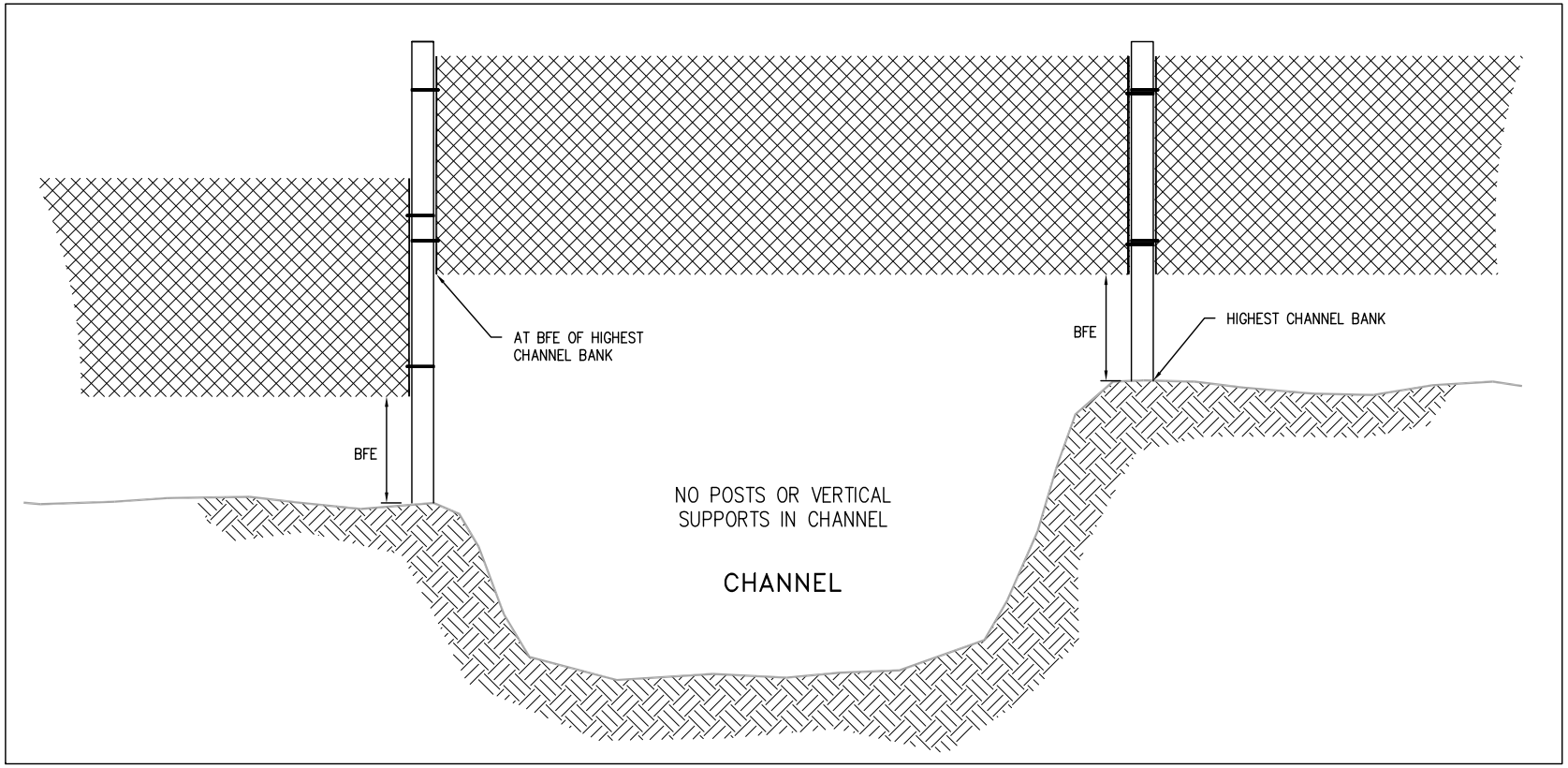
FLOODPLAIN MANAGEMENT PRACTICES FOR FENCES / WALLS IN REGULATORY FLOODPLAINS

TYPE OF FENCE, WALL (see below)	FLOOD HAZARD AREA IN WHICH FENCE / WALL IS CONSTRUCTED					
	FLOODWAY FRINGE (Ordinance 16.08.360)	**FLOODWAY (Ordinance 16.08.350)**	**PRIMARY CHANNEL (Q100 < 2000 CFS)**	**PRIMARY CHANNEL (Q100 = 2000 CFS or greater)**	**SHALLOW SHEET FLOW (Ordinance 16.08.640)**	**PONDING AREA (FEMA Zone AH, areas with Limited Velocity)**
	Conditions for Permitting					
A	Allowed	Allowed (No-Rise Certification required)	Allowed unless the purpose of the fencing is to contain livestock, and subject to other standards in Technical Policy 005	Allowed (No-Rise Certification required)	Allowed	Allowed
B	Allowed	Allowed with limited cross fencing (No-Rise Certification required)	Allowed subject to standards in Technical Policy 005	**Not Allowed**	Allowed	Allowed
C	Case by case review of design required	Case by case review of design required (No-Rise Certification required)	**Not Allowed**	**Not Allowed**	Case by case review of design required	Case by case review of design required
D	Allowed subject to standards in Technical Policy 005	Case by case review of design required. (No-Rise Certification required)	Allowed elevated to the BFE subject to standards in Technical Policy 005	**Not Allowed**	Allowed subject to standards in Technical Policy 005	Allowed
E	Allowed subject to standards in Technical Policy 005	**Not Allowed**	Allowed elevated to the BFE subject to standards in Technical Policy 005	**Not Allowed**	Allowed subject to standards in Technical Policy 005	Allowed
F	Allowed subject to standards in Technical Policy 005	**Not Allowed**	**Not Allowed**	**Not Allowed**	Allowed subject to standards in Technical Policy 005	Allowed subject to standards in Technical Policy 005

TYPE OF FENCE, WALL

A	"Open" barbed or barbless wire. For floodplain management purposes barbed or barbless wire will be considered "open" if there is no more than one horizontal strand per foot of height and no more than one vertical wire, stay, or post per six feet of fence length.
B	"Open pipe or rail fencing (e.g., corrals). For floodplain management purposes pipe fencing will be considered "open" if the horizontal pipes or rails occupy ten percent (10%) or less of the flow area obstructed by the fence, and posts are spaced no closer than 8 feet.
C	Collapsible (movable) fencing.
D	Other wire, pipe, wrought iron, or rail type fencing (e.g., wood rail fence) which does not meet the "open" requirements described abvove.
E	Woven wire fencing (chain-link, field, ranch, chicken wire, etc.).
F	Solid fences/walls (masonry (block) walls, wood or steel sheet fencing)

Date: Revised 4/16/2021



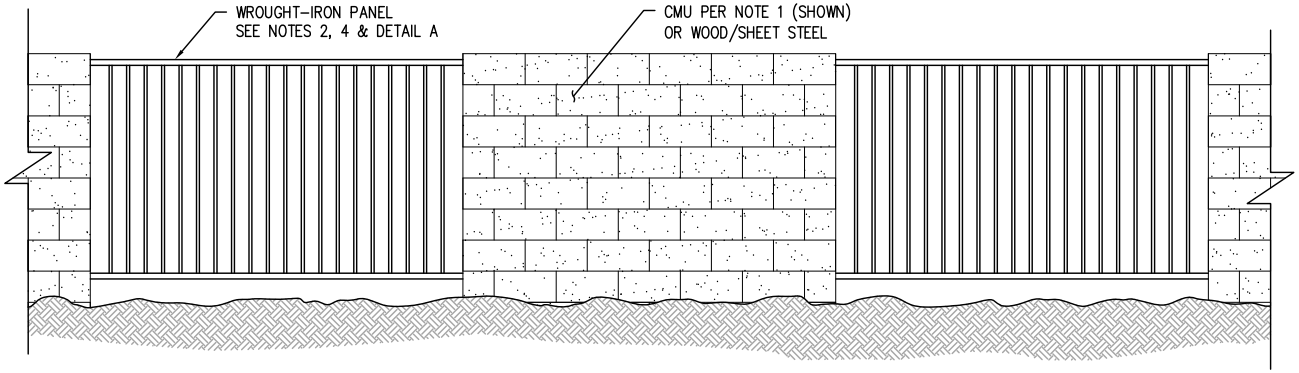
Registered Professional Engineer (Civil)
CERTIFICATE NO.
15610
Suzanne J.
Shields
Date Signed .....
ARIZONA, U.S.A.

PIMA COUNTY
FLOOD CONTROL

THE SEAL of PIMA COUNTY
ARIZONA

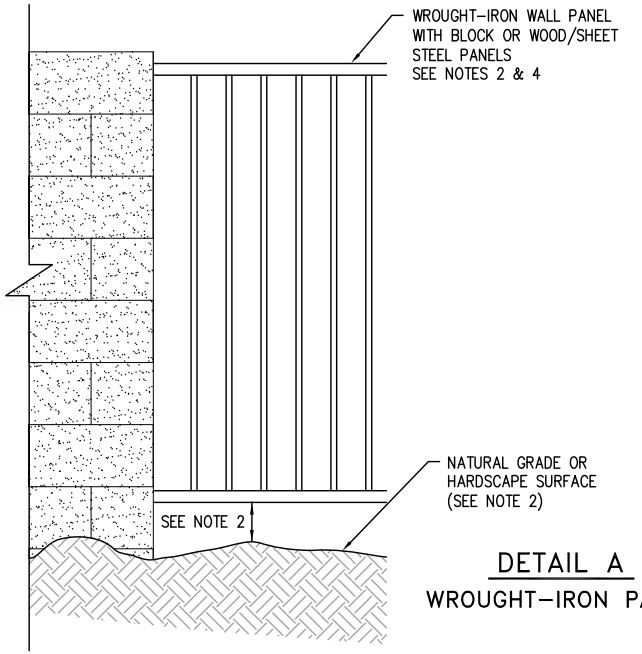
FIGURE 005–1
FENCE/WALL ELEVATION OVER CHANNELS

SCALE: N.T.S. DRAWN BY: sak DATE: Sept. 2019



SCHEMATIC ELEVATION

SHOWN: 50% OF WALL/LENGTH CONSISTS OF
WROUGHT–IRON PANELS (NOTE 5)



DETAIL A

WROUGHT–IRON PANEL

NOTES:

1. BASED ON STD 8"x8"x16" CMU BLOCK.
2. BOTTOM OF HORIZONTAL MEMBER IS MIN. 6" ABOVE NATURAL GRADE, OR, IF FENCE ENCLOSES A SWIMMING POOL, 4" ABOVE GRADE, WHICH MUST BE A HARDSCAPE SURFACE AT NATURAL GRADE.
3. SOLID PORTIONS OF WROUGHT–IRON PANEL TO OBSTRUCT NO MORE THAN 20% OF 100–YR FLOOD FLOW AREA, ASSUMING A 2 FT. FLOW DEPTH.
4. BLOCK WALL TO BE OFFSET A MIN. OF 25 FT. FROM PROPERTY BOUNDARY.
5. WALL DETAILS ADDRESS HYDRAULIC REQUIREMENTS ONLY. ADDITIONAL ANALYSIS MUST BE PERFORMED BY APPLICANT TO DETERMINE DETAILS FOR STRUCTURAL STABILITY OF WALL.
6. PROPERTY OWNER MUST COVENANT FLOOD OPENINGS AND WROUGHT IRON FENCE SHALL BE KEPT CLEAR OF DEBRIS OR BLOCKAGE AT ALL TIMES.
7. DETAILS PRESENTED DO NOT APPLY TO WALL CROSSING WASHES.

NOT FOR CONSTRUCTION

STANDARD DETAILS FOR WALLS/FENCES IN FLOODPLAINS

Registered Professional Engineer (Civil)
CERTIFICATE NO. 15610
Suzanne J. Shields
Date Signed .....
ARIZONA, U.S.A.

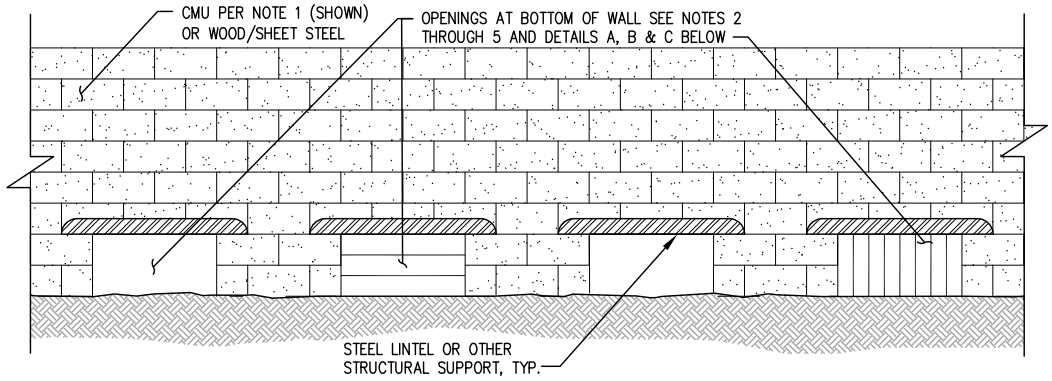
PIMA COUNTY
FLOOD CONTROL

THE SEAL of PIMA COUNTY ARIZONA

FIGURE 005–2

FLOOD OPENINGS COMPOSED OF WROUGHT IRON FENCE PANELS

SCALE: N.T.S. DRAWN BY: sak DATE: Sept. 2019

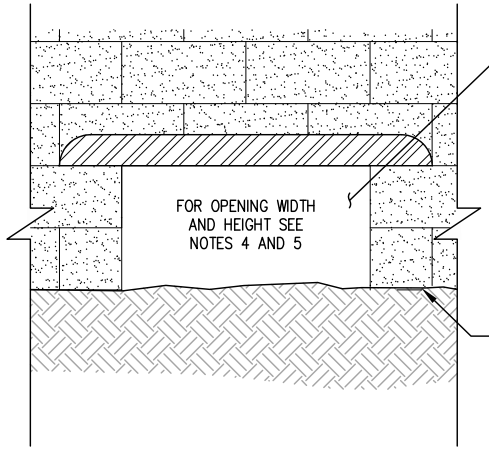


SCHEMATIC ELEVATION

SHOWN: 50% OF WALL/LENGTH CONSISTS OF FLOOD OPENINGS (NOTE 6)

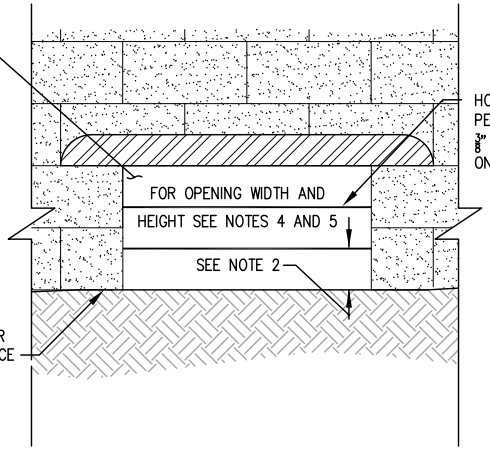
NOTES:

1. BASED ON STD 8"x8"x16" CMU BLOCK
2. IF REBAR IS PLACED IN OPENING, REBAR SHALL BE ORIENTED HORIZONTALLY WITH LOWEST BAR MIN. 6" ABOVE NATURAL GRADE WITH MIN. 6" SPACING ON CENTER. (SEE DETAIL B)
3. IF FENCE ENCLOSES A SWIMMING POOL, REBAR MUST BE ORIENTED VERTICALLY WITH 4" SPACING ON CENTER WITH HARDSCAPE SURFACE AT NATURAL GRADE AT BOTTOM OF OPENING. (SEE DETAIL C)
4. OPENINGS TO BE MIN. 2 BLOCKS (32") WIDE.
5. WHERE BASE FLOOD ELEVATION (BFE) IS >6", OPENING HEIGHT MIN. 2 FULL BLOCKS HIGH OR TO BFE, WHICHEVER IS GREATER. WHERE BFE IS 6" OR LESS, OPENING HEIGHT IS MIN 1 FULL BLOCK HIGH.
6. BLOCK WALL TO BE OFFSET A MIN. OF 25 FT. FROM PROPERTY BOUNDARY.
7. WALL DETAILS ADDRESS HYDRAULIC REQUIREMENTS ONLY. ADDITIONAL ANALYSIS MUST BE PERFORMED BY APPLICANT TO DETERMINE DETAILS FOR STRUCTURAL STABILITY OF WALL.
8. PROPERTY OWNER MUST SIGN COVENANTS REQUIRING MAINTENANCE OF FLOOD OPENINGS AND WROUGHT IRON FENCE TO BE KEPT CLEAR OF DEBRIS OR BLOCKAGE AT ALL TIMES.
9. DETAILS PRESENTED DO NOT APPLY WHERE WALLS CROSS WASH CHANNELS.



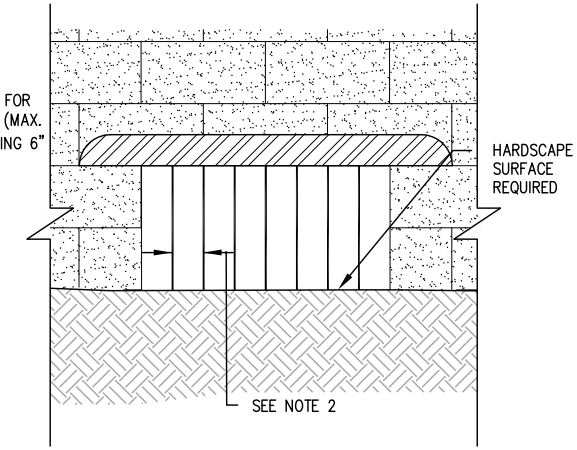
DETAIL A

FLOOD OPENING WITHOUT BARS



DETAIL B

FLOOD OPENING WITH HORIZONTAL BARS



DETAIL C

FLOOD OPENING WITH VERTICAL BARS (FOR POOL ENCLOSURES ONLY)

Registered Professional Engineer (Civil)
CERTIFICATE NO.
15610
Suzanne J.
Shields
Date Signed .....
ARIZONA, U.S.A.

PIMA COUNTY
FLOOD CONTROL

FIGURE 005-3

FLOOD OPENINGS LOCATED IN WALL/FENCES IN FLOODPLAINS

SCALE: N.T.S. DRAWN BY: sak DATE: Nov. 2020

THE SEAL of PIMA COUNTY ARIZONA

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT
TECHNICAL POLICY

POLICY NO.: Technical Policy, TECH-005~~– – – –~~ **EFFECTIVE DATE: November 5, 2007**
REVISED:~~– 11/2/15~~**5/18/21**

POLICY TITLE:~~–~~ Construction Standards for Fences and Walls within Regulatory Floodplains

PURPOSE:~~–~~ To clarify 16.20.020.C.5 by establishing guidelines regarding the design and construction of fencing and walls that may be approvable without providing an engineering study demonstrating no adverse impact (i.e. encroachment criteria have been met).

BACKGROUND:

~~The~~ Due to the typical amount of area enclosed and location on or near property boundaries, fences (wire, wrought iron, woven wire, chain-link, wood, sheet steel, etc.) and walls (masonry, block, etc.), hereafter collectively called fences/walls, have the potential to significantly impact flood flows to the adverse impact of adjacent properties and the floodplain in general. In addition to their impact to floodplains, the structural failure of fences/walls not designed to pass floods or withstand flood forces have caused structures to flood that otherwise may not have flooded. Floodplain Management Ordinance provision 16.20.020~~2~~.C states that an applicant proposing new development may be required to provide an engineering ~~study~~report~~,~~ prepared by an Arizona-registered civil engineer~~,~~ outlining the effects that the development will have on the flow of flood waters through the area being developed and through surrounding areas. If an engineering study reasonably demonstrates that there is no adverse impact (i.e. meets encroachment criteria), a Floodplain Use Permit (FPUP) may be issued for the new development. In many cases, fences and walls can be reasonably assured to have a negligible impact on flood waters through the use of certain construction and design standards without the need for an engineering analysis.

An FPUP is required for construction of any ~~wall or~~ fence~~-~~/wall within a regulatory floodplain in order to ensure compliance with the Ordinance.~~–~~ Depending on the nature of the flood hazard at the site~~,~~ and the proposed characteristics of the ~~wall or~~ fence/wall, the District may accept certain ~~wall or~~ fence~~-~~/wall configurations without requiring an engineering study.~~–~~ ~~T~~As a basic starting point, the ~~allowed wall or~~ fence /wall ~~configurations~~ types ~~are summarized~~ allowed for each flood hazard area can be found on the attached ~~T~~table titled: *FLOODPLAIN MANAGEMENT PRACTICES FOR FENCES / WALLS*.

In 2020, this policy was revised to add additional clarity, consistency and address rule changes or clarifications from local, state and federal agencies. New sections were added related to floodways, pool enclosures and wrought iron fences. ~~Because solid (masonry block) walls and certain types of fencing such as woven wire, wood or sheet steel (hereafter collectively described as fences/walls) have the potential to significantly obstruct or alter flow within floodprone areas and create hazardous conditions on surrounding properties, the Table indicates that these fences/walls may be allowed on a case-by-case basis. Often an engineering study is required in these cases.~~

~~This policy establishes specific standards that may affect the acceptability of fence/wall designs including the proximity of the fence/wall to property boundaries, the alignment of the fence/wall relative to flow direction, the total amount of area enclosed or obstructed by the fence/wall, and the incorporation of flood openings in the fence/wall construction. This will result in consistent implementation of the construction standards and the requirement to obtain an engineering study when these standards have not been met.~~

POLICY:

As a matter of good floodplain management practices, it is *preferable* that all fences and walls within floodprone areas be elevated at or above the Base Flood Elevation (BFE). The minimum standard is that fences/walls may not adversely impact adjacent properties. This policy dictates when elevating or creating openings in a fence or wall is required and also establishes when the standard design criteria presented in this policy may be used in lieu of an engineering analysis or an engineered design. ~~Depending on the nature of the flood hazard at the site and the proposed characteristics of the fence/wall, the District may accept certain defined fence/wall configurations in lieu of requiring an engineering study.~~ The allowed fence/wall configurations are summarized for each type of flood hazard area on the attached Table titled: *FLOODPLAIN MANAGEMENT PRACTICES FOR FENCES / WALLS*, effective January 13, 1994, and revised ~~November 5, 2007~~December 11, 2018. ~~This Table specifies a case-by-case review for fences/walls constructed within the floodway fringe area.~~ Designs that meet the standards outlined below may be approved by the District without an engineering study~~. Upon identification of unusual flood hazards, the District may still require an engineering study for designs in conformance with these standards.~~ unless uncertain, unusual, or high hazard conditions exist.

Fences and walls within regulatory Flow Corridors are further subject to the provisions of *Technical Policy 026: Regulation of Single-Lot Development within Flow Corridors*, which modifies some of the requirements within this policy.

A. Fences/W~~w~~alls within Floodways

The FEMA guidance document titled *Certification Requirements for Simple Floodway Encroachments* states, ". . . nothing that offers any resistance to the flow of floodwaters may be placed in a regulatory floodway unless compensatory action is taken to restore the lost conveyance." As such:

1. Walls and solid fences are not allowed in a floodway
2. Open, pipe rail, wrought iron and woven wire fence are allowed over the channel of a minor regulatory watercourse when constructed as detailed in B.6 and Figure 005-1.
3. Except as provided in A.3, any fence or wall proposed within a floodway area must:
    a. meet the requirements in Sections B through J of this policy, and
    b. be justified by an engineering analysis prepared by an Arizona registered civil engineer that:
        i. Addresses debris loading on the fence/wall, and
        ii. Addresses compensatory conveyance of flood flows, and
        iii. Demonstrates that the improvements cause no rise in the base flood elevation.
4. The Ordinance establishes that the primary channel of any regulatory watercourse is considered to be a floodway, however the District may waive the requirements above when all of the following conditions are met:
    a. Sections B through J of this policy are met,
    b. the floodway is designated such solely under Section 16.08.350.C of the Ordinance, expressly that the floodway is the primary channel of a minor regulatory watercourse with a discharge less than 2,000 cfs, and
    c. the portion of the fence within the channel is solely 3 or 4 strand barbed or barbless wire.

~~A.~~B. All Fences/~~w~~Walls

The requirements in this section apply to all ~~walls and~~ fences and walls.

1. ~~Accurate and Complete Site Plan –~~ The FPUP application must be accompanied by a site plan of the property, to a measurable scale, which meets all of the requirements of 16.20.020, including showing all existing and proposed development, existing and proposed grading, topography, and floodplain/erosion hazard setback delineations.

2. The site plan must also ~~provide~~ show the proposed fence/wall ~~alignment~~ location in relation to the property boundaries, as well as a dimensioned elevation view detail showing the height of the bottom of the fence/wall above natural grade and/or flood openings or a reference to one of the standard details ~~supplied by the District~~in this Policy, if applicable. The site plan must indicate the location and size of any required flood openings, and demonstrate that these flood openings are aligned with similar flood openings on adjacent properties (if existing).
3. ~~Covenant –~~ Approval of the FPUP shall ~~be conditioned on~~require the signing of a covenant stipulating that all flood openings will be kept free of debris at all times and remain open for the passage of floodwaters and/or that fences/walls will be elevated and kept free of debris, as applicable.~~–~~ The property owner must also acknowledge that if the fence/wall poses a flood hazard at any time in the future, the fence/wall shall be modified at the owner's expense to eliminate the hazard.
4. ~~Walls or fences~~Fences/walls that are intended to contain livestock are not allowed in the channel of a regulatory wash.
5. Single strands of wire may be placed below the bottom of a fence/wall at six inch intervals, except within the channel of a regulatory wash.
    a. The lowest strand shall be at least six inches above natural grade (natural grade is not to be altered).
    b. The highest strand shall be at least six inches below the bottom of the fence.
    c. For example, if the fence is elevated one foot above grade, a single strand is allowed below the bottom of the fence. One additional strand is allowed for each additional 6 inches that the fence is elevated.
6. For any type of fence other than a fence that meets the definition of open fencing in Section D, if the fence is across a regulatory wash, the bottom of the fence shall be elevated at or above the Base Flood Elevation (BFE). In floodplains such as sheetflow floodplains where the BFE is a depth of flow, the point of measurement for the bottom of the fence across the channel shall be the highest bank of the wash (see Figure 005-1).
    a. Vertical support posts are not allowed within the channel.
    ~~a.~~b. Nothing is allowed below the bottom of the fence within the channel, except as provided in B.7 and B.8.
7. Trash racks or any kind of mesh screening are not allowed within the channel of a regulatory wash unless the following conditions are met:
    a. The trash rack or screening is offset at least 25 feet from any property boundary for washes with a base flood discharge of less than 2000 cubic feet per second (cfs),
    b. The trash rack or screening is offset at least 50 feet from any property boundary for washes with a base flood discharge of 2000 cfs to less than 5000 cfs,
    c. Trash racks or screens are not allowed on washes with a discharge of 5000 cfs or more.
8. Flap gates, flip gates, or similar type designs are prohibited within regulatory washes unless a design by an Arizona registered civil engineer is approved by the District. Flap gates are commonly desired as a solution to allow the passage of floodwaters while preventing unwanted entry of wildlife or exit of domestic pets through the open space required by this policy. However, they often fail to perform as intended and as a result, divert, obstruct or retard flow.
9. Natural flow paths must be preserved and design considerations must be made to accommodate flow based on the type of fence/wall being constructed.
10. The requirements of Technical Policy 026 shall be applied to ~~walls and~~ fences and walls within Flow Corridors.

~~4.~~

C. Special Considerations for Pool Enclosures

For below-ground pools and above-ground pools less than four feet tall, Building Code safety requirements dictate that pool barriers are required and that the barrier shall not allow the passage of a 4-inch diameter sphere. This often conflicts with District requirements for opening sizes. In addition, the pool code requires the bottom of a pool enclosure fence to be no more than two inches above grade when grade is earth, as opposed to

a hardscape surface such as block or concrete. The bottom of a pool enclosure may be four inches above grade when grade is hardscaped, such as concrete. However, when properly spaced rebar is placed in wall openings, the top of a wall opening may be more than four inches above grade when grade is a hardscape surface. Pool safety guidelines also restrict the use of horizontal bars since they may be used as steps to scale the fence/wall. When a pool enclosure is proposed within a regulatory floodplain and this policy requires that flood openings or elevating the bottom of the fence are necessary, the following shall apply (see also Figure 005-3):

1. When a solid fence or block wall with openings is acceptable and the District determines that the top of flood openings must be higher than four inches above grade, the standard details for the wall openings shall be modified as follows.
    a. Openings shall be constructed with rebar placed in the openings.
    b. The rebar shall be oriented vertically so as to not offer a step to get over the wall.
    c. The rebar shall be spaced four inches apart, on center.
    d. The District may require more openings or larger openings in order to compensate for the less than optimal rebar orientation and spacing.
2. When a block wall is acceptable and the District determines that the top of the flood openings are allowed to be four inches above grade, the top of the opening shall be exactly four inches above natural grade in order to keep the bottom of the fence as high as possible within the limits of the pool safety requirements.
    a. As a result, the area below the fence must be hardscape and cannot be dirt or loose rock.
    b. A concrete footer, block, or concrete slab is acceptable under the fence to meet the 4 inch opening requirement. It is recommended that applicants verify the acceptability of any other materials with Development Services.
    c. The District may restrict the use of rebar or other materials within the flood openings.
    d. The District may require more openings or larger openings in order to compensate for the less than optimal flood opening size.
3. The District may require an alteration of the size or configuration of the fence to offset the reduced capacity to pass flows through the fence/wall caused by the pool enclosure safety requirements.
4. The District may require flow-through fencing or wrought iron to be used in lieu of a solid fence or block wall.

~~B.~~D. Open Fences

Open fences, which includes most pipe rail fences and 3 or 4 strand barbed/barbless wire fences, are subject to District approval and are generally considered to be the preferred fencing type within a floodplain.~~–~~ To qualify as open fencing, the fencing cannot occupy~~ies~~ more than 10% ~~or less~~ of the flow area obstructed by the fence. ~~Three or 4 strand wire fences are the only type of fence or wall allowed in a Floodway without an engineering analysis.~~ With respect to open fences, the following standards must be met:

1. Meets the provisions of Sections A and B of this policy.
~~1.~~2. Fence posts or vertical wires or stays shall be placed no closer than 6 feet apart for stranded wire fence
~~2.~~3. Fence posts shall be placed no closer than 8 feet apart for pipe rail type fence
~~3.~~4. Fence posts may not be placed in the primary channel of a regulatory wash
5. Not allowed in the primary channel if the purpose of the fence is to contain livestock
6. All fencing across the channel of a major regulatory watercourse (having a base flood discharge of 2,000 cfs or greater) must be supported by an engineering analysis as detailed in Section A of this policy.
~~4.~~7. The only fencing type allowed across the channel of a minor regulatory watercourse (having a base flood discharge of less than 2,000 cfs) is 3 or 4 strand barbed or barbless wire. All other provisions of this Section must be met.

An engineering analysis demonstrating no adverse impact may be provided to the District for approval in lieu of meeting the standards above.

E. Wrought Iron Fences

Wrought iron fences are subject to District approval. Since the bars of wrought iron fences are typically in a vertical orientation, they are prone to catching debris carried by floodwaters. In terms of the degree of floodplain impact, wrought iron fences are in between open fences and woven wire fences. In order to construct a wrought iron fence, the following standards must be met:

1. Meet the provisions of Sections A and B of this policy.
2. Elevate the bottom of the wrought iron fence at or above the BFE, **or**
3. If not elevated at or above the BFE, setbacks from property lines for wrought iron fence aligned perpendicular to the direction of flow are as follows:
    a. At least 5 feet where flow depths are 1 foot or less
    b. At least 10 feet where flow depths are greater than 1 foot but less than 3 feet.
    c. At least 15 feet where low depths are 3 feet or greater.
4. If not elevated at or above the BFE, setbacks from property lines for wrought iron fence aligned parallel to the direction of flow are as follows:
    a. Zero (0) feet where flow depths are 1 foot or less
    b. At least 5 feet where flow depths are greater than 1 foot but less than 3 feet.
    c. At least 10 feet where flow depths are 3 feet or greater.
5. Any portion of a wrought iron fence not meeting the above setback requirements shall be elevated such that the lowest part of the fence is elevated at or above the BFE.

An engineering analysis demonstrating no adverse impact may be provided to the District for approval in lieu of meeting the standards above.

~~C.~~F. Woven Wire Fences

Woven wire fence, which includes chain-link fence, field fence, and chicken wire fence, are subject to District approval and ~~are~~ can be deceptively hazardous in floodplains. While they are not solid obstructions to flow like a wall, they easily catch debris carried by floodwaters ~~and~~ . As such they may divert and ~~-~~obstruct flow just like a wall.~~–~~ Hydrodynamic pressure on the trapped debris also applies forces ~~that~~ to fences that they ~~were~~ are not designed to withstand, causing them to fail in a hazardous manner.~~–~~ In order to construct a woven wire fence, the following standards must be met:

1. Meet the provisions of Sections A and B of this policy.
2. Elevate the bottom of the woven wire fence at or above the BFE, **or**
3. If not elevated at or above the BFE, ~~W~~woven wire fence aligned perpendicular to the direction of flow shall be set back as follows:
    a. At least 20 feet from the upstream property boundary and at least 10 feet from the downstream property boundary where flow depths are 1 foot or less
    b. At least 30 feet from the upstream property boundary and at least 15 feet from the downstream property boundary where flow depths are greater than 1 foot but less than 3 feet.
    ~~a.~~c. At least 40 feet from the upstream property boundary and at least 20 feet from the downstream property boundary where low depths are 3 feet or greater. ~~a minimum of 50 feet from the upstream and 25 feet from the downstream property line unless the fence is elevated at or above the Base Flood Elevation~~.
4. If not elevated at or above the BFE, ~~W~~woven wire fence aligned parallel to the direction of flow shall be set back from any property boundary ~~a~~ as follows:
    a. At least 5 feet where flow depths are 1 foot or less
    b. At least 10 feet where flow depths are greater than 1 foot but less than 3 feet.
    c. At least 15 feet where flow depths are 3 feet or greater.

    ~~minimum of 15 feet from the property line unless the fence is elevated at or above the Base Flood Elevation~~

1. Single strands of wire may be placed below the bottom of the woven wire fence at 6 inch intervals, except as noticed in item 5 below. If the fence is elevated 1 foot above grade, a single strand is allowed, and one additional strand is allowed for each additional 6 inches that the fence is elevated.
2. Woven wire fences shall not be placed within the channel of a regulatory wash. A woven wire fence across a regulatory wash must span the wash from bank to bank with the bottom of the fence elevated at or above the Base Flood Elevation. Nothing is allowed below the bottom of the fence where it crosses a regulatory wash unless a report sealed by an Arizona registered civil engineer demonstrates that, when loaded with debris, the fence will not adversely impact an adjacent property.

An engineering analysis demonstrating no adverse impact may be provided to the District for approval in lieu of meeting the standards above.

D.G. Walls and Solid Fences and Walls Wwithout Flood Openings (50 Feet or More from Property Boundaries)

Subject to District approval, with consideration for natural drainage, in order to construct a solid fence/ or wall without flood openings 50 feet or more from property boundaries and without an engineering study, the following standards must be met:

1. Meet the provisions of Sections A and B of this policy.
1.2. The fence/wall shall be offset from all property boundaries by a minimum of 50 feet.
2.3. The total flow obstruction shall not exceed 50% of the extent of the floodplain impacting the property as measured perpendicular to the direction of flow, considered cumulatively with all other manmade obstructions to flow on the property (i.e. structures, fill, other fences/walls, elevated driveways, etc.).
3.4. For properties smaller than 1 acre, less than 50% of the total area of the property subject to flooding is enclosed or obstructed.
4.5. For properties larger than 1 acre, no more than 20,000 square feet of the subject property is enclosed.
5.6. The fence/wall is shall not be placed at grade across a defined wash or drainage swale path(hereafter drainage path).

E.H. Walls and Solid Fences and Walls Wwith Flood Openings (25-50 Feet from Property Boundaries)

Subject to District approval, with consideration for natural drainage, in order to construct a solid fence/ or wall within 25-50 feet of a property boundary without an engineering study, the following standards must be met (see also Exhibit DFigures 005-2 and 005-3):

1. Meet the provisions of Sections A and B of this policy.
1.2. The solid fence/ or wall must be offset from all property boundaries by a minimum of 25 feet.
2.3. The solid Ffences/ or walls must contain flood openings that comprise at least 50% of the total fence/wall length. In this case, the fThe bottom of flood openings shall be at natural grade, and the consist utilize one of any of the following standards: (See Exhibit D):
    a. Alternating Ppanels of Ssolid fFence/wall and flood openings provided by panels of Wwrought Iiron Ffence Panels, subject to the following minimum standards (see also Figure 005-2):
        i. At least 50% of the linear length of the wall shall be wrought iron panels,
        ii. Wrought iron panels shall be relatively evenly distributed along the entire length of the wall, though may be concentrated where more flow is expected,
        iii. TThe bottom horizontal member of the wrought iron fence panel must be at least six inches above grade (or four inches above grade if the fence/wall provides is a pool enclosure),
        i.iv. and tThe solid portions of the wrought iron fence located below flood level,BFE shall occupy 20% or less of the flow area for an assumed 2 foot flow depth. (See Exhibit D, Sheet 1), **or**

b. ~~F~~A solid fence~~/~~/wall with flood openings ~~provided by Bottom Holes~~, subject to the following minimum standards (see also Figure 005-3):

i. The bottom of all openings shall be at natural grade.

ii. ~~T~~The ~~height of the bottom holes~~ top of all openings shall be at ~~least equal to the 1 percent annual chance flood depth~~or above the BFE. ~~–~~ If pet containment within the fence/wall is desired, ~~bottom holes~~flood openings may be fitted with horizontal bars (3/8 inch max dia~~.~~meter) spaced no closer than 6 inches vertically (to be replaced with vertically oriented bars with 4 inches ~~vertical~~ of horizontal spacing if fence/wall ~~provides~~ is a pool enclosure). ~~–~~ (See ~~Exhibit D~~Figure 005-3 Details B or C~~, Sheet 2~~)

iii. ~~W~~Where ~~1 percent annual chance flood depths are~~the BFE is ~~-~~six inches or less, ~~bottom holes~~flood openings shall be a minimum of one full course of block high or ~~(~~a minimum of 8 inches~~)~~, whichever is greater, above natural grade and be a minimum of two blocks wide ~~(~~or a minimum of 32 inches, whichever is greater~~)~~.

iv. W~~W~~here ~~1 percent annual chance~~BFE flood depths are greater than six inches, ~~bottom holes~~flood openings shall be a minimum of two full courses of block high ~~(~~or a minimum of 16 inches) above natural grade, or to the ~~base flood elevation~~BFE, whichever is ~~higher~~greater, and be a minimum of two blocks wide ~~(~~or a minimum of 32 inches, whichever is greater~~)~~.

~~3.~~4. ~~Only Wrought iron fence panels may be placed across~~ Where the solid fence or wall crosses existing ~~defined~~ drainage paths only wrought iron or open type fences are allowed. The bottom ~~horizontal member~~ of the ~~wrought iron~~ fence crossing the ~~defined~~ drainage path shall be elevated above the defined drainage path to the height of the bank of the defined drainage path or above the ~~100-year flood surface elevation~~ BFE~~within the defined drainage path~~, whichever is higher. There shall be no vertical posts within the defined drainage path.

~~4.~~5. For the purpose of facilitating passage of flood flow through adjacent lots, the flood openings on one property shall be generally aligned with the flood openings (if ~~used~~existing) on adjacent properties.

The pertinent hydraulic features of this acceptable fence/wall are summarized on ~~the attached Exhibit D~~Figures 005-2 and 005-3, and are for hydraulic design purposes only; structural design of the fence/wall is the responsibility of the applicant.

~~F.~~I. ~~Elevated Walls and~~ Solid Fences and Elevated Walls (Within 25 Feet of Property Boundaries)

Subject to District approval, with consideration for natural drainage, in order to construct a fence/wall ~~on~~ within 25 feet of any ~~the~~ property boundary~~ies~~ without an engineering study, the following standards must be met.~~:~~

1. Meet the provisions of Sections A and B of this policy.

~~1.~~2. Any portion of the fence/wall within 25 feet of a property boundary ~~The bottom of the fence/wall is~~must be elevated at or above the ~~1 percent annual chance flood depth~~BFE ~~along the entire length of the fence/wall~~;

3. Vertical posts/pillars supporting the fence/wall ~~are~~shall be:

a. ~~S~~spaced no closer than 8 feet apart (measured from center to center),

b. If masonry, no more than 16 inches wide

~~a.~~c. If solid fence, no more than 6 inches wide.~~;~~

4. If masonry, submittal of a sealed report or design by a structural engineer is required demonstrating that the wall is structurally sound. This report does not need to address the impact to or from floodwaters, but is necessary to demonstrate that the structural design for the large openings is sufficient to maintain the structural integrity of the wall.

~~2.~~ Where the solid fence/wall crosses existing drainage paths or regulatory washes only wrought iron or open type fences are allowed. The bottom of the wrought iron fence crossing the defined drainage path shall be elevated above the defined drainage path to the height of the bank of the defined drainage path or above the BFE, whichever is higher. There shall be no vertical posts within the drainage path or wash channel.~~The bottom of the fence/wall crossing the defined drainage path is elevated above the~~

~~bank of the defined drainage path or above the 1 percent annual chance flood water surface elevation within the drainage path, whichever is higher;~~

~~3. If the fence/wall is elevated one foot or more above natural grade, a single strand of barbless wire may be placed below the solid fence with a minimum spacing of 6 inches between the strand of wire and the ground and/or the bottom of the fence/wall.~~

~~4.~~5.

~~G.~~J. ~~Walls and~~ Solid Fences and Walls that Do Not Satisfy the Standards of this Policy

Proposed fences/walls that do not ~~satisfy~~ meet the standards described above shall ~~be supported by~~require the submittal of an engineering ~~study~~ report for District approval that addresses the following (at a minimum):

1. The study must demonstrate that the fence/wall does not adversely ~~affect~~ impact any adjacent property by showing that:
    a. The fence/wall does not increase the ~~1 percent annual chance~~ BFE~~flood depth~~ by more than 0.1 feet, as measured at property boundaries,
    b. The fence/wall does not increase the ~~1 percent annual chance~~ base flood velocity by more than 1 foot per second or 10%, whichever is less, as measured at property boundaries,
    c. The fence/wall does not increase the potential for erosion on any adjacent property, and
    d. The fence/wall does not divert flow, meaning that flood waters enter~~s~~ and exit~~s~~ the subject property in substantially the same location and under identical flow conditions after the fence/wall is ~~present~~ constructed as it did before the fence/wall was constructed
2. The site plan must include a detail of the fence/wall design, ~~and include~~ a detail of any flood openings and the total number and location of the flood openings.
3. The site plan must be sealed by the engineer of record
4. The FPUP will be conditioned upon the requirement that an as-built certification letter from an Arizona-registered civil engineer be provided to the District upon completion of the work, confirming that the fence/wall was constructed in accordance with the FPUP, the engineering study, and the site plan.

APPROVED BY:

_____ _____

Suzanne Shields, P.E. **Date**
Director and Chief Engineer

Original Policy Approved:~~–~~ 11/5/07
Date(s) Revised:~~–~~ 11/2/15, 11/17/20, 5/18/21

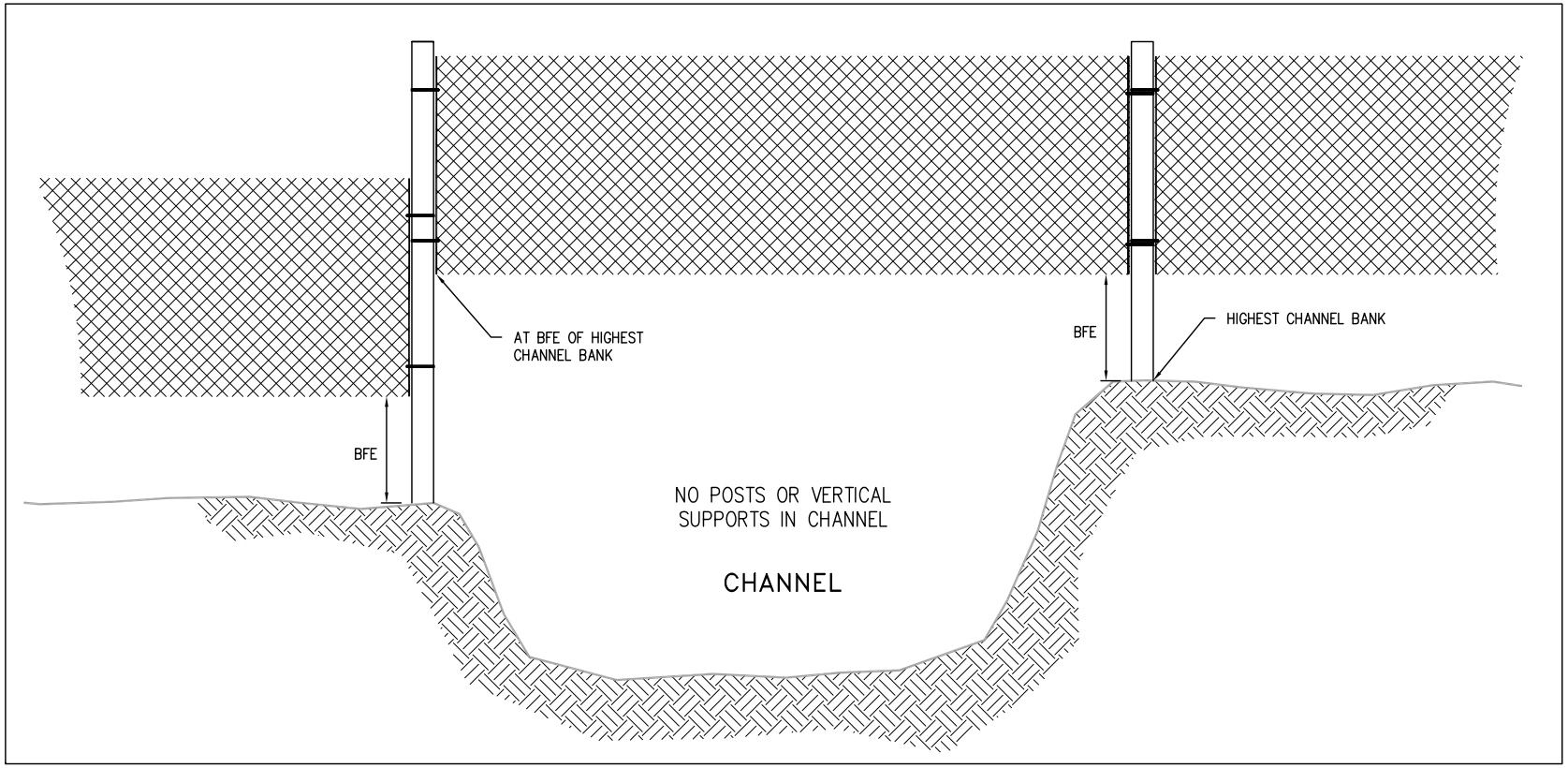
FLOODPLAIN MANAGEMENT PRACTICES FOR FENCES / WALLS IN REGULATORY FLOODPLAINS

TYPE OF FENCE, WALL (see below)	FLOOD HAZARD AREA IN WHICH FENCE / WALL IS CONSTRUCTED					
	FLOODWAY FRINGE (Ordinance 16.08.360)	**FLOODWAY (Ordinance 16.08.350)**	**PRIMARY CHANNEL (Q100 < 2000 CFS)**	**PRIMARY CHANNEL (Q100 = 2000 CFS or greater)**	**SHALLOW SHEET FLOW (Ordinance 16.08.640)**	**PONDING AREA (FEMA Zone AH, areas with Limited Velocity)**
	Conditions for Permitting					
A	Allowed	Allowed (No-Rise Certification required)	Allowed unless the purpose of the fencing is to contain livestock, and subject to other standards in Technical Policy 005	Allowed (No-Rise Certification required)	Allowed	Allowed
B	Allowed	Allowed with limited cross fencing (No-Rise Certification required)	Allowed subject to standards in Technical Policy 005	**Not Allowed**	Allowed	Allowed
C	Case by case review of design required	Case by case review of design required (No-Rise Certification required)	**Not Allowed**	**Not Allowed**	Case by case review of design required	Case by case review of design required
D	Allowed subject to standards in Technical Policy 005	Case by case review of design required. (No-Rise Certification required)	Allowed elevated to the BFE subject to standards in Technical Policy 005	**Not Allowed**	Allowed subject to standards in Technical Policy 005	Allowed
E	Allowed subject to standards in Technical Policy 005	**Not Allowed**	Allowed elevated to the BFE subject to standards in Technical Policy 005	**Not Allowed**	Allowed subject to standards in Technical Policy 005	Allowed
F	Allowed subject to standards in Technical Policy 005	**Not Allowed**	**Not Allowed**	**Not Allowed**	Allowed subject to standards in Technical Policy 005	Allowed subject to standards in Technical Policy 005

TYPE OF FENCE, WALL

A	"Open" barbed or barbless wire. For floodplain management purposes barbed or barbless wire will be considered "open" if there is no more than one horizontal strand per foot of height and no more than one vertical wire, stay, or post per six feet of fence length.
B	"Open pipe or rail fencing (e.g., corrals). For floodplain management purposes pipe fencing will be considered "open" if the horizontal pipes or rails occupy ten percent (10%) or less of the flow area obstructed by the fence, and posts are spaced no closer than 8 feet.
C	Collapsible (movable) fencing.
D	Other wire, pipe, wrought iron, or rail type fencing (e.g., wood rail fence) which does not meet the "open" requirements described abvove.
E	Woven wire fencing (chain-link, field, ranch, chicken wire, etc.).
F	Solid fences/walls (masonry (block) walls, wood or steel sheet fencing)

Date: Revised 4/16/2021



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CERTIFICATE NO.
15610
Suzanne J.
Shields
Date Signed .....
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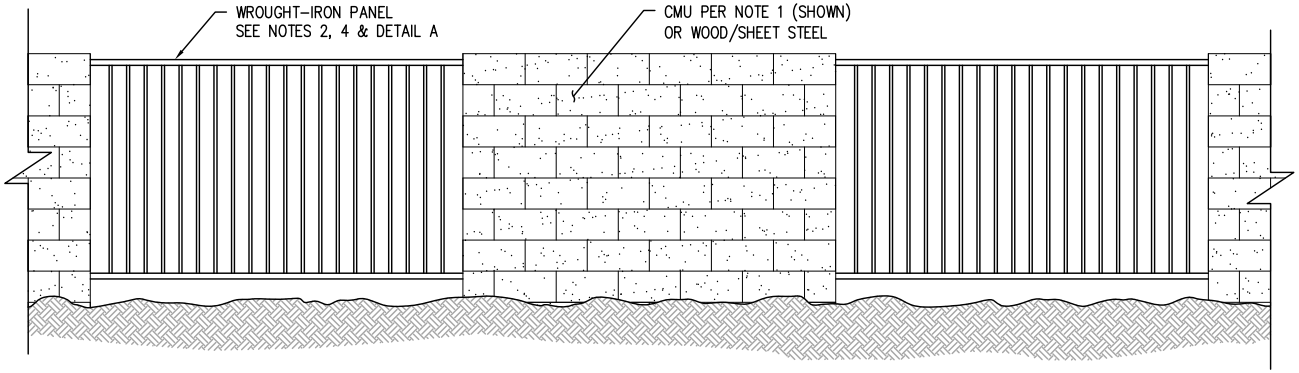
ARIZONA

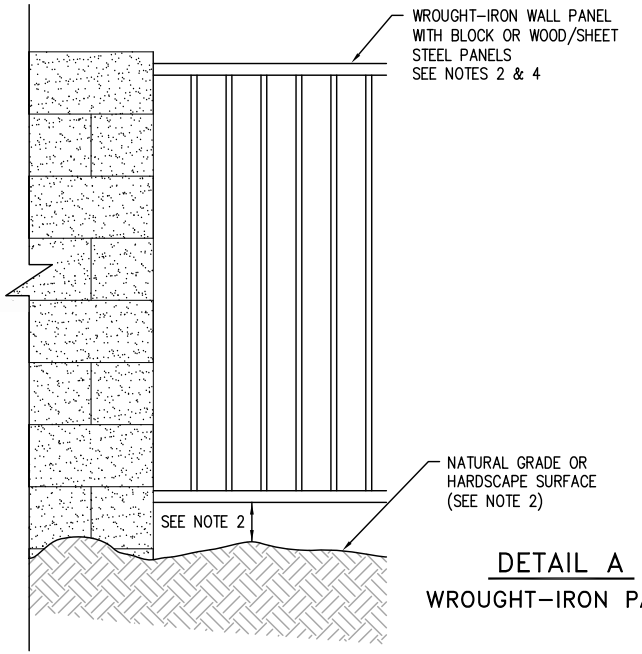
FIGURE 005–1
FENCE/WALL ELEVATION OVER CHANNELS

SCALE: N.T.S. DRAWN BY: sak DATE: Sept. 2019



SCHEMATIC ELEVATION

SHOWN: 50% OF WALL/LENGTH CONSISTS OF
WROUGHT–IRON PANELS (NOTE 5)



DETAIL A

WROUGHT–IRON PANEL

NOTES:

1. BASED ON STD 8"x8"x16" CMU BLOCK.
2. BOTTOM OF HORIZONTAL MEMBER IS MIN. 6" ABOVE NATURAL GRADE, OR, IF FENCE ENCLOSES A SWIMMING POOL, 4" ABOVE GRADE, WHICH MUST BE A HARDSCAPE SURFACE AT NATURAL GRADE.
3. SOLID PORTIONS OF WROUGHT–IRON PANEL TO OBSTRUCT NO MORE THAN 20% OF 100–YR FLOOD FLOW AREA, ASSUMING A 2 FT. FLOW DEPTH.
4. BLOCK WALL TO BE OFFSET A MIN. OF 25 FT. FROM PROPERTY BOUNDARY.
5. WALL DETAILS ADDRESS HYDRAULIC REQUIREMENTS ONLY. ADDITIONAL ANALYSIS MUST BE PERFORMED BY APPLICANT TO DETERMINE DETAILS FOR STRUCTURAL STABILITY OF WALL.
6. PROPERTY OWNER MUST COVENANT FLOOD OPENINGS AND WROUGHT IRON FENCE SHALL BE KEPT CLEAR OF DEBRIS OR BLOCKAGE AT ALL TIMES.
7. DETAILS PRESENTED DO NOT APPLY TO WALL CROSSING WASHES.

NOT FOR CONSTRUCTION

STANDARD DETAILS FOR WALLS/FENCES IN FLOODPLAINS

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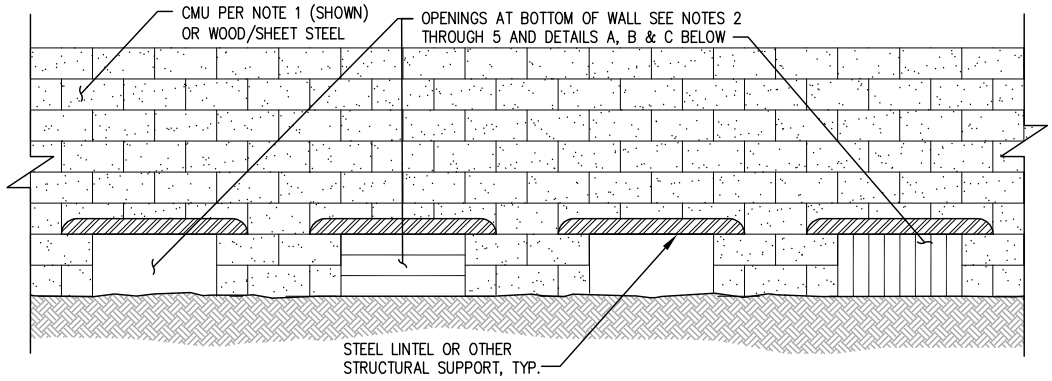
FIGURE 005–2

FLOOD OPENINGS COMPOSED OF WROUGHT IRON FENCE PANELS

SCALE: N.T.S. DRAWN BY: sak DATE: Sept. 2019

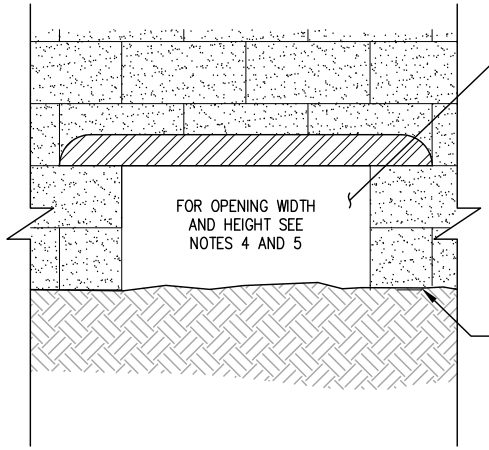


SCHEMATIC ELEVATION

SHOWN: 50% OF WALL/LENGTH CONSISTS OF FLOOD OPENINGS (NOTE 6)

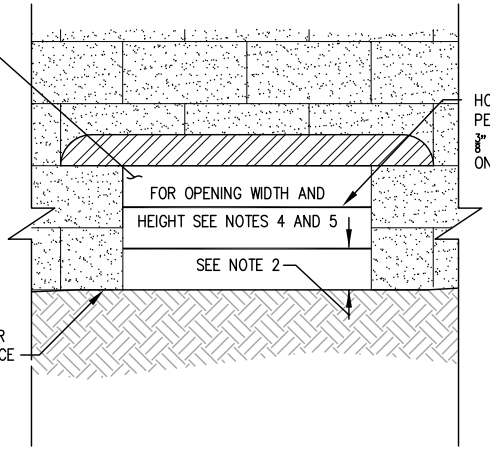
NOTES:

1. BASED ON STD 8"x8"x16" CMU BLOCK
2. IF REBAR IS PLACED IN OPENING, REBAR SHALL BE ORIENTED HORIZONTALLY WITH LOWEST BAR MIN. 6" ABOVE NATURAL GRADE WITH MIN. 6" SPACING ON CENTER. (SEE DETAIL B)
3. IF FENCE ENCLOSES A SWIMMING POOL, REBAR MUST BE ORIENTED VERTICALLY WITH 4" SPACING ON CENTER WITH HARDSCAPE SURFACE AT NATURAL GRADE AT BOTTOM OF OPENING. (SEE DETAIL C)
4. OPENINGS TO BE MIN. 2 BLOCKS (32") WIDE.
5. WHERE BASE FLOOD ELEVATION (BFE) IS >6", OPENING HEIGHT MIN. 2 FULL BLOCKS HIGH OR TO BFE, WHICHEVER IS GREATER. WHERE BFE IS 6" OR LESS, OPENING HEIGHT IS MIN 1 FULL BLOCK HIGH.
6. BLOCK WALL TO BE OFFSET A MIN. OF 25 FT. FROM PROPERTY BOUNDARY.
7. WALL DETAILS ADDRESS HYDRAULIC REQUIREMENTS ONLY. ADDITIONAL ANALYSIS MUST BE PERFORMED BY APPLICANT TO DETERMINE DETAILS FOR STRUCTURAL STABILITY OF WALL.
8. PROPERTY OWNER MUST SIGN COVENANTS REQUIRING MAINTENANCE OF FLOOD OPENINGS AND WROUGHT IRON FENCE TO BE KEPT CLEAR OF DEBRIS OR BLOCKAGE AT ALL TIMES.
9. DETAILS PRESENTED DO NOT APPLY WHERE WALLS CROSS WASH CHANNELS.



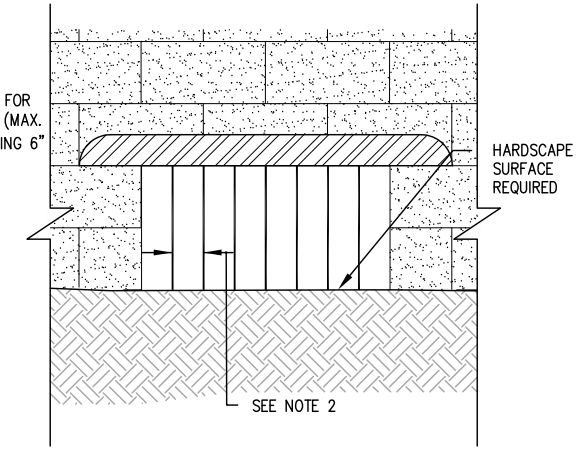
DETAIL A

FLOOD OPENING WITHOUT BARS



DETAIL B

FLOOD OPENING WITH HORIZONTAL BARS



DETAIL C

FLOOD OPENING WITH VERTICAL BARS (FOR POOL ENCLOSURES ONLY)

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FIGURE 005-3

FLOOD OPENINGS LOCATED IN WALL/FENCES IN FLOODPLAINS

SCALE: N.T.S. DRAWN BY: sak DATE: Nov. 2020

THE SEAL of PIMA COUNTY ARIZONA

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT
TECHNICAL POLICY

POLICY NO.: Technical Policy, TECH-006 **EFFECTIVE DATE: March 23, 2006**
REVISED DATE: 5/18/21

POLICY NAME: Erosion Protection of Fill Pads in Regulatory Floodplains

PURPOSE: To clarify Section 16.26.040.B of the Ordinance regarding the protection of fill pads from erosion in order to establish consistent permitting requirements that provide sufficient erosion protection for fill pads and associated structures.

BACKGROUND:

The Floodplain Management Ordinance (Ordinance) Section 16.26.040.B requires that any fill placed in a regulatory floodplain be adequately protected from erosion by rip-rap, vegetative cover, bulk-heading, or other approved method, but does not establish appropriate levels of erosion protection based on the hazards that may be encountered due to the erosive forces of moving water. In addition, the Ordinance encourages the placement of the least amount of fill necessary to achieve the purpose.

Historically, the need for erosion protection has not been strictly addressed at the time of permitting and therefore, erosion protection may not have been provided. The March 23, 2006 version of the policy addressed this deficiency with reference to the following publications:

- The FEMA publication, *Manufactured Home Installation in Flood Hazard Areas, FEMA85,* published in September 1985.
- The 2005 draft of *FEMA85.*
- The City of Tucson Drainage Standards Manual.

Refer to the March 23, 2006 version of the policy for a discussion regarding these publications.

Since 2006, new requirements have been promulgated and new information has become available, both of which affect this policy. The new requirements and information are as follows:

1) In October 2008, the State of Arizona's Office of Manufactured Housing (OMH) informed the District of new federal installation requirements for Manufactured Homes. One of these new requirements was for engineered foundations in all floodplains. These new requirements would become effective on January 1, 2009.

2) On January 3, 2009, the Chief Engineer approved Technical Policy *TECH-003* which established construction standards for manufactured home foundations. These were considered by the District to be engineered foundations that were compliant with OMH requirements.

3) On February 19, 2009, the Arizona Housing Association requested that the District reevaluate the standards for fill pads in an effort to reduce the fill pad dimension to 10 feet around the exterior

wall of a structure from 25 feet in order to reduce construction costs while offering the same level of protection.

4) The District commenced an evaluation of the flooding effects on fill pads using FLO-2D modeling. This reanalysis provided significant insights regarding the flow of water around fill pads, demonstrating that the previous policy may not have offered sufficient protection at the upstream edge and corners of fill pads, and may have been over protective at the downstream edge of fill pads.

5) Figure 006-D added in 2019 in order to provide additional flexibility and improve constructability.

POLICY:

This policy may be used to determine erosion protection for fill pads, including toe down depths, rip-rap size, and pad side slope, as long as the following conditions are met:

1) The fill pad does not encroach into an erosion hazard setback or erosion hazard area, a study area that establishes a requirement for an engineering analysis or an area that the District has determined that, due to unusual conditions, engineering is required. If a fill pad is proposed in these areas, the engineering analysis requirements supersede this policy.

2) For a manufactured home installed on a fill pad, OMH standard details shall be used for flow depths of one foot or less. The use of District standard details or a site-specific engineered design is required when the parameters for the use of OMH details are exceeded.

3) The fill pad is constructed according to the appropriate fill pad width tables. Tables have been provided for a 40 foot wide fill pad and an 80 foot wide fill pad. The use of Table 006-A is limited to fill pads that are 40 feet wide or less and the use of Table 006-B is limited to fill pads wider than 40 feet but no wider than 80 feet.

4) Fill pad erosion protection shall be constructed at the following locations as prescribed below:
   a. When the fill pad is surrounded by floodwaters:
      i. A toe-down depth is prescribed along the entire upstream edge of the fill pad and at least 10 feet along the sides of the fill pad extending from the upstream corners,
      ii. A second toe-down depth is prescribed along the remaining perimeter of the fill pad,
      iii. The rip-rap diameter sizing table shall apply to the entire fill pad.
   b. When the fill pad is not surrounded by floodwaters:
      i. One toe-down is prescribed along the upstream edge and at least 10 feet along the side of the fill pad that are located within the 100-year floodplain,
      ii. A second toe-down depth is prescribed along the remaining perimeter of the fill pad that experiences flood flows,
      iii. The rip-rap diameter sizing table shall apply to all portions of the fill pad that are located within the 100-year floodplain,
      iv. The portions of the fill pad that are not exposed to floodwaters do not require erosion protection.

5) The fill pad is oriented with the long axis parallel to the direction of flow. This will minimize the flow obstruction and reduce the anticipated scour depths to those shown in the attached Tables.

6) The fill pad shall be constructed at or above the BFE and shall extend at such elevation a minimum of 10 feet from the perimeter of the structure.
   a. The top of the fill pad shall be sloped a minimum of 2% in order to provide positive drainage away from the structure. As a result, the portion of fill pad adjacent to the structure will be a minimum of 0.2 feet (2.4") above the BFE.
   b. Once the fill pad extends 10 feet beyond the exterior walls of the structure, it shall be sloped down to natural grade,
      i. The side slopes shall be no steeper than 3:1 when no erosion protection or dumped rock rip-rap erosion protection is proposed.
      ii. The side slopes may be as steep as 1:1 when grouted rip-rap or gunite slope erosion protection is proposed.
      iii. In some circumstances, as described below, the use of a concrete/CMU cut-off wall may be used to provide fill pad erosion protection.

7) Erosion protection shall be constructed pursuant to the following description, and shall be considered the minimum necessary unless an alternative is justified by an Arizona registered engineer:

   a. Toe-down – The toe-down refers to the depth below natural grade of the erosion protection and may be constructed in one of two ways. Either the rip-rap can be continued at the same side slope below natural grade until the upper surface of the rip-rap reaches the required toe-down depth, or the below grade portion may be constructed as a 12-inch thick vertical concrete cut-off wall that extends below natural grade to the toe-down depth. It is not acceptable to place the rip-rap vertically below natural grade. See Figures 006 A, B, C and D for additional requirements.
   b. Rip-rap sizing - The site plan shall specify the diameter (D_{50}) of the rip-rap from the appropriate Table and shall contain a note that states that the rip-rap is angular, durable, free of organic material, and meets the requirements provided on the construction detail. In addition, the site plan shall specify that the fill be protected by the use of geo-textile filter fabric underlying rock rip-rap, that the minimum rip-rap blanket thickness be twice the diameter of the minimum rip-rap diameter (D_{50}), and extend below natural grade to the required toe-down depth. See Figures for fill pad construction for additional requirements.
   c. For a specific range of flow depth and ground slope conditions, Tables 006-A and –B specify that erosion protection is required only at the upstream edge and corners of the fill pad. Under these conditions, an additional option of constructing a vertical cut-off wall is available, as illustrated in Figure 006-D. This option eliminates the rip-rap component and uses a vertical wall that extends above grade to the BFE (minimum) and below grade to the required toe-down depth (minimum).

8) Fill pad details and specifications shall either be provided in the building plan set, or the appropriate Figure(s) shall be referenced on the site plan.

APPROVED BY:

_____ _____

Suzanne Shields, P.E. **Date**
Director and Chief Engineer

Original Policy Approved: 3/23/06
Date(s) Revised: 8/31/09, 11/2/15, 5/18/21

TABLE 006-A

40 Foot Wide Fill Pad

RIP-RAP SIZE & TOE-DOWN DEPTH REQUIREMENTS FOR EROSION PROTECTION OF FILL PADS
PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT TECHNICAL POLICY TECH-006

TOE-DOWN DEPTH BELOW NATURAL GRADE FOR UPSTREAM EDGE AND CORNERS OF 40 FOOT WIDE FILL PAD

Flow Depth, ft	slope, ft/ft														
	0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.50															
1.00															
1.50															
2.00															
2.50															
3.00															

TOE-DOWN DEPTH BELOW NATURAL GRADE FOR SIDES AND DOWNSTREAM EDGE OF 40 FOOT WIDE FILL PAD

Flow Depth, ft	slope, ft/ft														
	0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.50															
1.00															
1.50															
2.00															
2.50															
3.00															

= DV^2 greater than 18		= no toe-down required, see below for rip-rap size for exposed slopes	24 Inches	= 24 inch toe-down required, see below for rip-rap size	36 inches	= 36 inch toe-down required, see below for rip-rap size	48 inches	= 48 inch toe-down required, see below for rip-rap size		= Engineering required

RIP-RAP SIZE (D50)

Flow Depth, ft	slope, ft/ft														
	0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.50															
1.00															
1.50															
2.00															
2.50															
3.00															

= DV^2 greater than 18		None/6 in.	= No rip-rap on sides, back; 6 inch rip-rap on front and upstream corners	6 inches	= 6 inch rip-rap	9 inches	= 9 inch rip-rap		= Engineering required

TABLE 006-B

80 Foot Wide Fill Pad

RIP-RAP SIZE & TOE-DOWN DEPTH REQUIREMENTS FOR EROSION PROTECTION OF FILL PADS
PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT TECHNICAL POLICY TECH-006

TOE-DOWN DEPTH BELOW NATURAL GRADE FOR UPSTREAM EDGE AND CORNERS OF 80 FOOT WIDE FILL PAD

Flow Depth, ft	slope, ft/ft 0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.50															
1.00															
1.50															
2.00															
2.50															
3.00															

TOE-DOWN DEPTH BELOW NATURAL GRADE FOR SIDES AND DOWNSTREAM EDGE OF 80 FOOT WIDE FILL PAD

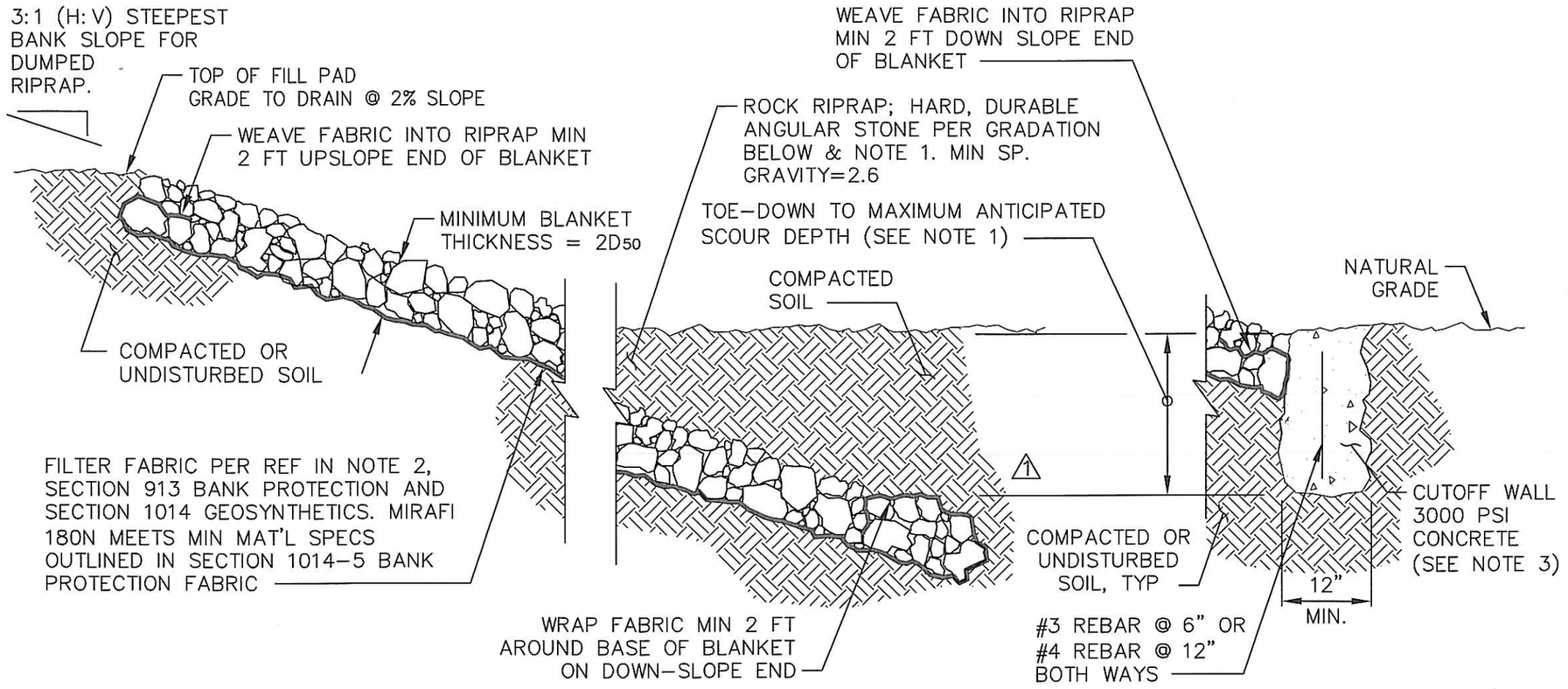
Flow Depth, ft	slope, ft/ft 0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.50															
1.00															
1.50															
2.00															
2.50															
3.00															

= DV^2 greater than 18		**= no toe-down required, see below for rip-rap size for exposed slopes**	**24 Inches**	**= 24 inch toe-down required, see below for rip-rap size**	**36 inches**	**= 36 inch toe-down required, see below for rip-rap size**	**48 inches**	**= 48 inch toe-down required, see below for rip-rap size**	**= Engineering required**

RIP-RAP SIZE (D50)

Flow Depth, ft	slope, ft/ft 0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.50															
1.00															
1.50															
2.00															
2.50															
3.00															

= DV^2 greater than 18			**None/6 in.**	**= No rip-rap on sides, back; 6 inch rip-rap on front and upstream corners**	**6 inches**	**= 6 inch rip-rap**	**9 inches**	**= 9 inch rip-rap**	**= Engineering required**



OPTION A
EXTENSION OF DUMPED RIPRAP BLANKET BELOW GRADE

OPTION B
CONCRETE CUTOFF WALL BELOW GRADE

NOTES

1. D_{50} AND TOE-DOWN DEPTH FROM TABLE TITLED: "RIPRAP AND TOE-DOWN REQUIREMENTS FOR EROSION PROTECTION OF FILL PADS IN FLOODWAY FRINGE AREAS":
   TABLE 006-A 40-FOOT WIDE FILL PAD, AND
   TABLE 006-B 80-FOOT WIDE FILL PAD

2. UNLESS NOTED OTHERWISE HEREIN, ALL MATERIAL & INSTALLATION PER "STANDARD SPECIFICATIONS FOR PUBLIC IMPROVEMENTS", CURRENT ED.

3. CONCRETE CUTOFF WALL (OPTION B) MAY BE SUBSTITUTED FOR TOE-DOWN OF DUMPED RIPRAP BLANKET (OPTION A) BELOW GRADE. (OPTIONS A AND B SHOWN ABOVE REFER ONLY TO THE BELOW GRADE PORTION OF THE EROSION PROTECTION. SELECTED OPTION MUST BE USED EXCLUSIVELY. A HYBRID OF THE TWO OPTIONS IS NOT ALLOWED.)

DUMPED/HAND-PLACED RIPRAP GRADATION	
% PASSING	SIZE
100 - 90	2.00 D_{50}
85 - 70	1.50 D_{50}
50 - 30	1.00 D_{50}
15 - 5	0.67 D_{50}
5 - 0	0.33 D_{50}

1 6/15/10 FIX TOE-DOWN

Registered Professional Engineer (Civil) CERTIFICATE NO. 15610 SUZANNE J. SHIELDS DATE SIGNED 6/15/2010 ARIZONA U.S.A.

THE SEAL OF PIMA COUNTY ARIZONA

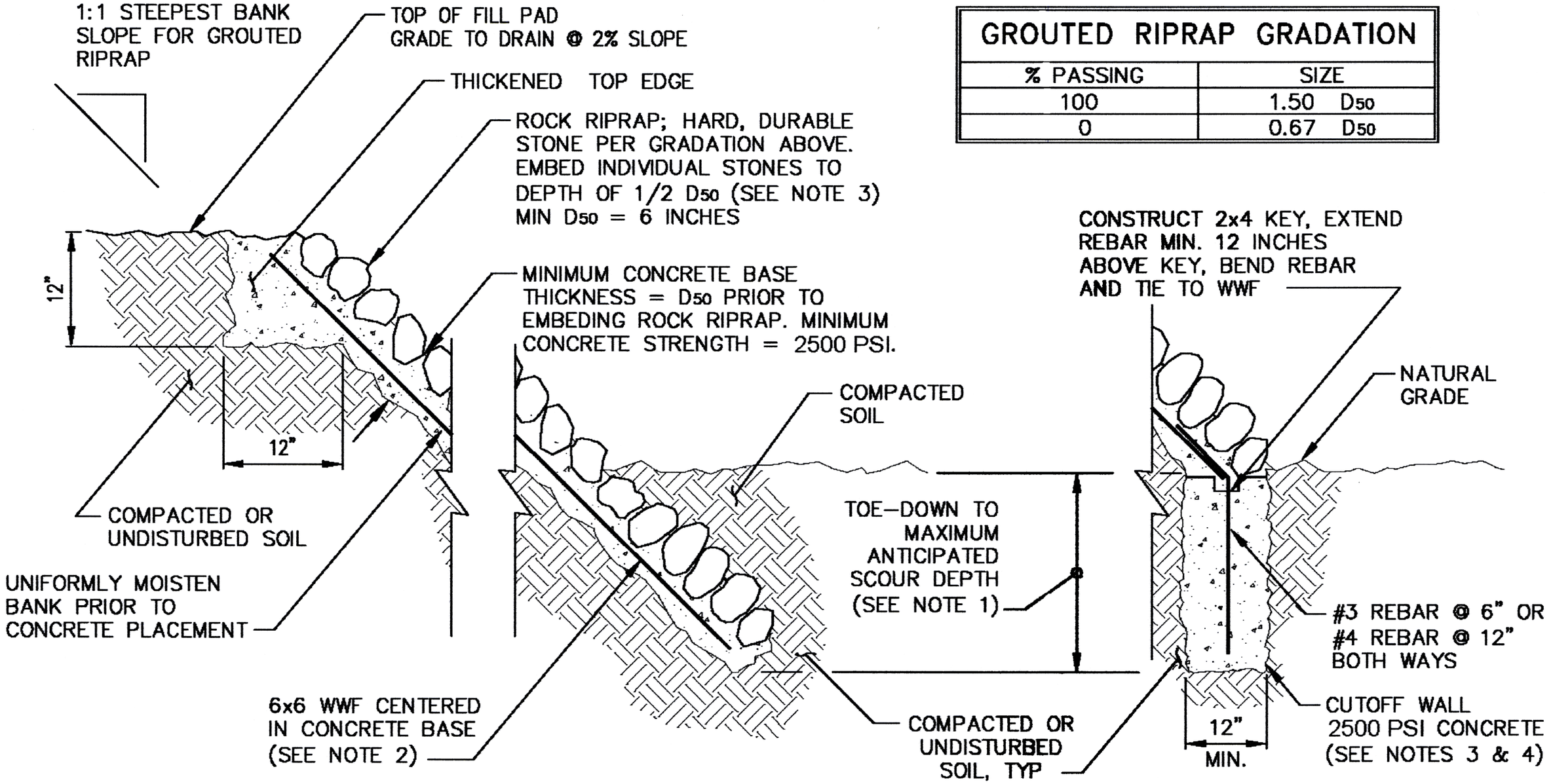
Pima County Regional FLOOD CONTROL DISTRICT

FIGURE 006-A
DUMPED RIPRAP EROSION PROTECTION OF FILL PADS IN FLOODWAY FRINGE AREAS

SCALE: NONE | DRAWN BY: sak | DATE: AUG 2009

I:\Data\FPM-division\Rules and Policies\Technical Policies and Procedures\Tech 006 supporting docs\TECH 006 Fg 006-A.dwg, 6/16/2010 8:12:31 AM

GROUTED RIPRAP GRADATION	
% PASSING	SIZE
100	1.50 D_{50}
0	0.67 D_{50}



OPTION A
EXTENTION OF GROUTED RIPRAP BLANKET BELOW GRADE

OPTION B
CUTOFF WALL BELOW GRADE

NOTES

1. TOE-DOWN DEPTH FROM TABLE TITLED: "RIPRAP AND TOE-DOWN REQUIREMENTS FOR EROSION PROTECTION OF FILL PADS IN FLOODWAY FRINGE AREAS":
   TABLE 006-A 40-FOOT WIDE FILL PAD, AND
   TABLE 006-B 80-FOOT WIDE FILL PAD
2. FOR D_{50}=6 INCHES, USE W3.5xW3.5. FOR D_{50}=9 INCHES, USE W5.5 x W5.5.
3. UNLESS NOTED OTHERWISE HEREIN, ALL MATERIAL & INSTALLATION PER STANDARD SPECIFICATIONS FOR PUBLIC IMPROVEMENTS", CURRENT ED.
4. CONCRETE CUTOFF WALL (OPTION B) MAY BE SUBSTITUTED FOR TOE-DOWN OF GROUTED RIPRAP BLANKET (OPTION A) BELOW GRADE. (OPTIONS A AND B SHOWN ABOVE REFER ONLY TO THE BELOW GRADE PORTION OF THE EROSION PROTECTION. SELECTED OPTION MUST BE USED EXCLUSIVELY. A HYBRID OF THE TWO OPTIONS IS NOT ALLOWED.)

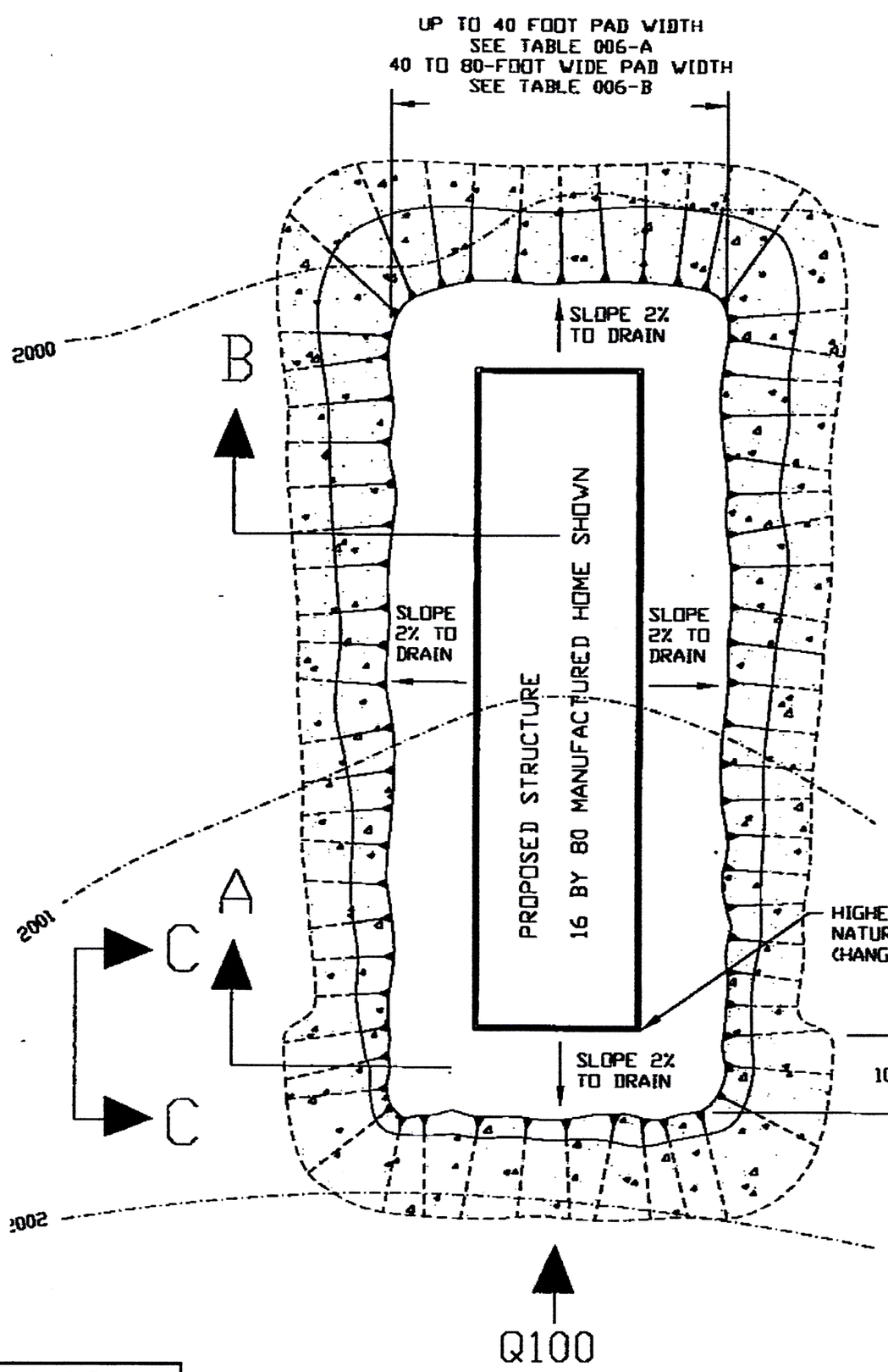
Pima County Regional FLOOD CONTROL DISTRICT

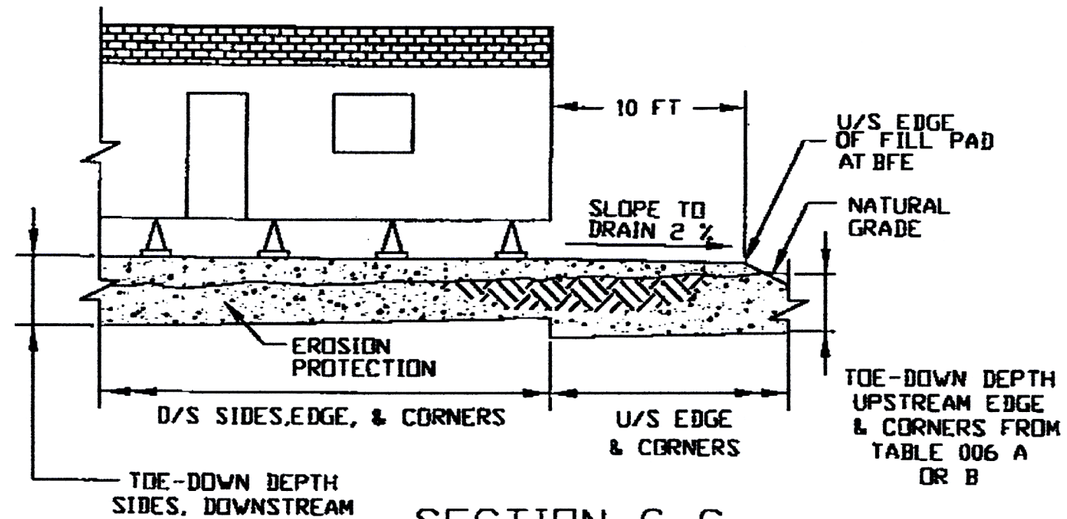
Registered Professional Engineer (Civil) CERTIFICATE NO. 15610 SUZANNE J. SHIELDS DATE SIGNED 9/2/09 ARIZONA U.S.A.
EXPIRES 6/30/2010

THE SEAL OF PIMA COUNTY ARIZONA

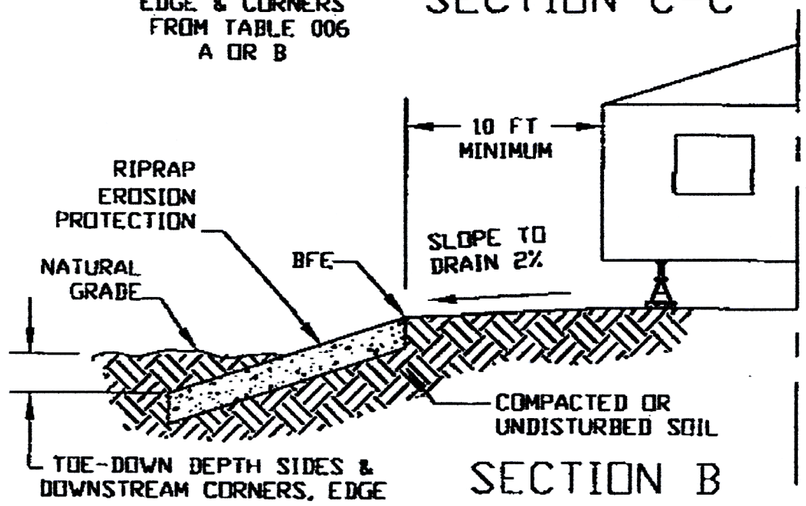
FIGURE 006-B
GROUTED RIPRAP EROSION PROTECTION OF FILL PADS IN FLOODWAY FRINGE AREAS

SCALE: NONE DRAWN BY: sak DATE: AUG 2009

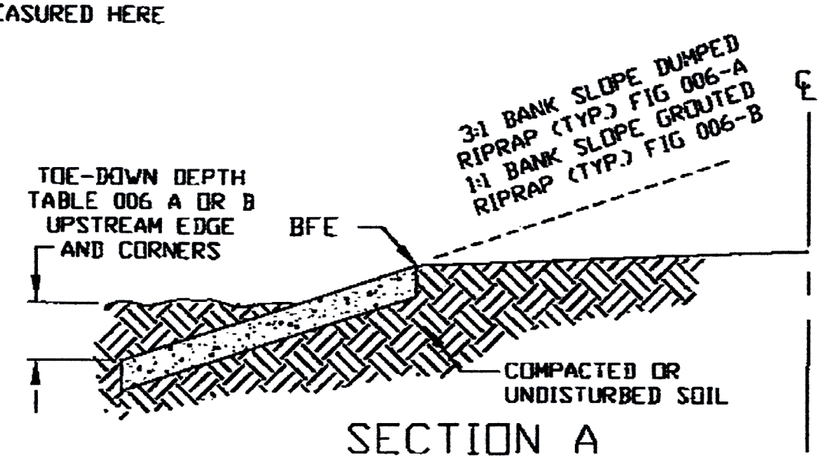




SECTION C-C



SECTION B



SECTION A

NOTES:

1. EXAMPLE SHOWN: 100-YR FLOW DEPTH = 1 FT, HANG = 2001.5 FT EL. LAND SLOPE = 0.022, 16 FT BY 80 FT MH, FILL PAD WIDTH = 36 FT, FROM TABLE 006-A (FOR 40-WIDE FILL PAD): D50 = 9-IN., TOE-DOWN U/S EDGE, CORNERS = 3 FT, TOE-DOWN SIDES, D/S EDGE CORNERS = 2 FT.

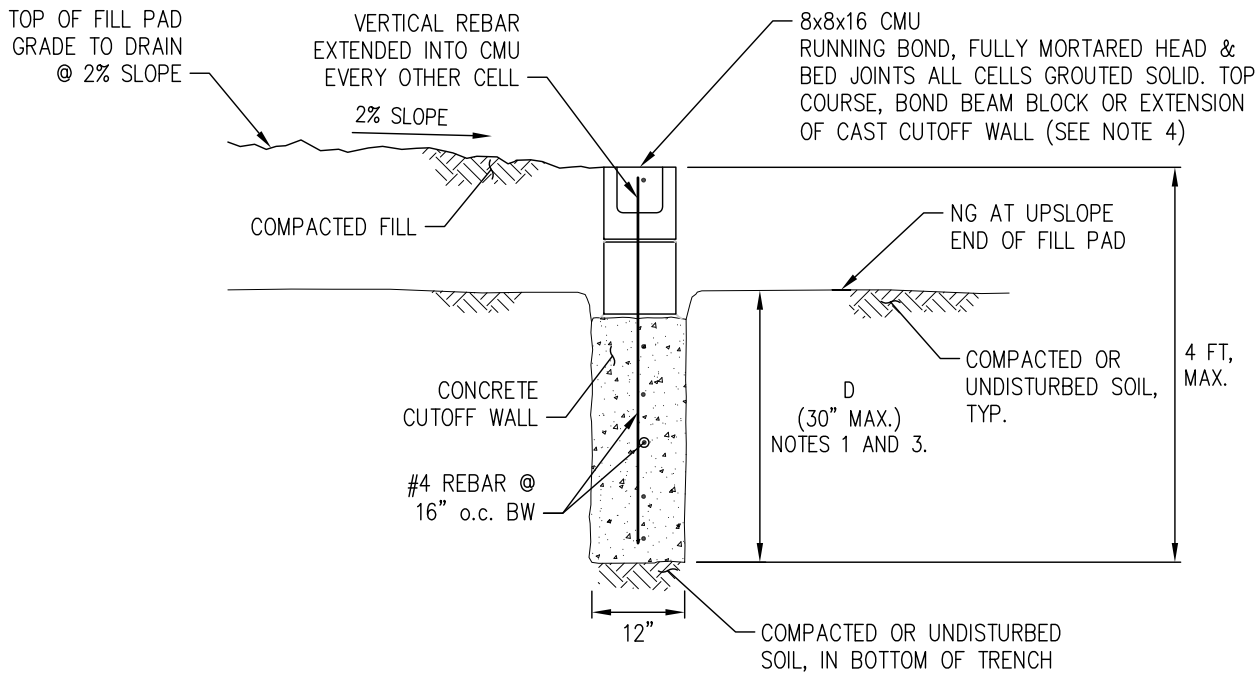
Pima County Regional FLOOD CONTROL DISTRICT

FIGURE 006-C

GROUTED OR DUMPED RIPRAP EROSION PROTECTION OF FILL PADS IN FLOODWAY FRINGE AREAS

SCALE: NONE DRAWN BY: sak DATE: AUG 2009

THE SEAL of PIMA COUNTY ARIZONA



ABBREVIATIONS

BW = BOTH WAYS
BFE = BASE FLOOD ELEVATION
CMU = CONCRETE MASONRY UNIT
D = TOE-DOWN DEPTH
d = DEPTH OF EXISTING FOOTER
FFE = FINISH FLOOR ELEVATION
HANG = HIGHEST ADJACENT NATURAL GRADE
ksi = KILOPOUND PER SQUARE INCH
NG = NATURAL GROUND
N.T.S. = NOT TO SCALE
o.c = ON CENTER
SSPI = PC/DOT STANDARD SPECIFICATIONS for PUBLIC IMPROVEMENT
WWF = WELDED WIRE FABRIC

NOTES

1. TOE-DOWN DEPTH FROM TABLE 006-A OR 006-B.
2. MATERIALS: CONCRETE 3000 PSI; REBAR 60 ksi, CMU ASTM C-90 TYPE I OR II, MORTAR TYPE M, N, OR S PER ASTM C-270, GROUT PER ASTM VC-476.
3. THIS OPTION IS APPLICABLE TO FILL PADS REQUIRING ONLY UPSTREAM EROSION PROTECTION. APPLICATION TO OTHER CONFIGURATIONS REQUIRES PRE-APPROVAL BY THE DISTRICT.
4. FORMED CONCRETE OF DIMENSIONAL & MATERIAL CHARACTERISTICS IDENTICAL TO THE CUTOFF WALL MAY BE SUBSTITUTED FOR CMU.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
15610
Suzanne J.
Shields
Date Signed
ARIZONA, U.S.A.

PIMA COUNTY
FLOOD CONTROL

FIGURE 006-D
VERTICAL WALL EROSION PROTECTION OF FILL PADS IN FLOODWAY FRINGE AREAS

SCALE: None | DRAWN BY: sak | DATE: July 2019

THE SEAL of PIMA COUNTY ARIZONA

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT
TECHNICAL POLICY

POLICY NO.: Technical Policy, TECH-006 **EFFECTIVE DATE: March 23, 2006**
REVISED DATE: ~~8/31/2009,~~ ~~11/2/2015~~**5/18/21**

POLICY NAME: Erosion Protection of Fill Pads in ~~Floodway Fringe Areas~~Regulatory Floodplains

PURPOSE: To clarify Section 16.26.040.B of ~~the~~ Ordinance regarding the protection of ~~the~~ fill pads from erosion in order to establish consistent permitting requirements that ~~are~~ provide sufficient~~ly~~ erosion protection~~ve of the~~ for fill pads and associated structures ~~for the flood and erosion hazards that have been identified~~.

BACKGROUND:

The Floodplain Management Ordinance (Ordinance) Section 16.26.040.B requires that any fill placed in a ~~floodway fringe~~regulatory floodplain be adequately protected from erosion by rip-rap, vegetative cover, bulk-heading, or other approved method, but does not establish appropriate levels of erosion protection based on the hazards that may be encountered due to the erosive forces of moving water. In addition, the Ordinance encourages the placement of the least amount of fill necessary to achieve the purpose.

Historically, the need for erosion protection has not been strictly addressed at the time of permitting and therefore, erosion protection may not have been provided. The March 23, 2006 version of the policy addressed this deficiency with reference to the following publications:

- ~~1)~~ The FEMA publication, *Manufactured Home Installation in Flood Hazard Areas, FEMA85*, published in September 1985.
- ~~2)~~ The 2005 draft of *FEMA85.*
- ~~3)~~ The City of Tucson Drainage Standards Manual.

Refer to the March 23, 2006 version of the policy for a discussion regarding ~~about~~ these publications.

Since 2006, new requirements have been promulgated and new information has become available, both of which affect this policy. The new requirements and information are as follows:

1) In October 2008, the State of Arizona's Office of Manufactured Housing (OMH) informed the District of new federal installation requirements for Manufactured Homes. One of these new requirements was for engineered foundations in all floodplains. These new requirements would become effective on January 1, 2009.

2) On January 3, 2009, the Chief Engineer approved Technical Policy *TECH-003* which established construction standards for manufactured home foundations. These were considered by the District to be engineered foundations that were compliant with OMH requirements.

3) On February 19, 2009, the Arizona Housing Association requested that the District reevaluate the standards for fill pads in an effort to reduce the fill pad dimension to 10 feet around the exterior wall of a structure from 25 feet in order to reduce construction costs while offering the same level of protection.

4) The District commenced an evaluation of the flooding effects on fill pads using FLO-2D modeling. This reanalysis provided significant insights regarding the flow of water around fill pads, demonstrating that the previous policy may not have offered sufficient protection at the upstream edge and corners of fill pads, and may have been over protective at the downstream edge of fill pads.

5) Figure 006-D added in 2019 in order to provide additional flexibility and improve constructability.

POLICY:

This policy may be used to determine erosion protection for fill pads, including toe down depths, rip-rap size, and pad side slope, as long as the following conditions are met:

1) The fill pad does not encroach into an ~~E~~erosion ~~H~~hazard ~~S~~setback or erosion hazard area, a study area that establishes a requirement for an engineering analysis or an area that the District has determined that, due to unusual conditions, engineering is required. If a fill pad is proposed in these areas, the engineering analysis requirements supersede this policy.

2) For a manufactured home installed on a fill pad, OMH standard details shall be used for flow depths of one foot or less. The use of District standard details or a site-specific engineered design is required when the parameters for the use of OMH details are exceeded.

~~2)~~3)The fill pad~~s~~ ~~are~~is constructed according to the appropriate fill pad width tables. Tables have been provided for a 40 foot wide fill pad and an 80 foot wide fill pad. ~~-~~The use of Table 006-A ~~may be used for~~ is limited to fill pads that are 40 feet wide or less~~, but~~ and the use of Table 006-B ~~shall be used for~~ is limited to fill pads ~~with widths greater~~ wider than 40 feet~~, up to and including~~ but no wider than 80 feet.

~~3)~~4)Fill pad erosion protection shall be constructed at the following locations as prescribed below:

a. When the fill pad is surrounded by floodwaters:
   i. A toe-down depth is prescribed along the entire upstream edge of the fill pad and at least 10 feet along the sides of the fill pad extending from the upstream corners,
   ii. A second toe-down depth is prescribed along the remaining perimeter of the fill pad,
   iii. The rip-rap diameter sizing table shall apply to the entire fill pad.
b. When the fill pad is not surrounded by floodwaters:
   i. One toe-down is prescribed along the upstream edge and at least 10 feet along the side of the fill pad that are located within the 100-year floodplain,

ii. A second toe-down depth is prescribed along the remaining perimeter of the fill pad that experiences flood flows,
iii. The rip-rap diameter sizing table shall apply to all portions of the fill pad that are located within the 100-year floodplain,
iv. The portions of the fill pad that are not exposed to floodwaters do not require erosion protection.

~~c.~~

~~4)~~5)The fill pad is oriented with the long axis parallel to the direction of flow. This will minimize the flow obstruction and reduce the anticipated scour depths to those ~~presented~~ shown in the attached Tables.

~~5)~~6)The fill pad shall be constructed at or above the BFE and shall extend at ~~that~~ such elevation a minimum of 10 feet from the perimeter of the structure.
a. The top of the fill pad shall be sloped a minimum of 2% in order to provide positive drainage away from the structure. As a result, the portion of fill pad adjacent to the structure will be a minimum of 0.2 feet (2.4") above the BFE.
b. Once the fill pad extends 10 feet beyond the exterior walls of the structure, it ~~may~~ shall be sloped down to natural grade,
i. The side slopes shall be no steeper than 3:1 when no erosion protection or dumped rock rip-rap erosion protection is proposed.
ii. The side slopes may be as steep as 1:1 when grouted rip-rap or gunite slope erosion protection is proposed.
iii. In some circumstances, as described below, the use of a concrete/CMU cut-off wall may be used to provide fill pad erosion protection.

~~6)~~7)Erosion protection shall be constructed pursuant to the following description, and shall be considered the minimum ~~amount~~ necessary unless an alternative is justified by an Arizona registered engineer:

a. Toe-down – The toe-down refers to the depth below natural grade of the erosion protection and may be constructed in one of two ways. Either the rip-rap can be continued at the same side slope below natural grade until the upper surface of the rip-rap reaches the required toe-down depth, or the below grade portion may be constructed as a 12-inch thick vertical concrete cut-off wall that extends below natural grade to the toe-down depth. ~~-~~It is not~~NOT~~ acceptable to place the rip-rap vertically below natural grade. ~~-~~See Figures 006 A, ~~b~~B, ~~and~~ C and D ~~for fill pad construction~~ for additional requirements.

b. Rip-rap sizing - The site plan shall specify the diameter (D_{50}) of the rip-rap from the appropriate Table and shall contain a note that states that the rip-rap is angular, durable, free of organic material, and meets the requirements provided on the construction detail. In addition, the site plan shall specify that the fill be protected by the use of geo-textile filter fabric underlying rip-rap, that the minimum rip-rap blanket thickness be twice the diameter of the minimum rip-rap diameter (D_{50})~~-~~, and extend below natural grade to the required toe-down depth. See Figures for fill pad construction for additional requirements.

c. For a specific range of flow depth and ground slope conditions, Tables 006-A and –B specify that erosion protection is required only at the upstream edge and corners of the fill pad. Under these conditions, an additional option of constructing a vertical cut-off wall is available, as illustrated in Figure 006-D. This option eliminates the rip-rap component and uses a vertical wall that extends above grade to the BFE (minimum) and below grade to the required toe-down depth (minimum).

~~7)~~8) Fill pad details and specifications shall either be ~~shown on the site~~ provided in the building plan set, or the appropriate Figure(s) shall be referenced on the site plan.

APPROVED BY:

Suzanne Shields, P.E. **Date**
Director and Chief Engineer

Original Policy Approved: 3/23/06
Date(s) Revised: 8/31/09, 11/2/15, 5/18/21

TABLE 006-A

40 Foot Wide Fill Pad

RIP-RAP SIZE & TOE-DOWN DEPTH REQUIREMENTS FOR EROSION PROTECTION OF FILL PADS
PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT TECHNICAL POLICY TECH-006

TOE-DOWN DEPTH BELOW NATURAL GRADE FOR UPSTREAM EDGE AND CORNERS OF 40 FOOT WIDE FILL PAD

Flow Depth, ft	slope, ft/ft														
	0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.50															
1.00															
1.50															
2.00															
2.50															
3.00															

TOE-DOWN DEPTH BELOW NATURAL GRADE FOR SIDES AND DOWNSTREAM EDGE OF 40 FOOT WIDE FILL PAD

Flow Depth, ft	slope, ft/ft														
	0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.50															
1.00															
1.50															
2.00															
2.50															
3.00															

= DV^2 greater than 18		= no toe-down required, see below for rip-rap size for exposed slopes	24 Inches	= 24 inch toe-down required, see below for rip-rap size	36 inches	= 36 inch toe-down required, see below for rip-rap size	48 inches	= 48 inch toe-down required, see below for rip-rap size		= Engineering required

RIP-RAP SIZE (D50)

Flow Depth, ft	slope, ft/ft														
	0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.50															
1.00															
1.50															
2.00															
2.50															
3.00															

= DV^2 greater than 18		None/6 in.	= No rip-rap on sides, back; 6 inch rip-rap on front and upstream corners	6 inches	= 6 inch rip-rap	9 inches	= 9 inch rip-rap		= Engineering required

TABLE 006-B

80 Foot Wide Fill Pad

RIP-RAP SIZE & TOE-DOWN DEPTH REQUIREMENTS FOR EROSION PROTECTION OF FILL PADS
PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT TECHNICAL POLICY TECH-006

TOE-DOWN DEPTH BELOW NATURAL GRADE FOR UPSTREAM EDGE AND CORNERS OF 80 FOOT WIDE FILL PAD

Flow Depth, ft	slope, ft/ft 0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.50															
1.00															
1.50															
2.00															
2.50															
3.00															

TOE-DOWN DEPTH BELOW NATURAL GRADE FOR SIDES AND DOWNSTREAM EDGE OF 80 FOOT WIDE FILL PAD

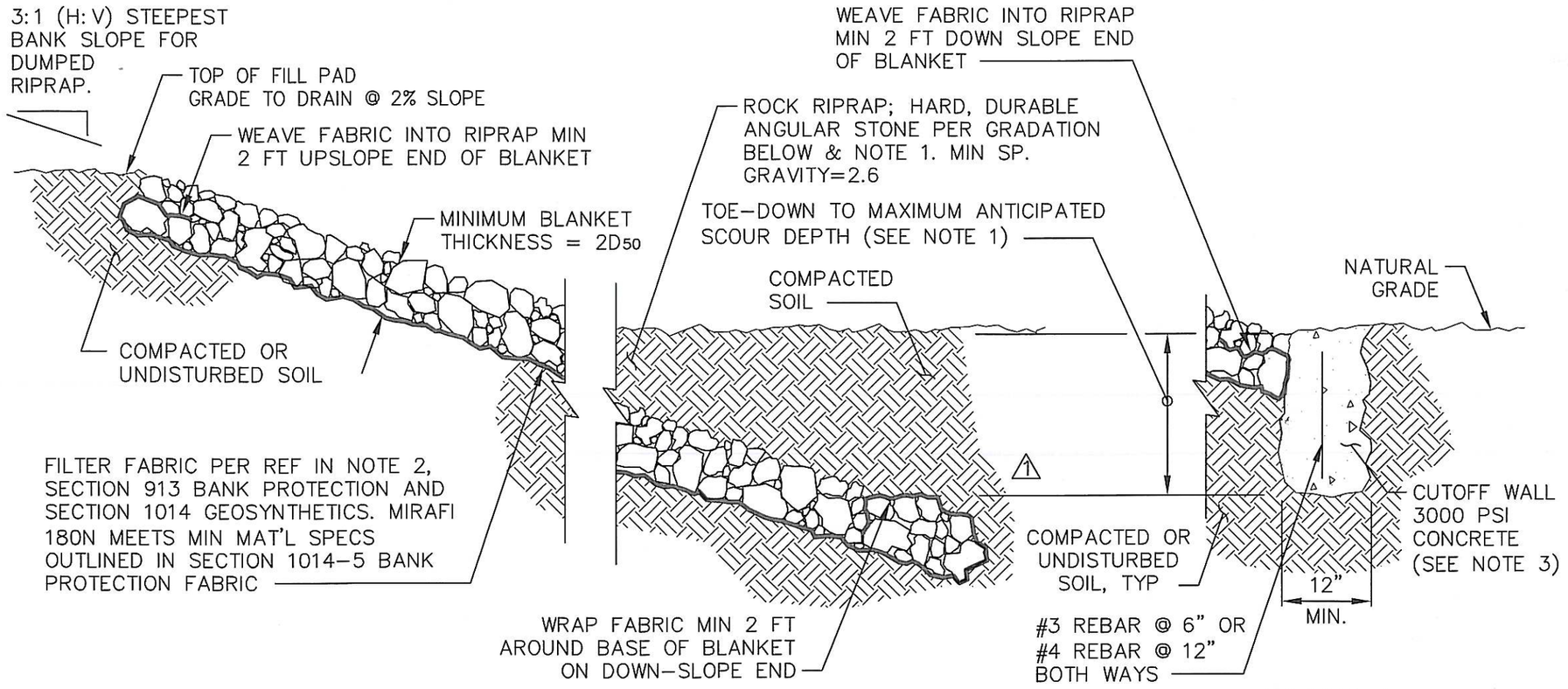
Flow Depth, ft	slope, ft/ft 0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.50															
1.00															
1.50															
2.00															
2.50															
3.00															

= DV^2 greater than 18		**= no toe-down required, see below for rip-rap size for exposed slopes**	**24 Inches**	**= 24 inch toe-down required, see below for rip-rap size**	**36 inches**	**= 36 inch toe-down required, see below for rip-rap size**	**48 inches**	**= 48 inch toe-down required, see below for rip-rap size**	**= Engineering required**

RIP-RAP SIZE (D50)

Flow Depth, ft	slope, ft/ft 0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.50															
1.00															
1.50															
2.00															
2.50															
3.00															

= DV^2 greater than 18			**None/6 in.**	**= No rip-rap on sides, back; 6 inch rip-rap on front and upstream corners**	**6 inches**	**= 6 inch rip-rap**	**9 inches**	**= 9 inch rip-rap**	**= Engineering required**



OPTION A
EXTENSION OF DUMPED RIPRAP BLANKET BELOW GRADE

OPTION B
CONCRETE CUTOFF WALL BELOW GRADE

NOTES

1. D_{50} AND TOE-DOWN DEPTH FROM TABLE TITLED: "RIPRAP AND TOE-DOWN REQUIREMENTS FOR EROSION PROTECTION OF FILL PADS IN FLOODWAY FRINGE AREAS":
   TABLE 006-A 40-FOOT WIDE FILL PAD, AND
   TABLE 006-B 80-FOOT WIDE FILL PAD

2. UNLESS NOTED OTHERWISE HEREIN, ALL MATERIAL & INSTALLATION PER "STANDARD SPECIFICATIONS FOR PUBLIC IMPROVEMENTS", CURRENT ED.

3. CONCRETE CUTOFF WALL (OPTION B) MAY BE SUBSTITUTED FOR TOE-DOWN OF DUMPED RIPRAP BLANKET (OPTION A) BELOW GRADE. (OPTIONS A AND B SHOWN ABOVE REFER ONLY TO THE BELOW GRADE PORTION OF THE EROSION PROTECTION. SELECTED OPTION MUST BE USED EXCLUSIVELY. A HYBRID OF THE TWO OPTIONS IS NOT ALLOWED.)

DUMPED/HAND-PLACED RIPRAP GRADATION	
% PASSING	SIZE
100 - 90	2.00 D_{50}
85 - 70	1.50 D_{50}
50 - 30	1.00 D_{50}
15 - 5	0.67 D_{50}
5 - 0	0.33 D_{50}

1 6/15/10 FIX TOE-DOWN

Registered Professional Engineer (Civil) CERTIFICATE NO. 15610 SUZANNE J. SHIELDS DATE SIGNED 6/15/2010 ARIZONA U.S.A.

THE SEAL OF PIMA COUNTY ARIZONA

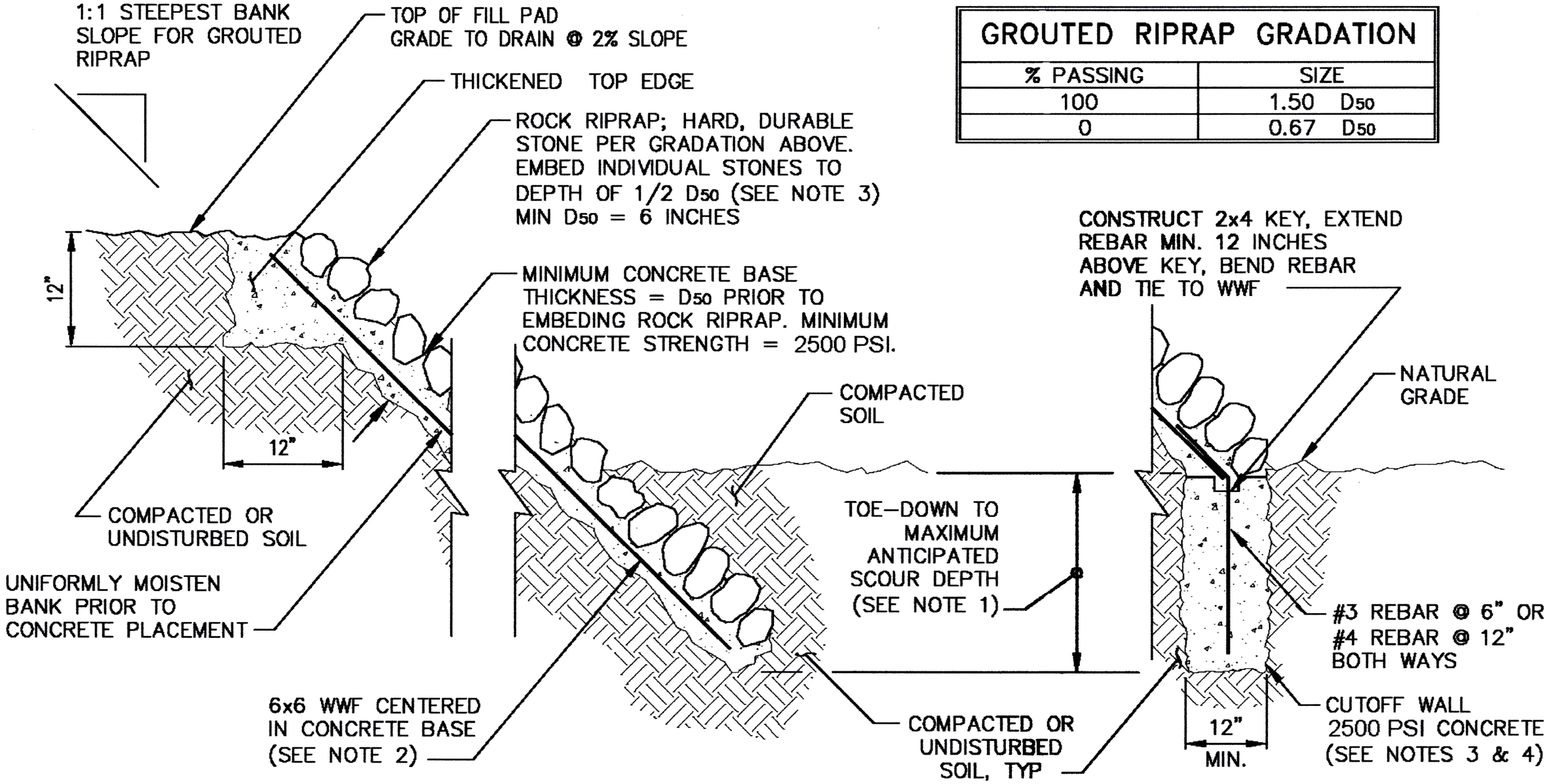
Pima County Regional FLOOD CONTROL DISTRICT

FIGURE 006-A
DUMPED RIPRAP EROSION PROTECTION OF FILL PADS IN FLOODWAY FRINGE AREAS

SCALE: NONE | DRAWN BY: sak | DATE: AUG 2009

I:\Data\FPM-division\Rules and Policies\Technical Policies and Procedures\Tech 006 supporting docs\TECH 006 Fg 006-A.dwg, 6/16/2010 8:12:31 AM

GROUTED RIPRAP GRADATION	
% PASSING	SIZE
100	1.50 D_{50}
0	0.67 D_{50}



OPTION A
EXTENTION OF GROUTED RIPRAP BLANKET BELOW GRADE

OPTION B
CUTOFF WALL BELOW GRADE

NOTES

1. TOE-DOWN DEPTH FROM TABLE TITLED: "RIPRAP AND TOE-DOWN REQUIREMENTS FOR EROSION PROTECTION OF FILL PADS IN FLOODWAY FRINGE AREAS":
   TABLE 006-A 40-FOOT WIDE FILL PAD, AND
   TABLE 006-B 80-FOOT WIDE FILL PAD
2. FOR D_{50}=6 INCHES, USE W3.5xW3.5. FOR D_{50}=9 INCHES, USE W5.5 x W5.5.
3. UNLESS NOTED OTHERWISE HEREIN, ALL MATERIAL & INSTALLATION PER STANDARD SPECIFICATIONS FOR PUBLIC IMPROVEMENTS", CURRENT ED.
4. CONCRETE CUTOFF WALL (OPTION B) MAY BE SUBSTITUTED FOR TOE-DOWN OF GROUTED RIPRAP BLANKET (OPTION A) BELOW GRADE. (OPTIONS A AND B SHOWN ABOVE REFER ONLY TO THE BELOW GRADE PORTION OF THE EROSION PROTECTION. SELECTED OPTION MUST BE USED EXCLUSIVELY. A HYBRID OF THE TWO OPTIONS IS NOT ALLOWED.)

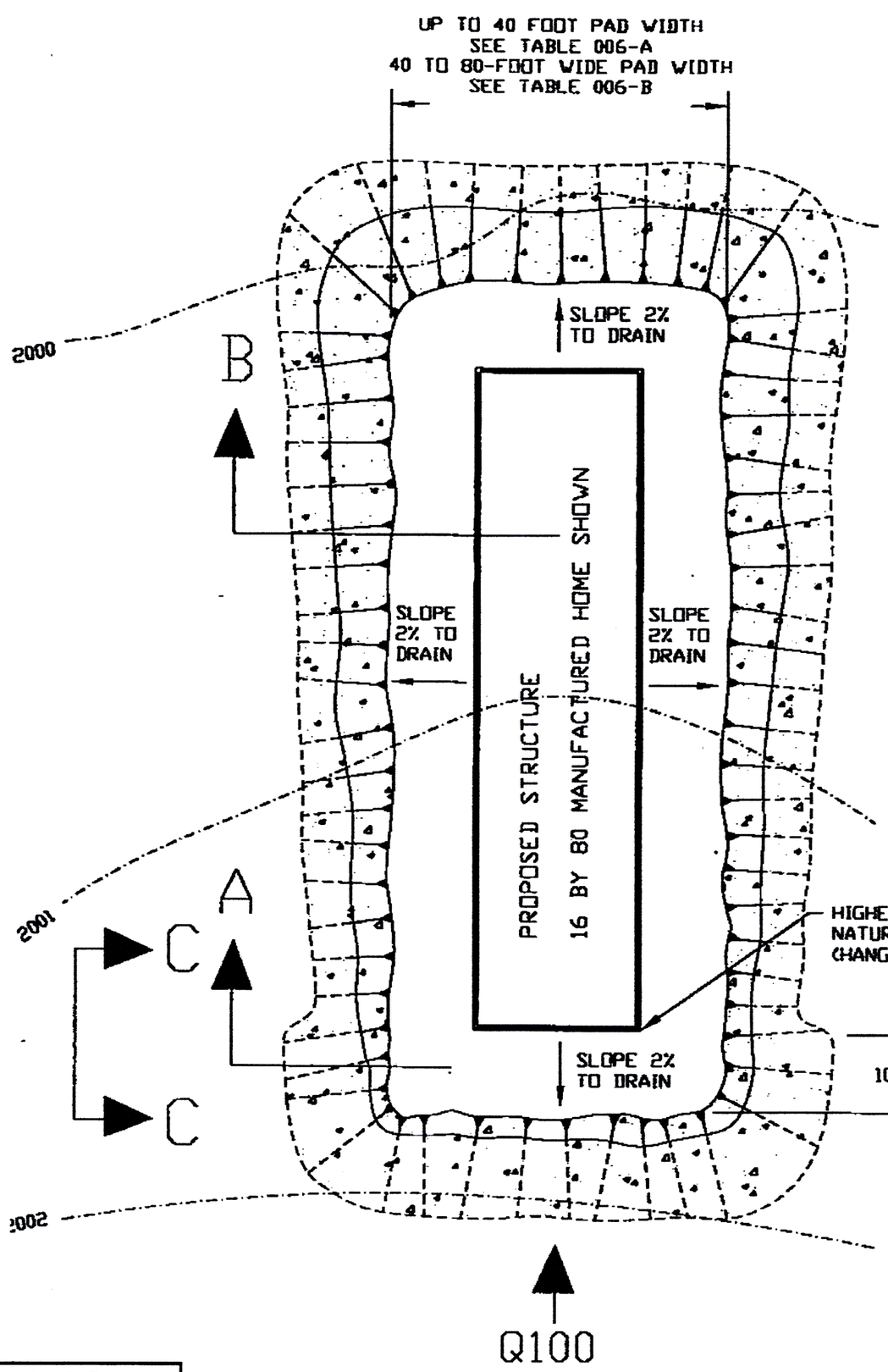
Pima County Regional FLOOD CONTROL DISTRICT

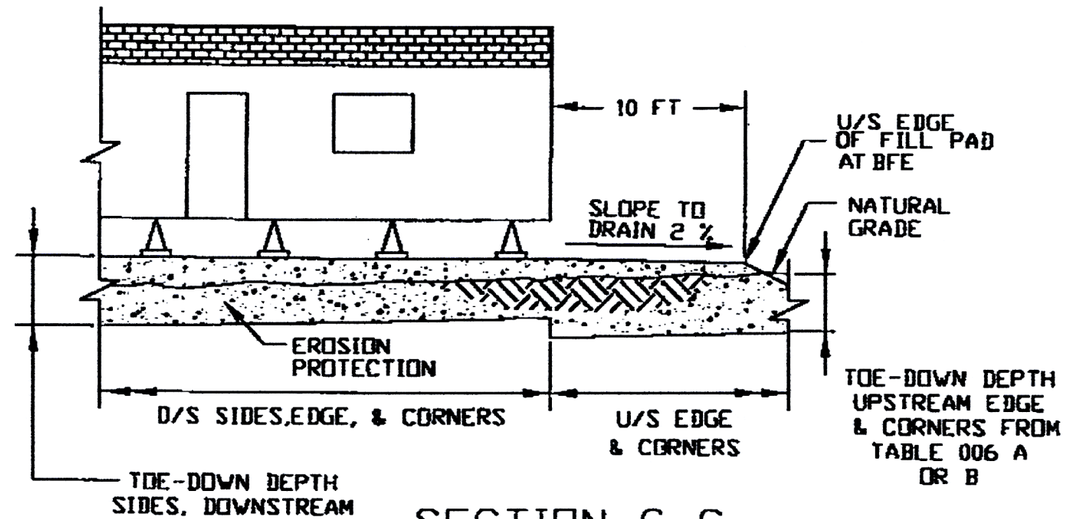
Registered Professional Engineer (Civil) CERTIFICATE NO. 15610 SUZANNE J. SHIELDS DATE SIGNED 9/2/09 ARIZONA U.S.A.
EXPIRES 6/30/2010

THE SEAL OF PIMA COUNTY ARIZONA

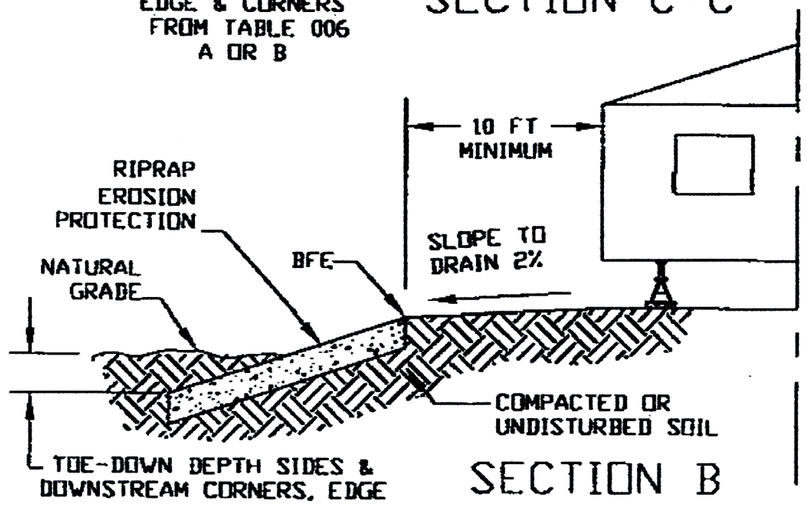
FIGURE 006-B
GROUTED RIPRAP EROSION PROTECTION OF FILL PADS IN FLOODWAY FRINGE AREAS

SCALE: NONE DRAWN BY: sak DATE: AUG 2009

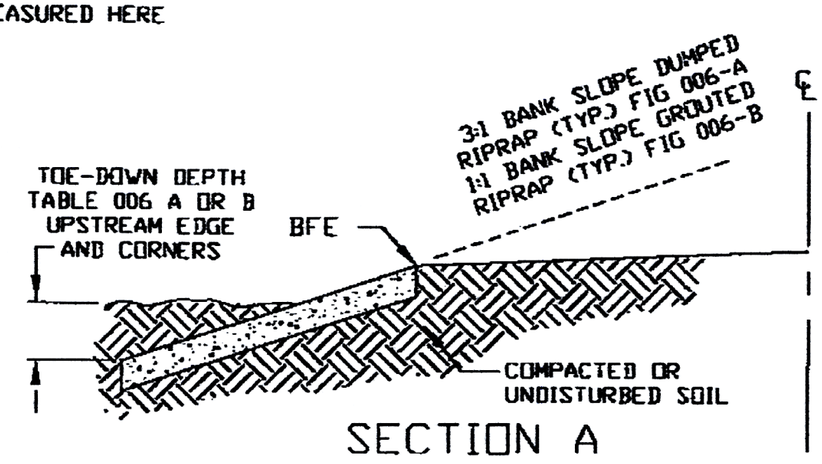




SECTION C-C



SECTION B



SECTION A

NOTES:

1. EXAMPLE SHOWN: 100-YR FLOW DEPTH = 1 FT, HANG = 2001.5 FT EL. LAND SLOPE = 0.022, 16 FT BY 80 FT MH, FILL PAD WIDTH = 36 FT, FROM TABLE 006-A (FOR 40-WIDE FILL PAD): D50 = 9-IN., TOE-DOWN U/S EDGE, CORNERS = 3 FT, TOE-DOWN SIDES, D/S EDGE CORNERS = 2 FT.

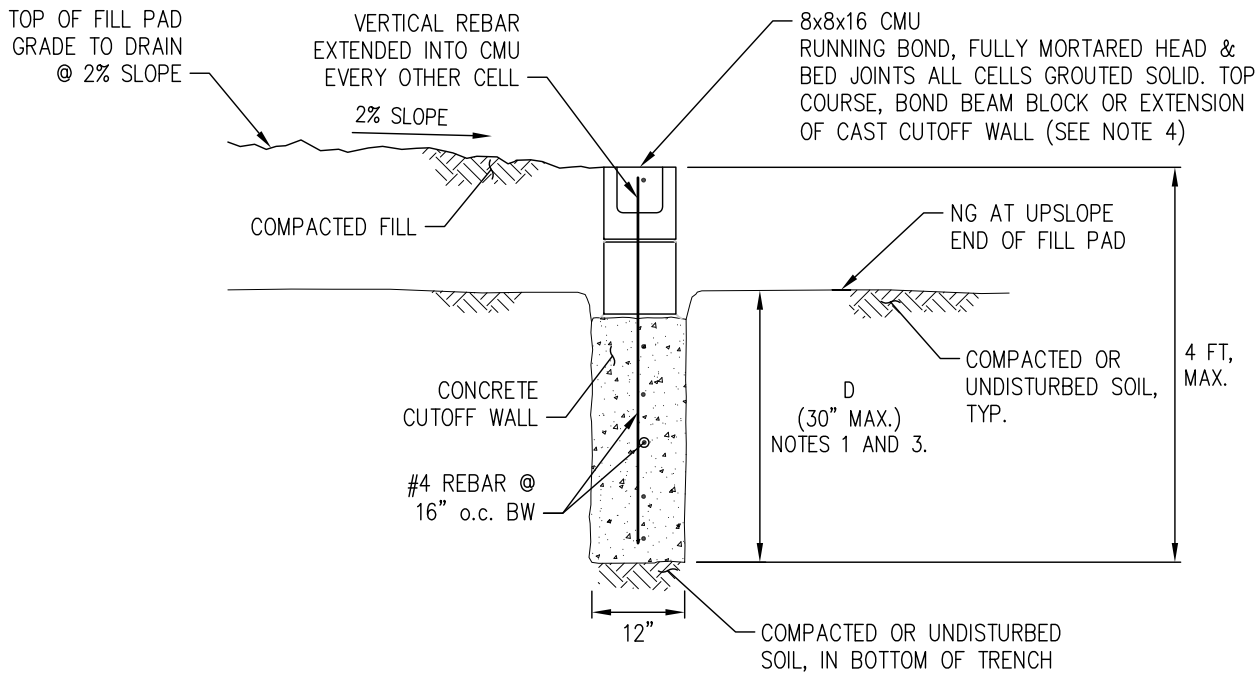
Pima County Regional FLOOD CONTROL DISTRICT

FIGURE 006-C

GROUTED OR DUMPED RIPRAP EROSION PROTECTION OF FILL PADS IN FLOODWAY FRINGE AREAS

SCALE: NONE DRAWN BY: sak DATE: AUG 2009

THE SEAL of PIMA COUNTY ARIZONA



ABBREVIATIONS

BW = BOTH WAYS
BFE = BASE FLOOD ELEVATION
CMU = CONCRETE MASONRY UNIT
D = TOE-DOWN DEPTH
d = DEPTH OF EXISTING FOOTER
FFE = FINISH FLOOR ELEVATION
HANG = HIGHEST ADJACENT NATURAL GRADE
ksi = KILOPOUND PER SQUARE INCH
NG = NATURAL GROUND
N.T.S. = NOT TO SCALE
o.c = ON CENTER
SSPI = PC/DOT STANDARD SPECIFICATIONS for PUBLIC IMPROVEMENT
WWF = WELDED WIRE FABRIC

NOTES

1. TOE-DOWN DEPTH FROM TABLE 006-A OR 006-B.
2. MATERIALS: CONCRETE 3000 PSI; REBAR 60 ksi, CMU ASTM C-90 TYPE I OR II, MORTAR TYPE M, N, OR S PER ASTM C-270, GROUT PER ASTM VC-476.
3. THIS OPTION IS APPLICABLE TO FILL PADS REQUIRING ONLY UPSTREAM EROSION PROTECTION. APPLICATION TO OTHER CONFIGURATIONS REQUIRES PRE-APPROVAL BY THE DISTRICT.
4. FORMED CONCRETE OF DIMENSIONAL & MATERIAL CHARACTERISTICS IDENTICAL TO THE CUTOFF WALL MAY BE SUBSTITUTED FOR CMU.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
15610
Suzanne J.
Shields
Date Signed
ARIZONA, U.S.A.

PIMA COUNTY
FLOOD CONTROL

FIGURE 006-D
VERTICAL WALL EROSION PROTECTION OF FILL PADS IN FLOODWAY FRINGE AREAS

SCALE: None | DRAWN BY: sak | DATE: July 2019

THE SEAL of PIMA COUNTY ARIZONA

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT
TECHNICAL POLICY

POLICY NO.: Technical Policy, TECH-007 **EFFECTIVE DATE: May 18, 2021**
REVISED DATE: N/A

POLICY TITLE: Use of Piers for Site-built Structures within Regulatory Floodplains

PURPOSE:
Provide clarity on the use of piers and pilings to elevate site-built structures in a floodplain.

BACKGROUND:
Section 16.34 of the Floodplain Management Ordinance (Ordinance) refers to the use of piers or pilings (hereafter, piers) as a method to elevate manufactured homes within a regulatory floodplain. Elevating manufactured homes on piers, regardless of location in a floodplain, is standard practice in Pima County and the nation as a whole. Since 16.34 is the only section of the Ordinance to refer to piers, the District has long held that piers are methods of elevation that are available only for manufactured homes.

Applicants have proposed elevating site-built structures on piers in extreme hazard areas to address the issue of adverse impact due to encroachment, and/or to reduce foundation costs. In the past, the District has denied these requests because piers do not address the underlying risk of placing structures in extremely hazardous areas, including the need for emergency response. It is recognized, however, that in certain circumstances, constructing site-built structures on piers does not create additional risk and may even be preferable in some cases. This policy has been created to establish criteria for the use of piers for site-built structures in a floodplain.

POLICY:

A. Prohibitions on the Use of Piers in Floodplains

Piers shall be prohibited in high hazard conditions, as determined by the Chief Engineer, including but not limited to:

1. Locations where the construction of a site-built structure on fill or a stem wall would otherwise be prohibited by the Ordinance, including floodways.
2. Areas where the flow depth is greater than 3 feet or the product of the depth of flow times the square of the flow velocity (DV^2) is greater than 18.
3. Within or spanning the channel of a regulatory wash or spanning a defined drainage area within a sheetflow floodplain.
4. Within the erosion hazard area of a regulatory wash or within an area with identified foundation hazards (e.g., Tortolita Soils).

B. Allowable Use of Piers in Sheetflow Floodplains

Piers may be allowed in sheetflow floodplains provided none of the prohibitions detailed in Section A above apply. In addition, the following criteria must be met.

1. Piers must be constructed per a sealed design based on an analysis performed by an Arizona registered civil engineer (structural). This analysis must be submitted to the District for review and approval. The analysis must determine, at minimum:

a. The hydraulic characteristics of the base flood flow surrounding and beneath the footprint of the structure, including the maximum depth of flow impacting the piers. If the placement of piers will affect the flow characteristics, then the analysis must also include this effect;
b. The pier with the maximum anticipated scour depth, including considerations for anticipated debris collection on the piers;
c. The load supporting capacity of the piers under conditions of the maximum anticipated scour evaluated above;
d. The anticipated aggradation depth, if the area is within an active alluvial fan or other area subject to aggradation (e.g., floodplain of Sutherland Wash post Aspen fire or outflow area of Finger Rocks wash).

2. The depth of flow at any point within the footprint of the structure shall not exceed two (2) feet.
3. To ensure adequate access beneath the structure for repair, maintenance, and passage/removal of debris, the pier foundation must provide a minimum elevation of 2.5 feet plus aggradation depth, above natural grade regardless of the Regulatory Flood Elevation;
4. All piers must extend below natural grade based on the engineered calculated scour depth for the pier with the maximum anticipated scour.
5. No portion of the structure other than the piers shall extend below the Regulatory Flood Elevation plus aggradation, or 2.5 feet above HANG plus aggradation, whichever is greater, including pier caps, any electrical/mechanical equipment, associated pipes, wires or ductwork, or any other appurtenances.
6. The property owner(s) must sign covenants and restrictions stating that the area under the structure:
    a. Shall be maintained open to flow
    b. Shall not be enclosed
    c. Shall not be used for storage of equipment or materials
7. The structure need not be oriented parallel to flow, but piers must be aligned with the direction of flow to minimize obstruction.

APPROVED BY:

_____ _____

Suzanne Shields, P.E. **Date**
Director and Chief Engineer

Original Policy Approved: 5/18/21
Date(s) Revised: N/A

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT
TECHNICAL POLICY

POLICY NO.: Technical Policy, TECH-007 **EFFECTIVE DATE: May 18, 2021**
REVISED DATE: N/A

POLICY TITLE: Use of Piers for Site-built Structures within Regulatory Floodplains

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Applicants have proposed elevating site-built structures on piers in extreme hazard areas to address the issue of adverse impact due to encroachment, and/or to reduce foundation costs. In the past, the District has denied these requests because piers do not address the underlying risk of placing structures in extremely hazardous areas, including the need for emergency response. It is recognized, however, that in certain circumstances, constructing site-built structures on piers does not create additional risk and may even be preferable in some cases. This policy has been created to establish criteria for the use of piers for site-built structures in a floodplain.

POLICY:

A. Prohibitions on the Use of Piers in Floodplains

Piers shall be prohibited in high hazard conditions, as determined by the Chief Engineer, including but not limited to:

1. Locations where the construction of a site-built structure on fill or a stem wall would otherwise be prohibited by the Ordinance, including floodways.
2. Areas where the flow depth is greater than 3 feet or the product of the depth of flow times the square of the flow velocity (DV^2) is greater than 18.
3. Within or spanning the channel of a regulatory wash or spanning a defined drainage area within a sheetflow floodplain.
4. Within the erosion hazard area of a regulatory wash or within an area with identified foundation hazards (e.g., Tortolita Soils).

B. Allowable Use of Piers in Sheetflow Floodplains

Piers may be allowed in sheetflow floodplains provided none of the prohibitions detailed in Section A above apply. In addition, the following criteria must be met.

1. Piers must be constructed per a sealed design based on an analysis performed by an Arizona registered civil engineer (structural). This analysis must be submitted to the District for review and approval. The analysis must determine, at minimum:

a. The hydraulic characteristics of the base flood flow surrounding and beneath the footprint of the structure, including the maximum depth of flow impacting the piers. If the placement of piers will affect the flow characteristics, then the analysis must also include this effect;
b. The pier with the maximum anticipated scour depth, including considerations for anticipated debris collection on the piers ~~and/or lateral migration scour for any pier within an erosion hazard setback area from a regulatory wash~~;
c. The load supporting capacity of the piers under conditions of the maximum anticipated scour evaluated above;
d. The anticipated aggradation depth, if the area is within an active alluvial fan or other area subject to aggradation (e.g., floodplain of Sutherland Wash post Aspen fire or outflow area of Finger Rocks wash).

2. The depth of flow at any point within the footprint of the structure shall not exceed two (2) feet.
3. To ensure adequate access beneath the structure for repair, maintenance, and passage/removal of debris, the pier foundation must provide a minimum elevation of 2.5 feet plus aggradation depth, above natural grade regardless of the Regulatory Flood Elevation;
4. All piers must extend below natural grade based on the engineered calculated scour depth for the pier with the maximum anticipated scour.
5. No portion of the structure other than the piers shall extend below the Regulatory Flood Elevation plus aggradation, or 2.5 feet above HANG plus aggradation, whichever is greater, including pier caps, any electrical/mechanical equipment, associated pipes, wires or ductwork, or any other appurtenances.
6. The property owner(s) must sign covenants and restrictions stating that the area under the structure:
    a. Shall be maintained open to flow
    b. Shall not be enclosed
    c. Shall not be used for storage of equipment or materials
7. The structure need not be oriented parallel to flow, but piers must be aligned with the direction of flow to minimize obstruction.

APPROVED BY:

_____ _____

Suzanne Shields, P.E. **Date**
Director and Chief Engineer

Original Policy Approved: 5/18/21
Date(s) Revised: N/A

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT
TECHNICAL POLICY

POLICY NO.: Technical Policy, TECH-011 **EFFECTIVE DATE: March 3, 2009**
REVISED DATE: 5/18/21

POLICY NAME: Permitting Accessory Structures less than 200 square feet

PURPOSE: The purpose of this policy is to clarify Section 16.20.015.A of the Floodplain Management Ordinance (Ordinance) regarding when a floodplain use permit is necessary for structures less than 200 square feet.

BACKGROUND:

Chapter 16.04.020 of the Ordinance provides the District the authority to regulate all structures which may divert, retard or obstruct flood water and threaten public health and safety. The Ordinance also requires a floodplain use permit (FPUP) for all structures within a floodplain and to establish appropriate flood protection for said structures. However, Section 16.20.015.A of the Ordinance exempts certain small accessory structures, such as sheds from the requirement to obtain an FPUP under certain conditions. Given the availability and ease of construction of these structures, it is unreasonable for property owners to expect such structures would require an FPUP.

One of the conditions for these exempted structures is compliance with the relevant floodplain management provisions of the Ordinance and adopted policies and procedures. This means that when structures that are less than 200 square feet are built within an erosion hazard area or within a high hazard area then they are not exempt from permitting. This policy addresses this confusion.

POLICY:

Small accessory structures less than 200 square feet do not require an FPUP when built in accordance with the Ordinance. This includes elevating the structure or using flood-venting and flood-proofing in accordance with Technical Policies TECH-021 and TECH-022. It also means conformance to erosion hazard setback criteria and anchoring requirements.

When the District observes the placement of these structures and they are in non-conformance with provisions of the Ordinance, the District may require that a permit be obtained to order to ensure compliance is achieved.

APPROVED BY:

_____ _____

Suzanne Shields, P.E. **Date**
Director and Chief Engineer

Original Policy Approved: 3/3/2009
Date(s) Revised: 8/20/19, 5/18/21

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT
TECHNICAL POLICY

POLICY NO.: Technical Policy, TECH-011 **EFFECTIVE DATE: March 3, 2009**
REVISED DATE: 5/18/21

POLICY NAME: Permitting ~~Requirements for~~ Accessory Structures less than 200 square feet

PURPOSE: The purpose of this policy is to ~~establish minimum criteria for applicability~~clarify Section 16.20.015.A of the Floodplain ~~and Erosion Hazard~~ Management Ordinance (Ordinance) regarding when a floodplain use permit is necessary for structures less than 200 square feet.~~to accessory structures.~~

BACKGROUND:

Chapter 16.04.020 of the Ordinance provides the District the authority to regulate all structures which may divert, retard or obstruct flood water and threaten public health and safety. The Ordinance also requires a floodplain use permit (FPUP) for all structures within a floodplain and to establish appropriate flood protection for said structures. ~~The Ordinance places no lower limit on the size of the structure or the monetary value of the structure subject to the Ordinance.~~
However, Section 16.20.015.A of the Ordinance exempts certain small accessory structures~~,~~, such as sheds from the requirement to obtain an FPUP under certain conditions. Given th~~such as sheds are often small enough that it is not practical to require property owners to obtain an FPUP for the structure. Furthermore, given the~~ availability and ease of construction of~~such~~ these structures ~~in kit form from hardware stores~~, it is unreasonable for property owners to expect such structures would require an FPUP.

~~As a result, it is prudent to establish a minimum threshold, above which an FPUP for the structure would be required. All structures are required toshall conform to the Ordinance; however, only structures above below this threshold will may not be required to obtain an FPUP, at the discretion of the District.~~

~~Since the monetary value of an accessory structure is difficult to verify, especially for existing accessory structures, a more concrete criteria is the area or square footage of the structure. The International Building Code, administered locally through the Building Safety Office of the Pima County Development Services Department, establishes a permitting requirement for structures that are 200 square feet or larger. This threshold is applied in a similar fashion insuch a way that structures less than 200 square feet are subject to the Building Code, but review and permitting is not required if there is no electricity or plumbing servicing the structure. If structures less than 200 square feet are determined by the Chief Building Official to be improperly constructed, compliance enforcement can be initiated. Establishing a policy that is consistent with Building Code is desirable.~~

One of the conditions for these exempted structures is compliance with the relevant floodplain management provisions of the Ordinance and adopted policies and procedures. This means that when structures that are less than 200 square feet are built within an erosion hazard area or within a high hazard area then they are not exempt from permitting. This policy addresses this confusion.
~~Chapter 16.20.040B.6.a gives the District the authority to require structures to be anchored to resist flotation and lateral movement.~~

POLICY:

Small accessory structures less than 200 square feet do not require an FPUP when built in accordance with the Ordinance. This includes elevating the structure or using ~~All structures must be constructed in compliance with the Ordinance considering the flood and erosion hazards identified on the property at the time of construction. However, an FPUP is required only if the structure is 200 square feet or larger or if a for structures less than 200 square feet in size is either located within an erosion hazard area or is found to be otherwise non-compliant with the Ordinance. No structures of any size may be placed within a floodway unless an engineering analysis performed by an Arizona registered civil engineer is submitted toand approved by the District.~~

~~In order to comply with the elevation requirements of the Ordinance, all accessory structures, no matter the size or cost, shall be elevated to at or above the Regulatory Flood Elevation (RFE) unless the structure is used solely for the parking of vehicles, building access, or limited storage. These accessory structures may be~~ flood-vent~~ing~~ed and flood-proof~~ing~~ed in accordance with Technical Policies TECH-021 and TECH-022. It also means ~~in lieu of elevation of the lowest finished floor. Technical Policy TECH-023 provides clarification as to which structures may be flood-vented and flood-proofed.~~conformance to erosion hazard setback criteria and anchoring requirements.

~~In addition, in order to comply with the flotation and lateral movement requirements of the Ordinance, structures that are not constructed on a permanent foundation shall be anchored to prevent flotation, collapse or lateral movement. This requirement is designed to prevent structures from being moved by floodwaters which may increase the obstruction of flows, damage adjacent property or block drainage infrastructure.~~When the District observes the placement of these structures and they are in non-conformance with provisions of the Ordinance, the District may require that a permit be obtained to order to ensure compliance is achieved.

APPROVED BY:

_____ _____

Suzanne Shields, P.E. **Date**
Director and Chief Engineer

Original Policy Approved: 3/3/2009
Date(s) Revised: 8/20/19, 5/18/21

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT
TECHNICAL POLICY

POLICY NO.: Technical Policy, TECH-014 **EFFECTIVE DATE: August 31, 2009**
REVISED DATE: 5/18/2021

POLICY NAME: Erosion Protection of Stem Wall Foundations in Regulatory Floodplains

PURPOSE: To clarify 16.20.020.C.4 of the Ordinance regarding the specifications for building construction and materials in order to establish consistent permitting requirements that are sufficiently protective of the structure elevated on stem walls for the flood and erosion hazards that have been identified without the need for site-specific engineering.

BACKGROUND:
The Floodplain Management Ordinance (Ordinance) provision 16.20.020.C.4 requires that an applicant submit specifications for building construction when requested by the Chief Engineer. Historically, this placed the burden on the District to identify when the foundation design considerations would be required, and when found necessary, this requirement was often objectionable to the applicant due to the unanticipated cost and time associated with the evaluation, design, and approval of the foundation.

In order to more consistently implement this provision, reduce engineering costs and review times, and sufficiently protect the structure from flood and erosion hazards, the District has developed this policy which establishes minimum toe-down depths for stem wall foundations. The toe-down depths have been developed using standard engineering practice including use of the following:

1) The City of Tucson Drainage Standards Manual, specifically Chapter 6, which provides methods to determine maximum anticipated erosion/scour depths. The scour equation in Chapter 6 includes the effects of local scour due to obstructions of flow, such as a structure. The applicable portions of the scour equation are used in estimating maximum anticipated scour. However, Equation 6-3 of the Manual is an additive equation that establishes maximum anticipated scour based on a variety of scour components. Since some of these components are not applicable for structures in broad floodplains, this policy may establish design criteria that is not as restrictive as the equation.

2) FLO-2D - The District commenced an evaluation of the flooding effects on stem wall foundation using FLO-2D modeling. This analysis provided significant insights regarding the flow of water around structures, demonstrating that an increased level of protection at the upstream corners should be provided.

In addition, in order to efficiently and effectively address the need for minimum erosion protection standards across a wide variety of flow regimes, the District has chosen to apply minimum standards categories using ranges of flow depths and flow velocities. The criteria from these publications and calculations are used as the basis for this policy.

In part to address the issue of constructing scour protection for existing foundations, and also to provide additional construction options for owners/applicants, the District created additional standard

details in 2019. These details cover the construction of concrete cut-off walls to protect existing foundations and the use of hardscaping adjacent to new or existing structures to protect the structure from scour.

POLICY:
Applicants may choose to use to use the standard details in lieu of providing a site-specific engineered foundation to address flood and scour hazards for structures, provided the floodplain conditions are within the foundation matrices that are a part of this policy. Deviation from the standard details and stipulations of this policy may require a site-specific engineering analysis and/or foundation design. This policy may be used to calculate stem wall foundation toe-down depths or establish specifications for other protective measures as detailed in Figures 014-A, 014-B and 014-C of this policy, as long as the following conditions are met:

1) The structure does not encroach into an Erosion Hazard Area, a study area that establishes a requirement for an engineering analysis or an area that the District has determined that, due to unusual conditions, engineering is required. If a structure is proposed in these areas, an engineering analysis to specify foundation construction characteristics will be required and will supersede this policy.

2) The obstructive width of the structure is 40 feet or less. Table 014 has been developed for a structure that is 40 feet wide and may be used for structures that are 40 feet wide or less. Structures wider than 40 feet will require an engineering analysis to determine the foundation construction characteristics.

3) The structure shall be oriented with the long axis parallel to the direction of flow. This will minimize the flow obstruction and reduce the potential scour depths.

4) Stem wall foundation scour protection shall be constructed in accordance with Table 014, which prescribes protection at specific locations:
    a) When the structure is surrounded by floodwaters:
        i) A toe-down depth is prescribed along the entire upstream edge of the structure and at least 10 feet along the sides of the structure extending from the upstream corners,
        ii) A second toe-down depth is prescribed along the remaining perimeter of the structure.
    b) When the structure is not surrounded by floodwaters:
        i) A toe-down depth is prescribed along the upstream edge and at least 10 feet along the side(s) of the structure that are located within the 100-year floodplain,
        ii) A second toe-down depth is prescribed along the remaining perimeter of the structure that is located within the 100-year floodplain,
        iii) The portions of the structure that are not exposed to floodwaters do not require erosion protection.

5) Foundation scour protection for a stem wall foundation shall be accomplished by one of the following methods:
    a) Extending the bottom of the foundation footer down to the toe-down depth specified by Table 014. Toe-down depth shall be referenced to natural grade beneath the perimeter of the foundation. This scour protection is detailed in Figure 014-A.

b) Foundation scour protection from local (abutment) scour at the upstream end of an obstruction may be accomplished by the hardscaping option detailed in Figure 014-B. Protection of the remainder of the perimeter of the foundation from general scour shall utilize a foundation footer as detailed in Figure 014-A.
c) Existing structures built without consideration for foundation erosion protection may have foundations retrofitted for erosion protection as shown in Figure 014-C.

6) If the stem wall or cut-off wall, extended to the toe-down depth specified in Table 014, has the potential to retain more than 4 feet of fill under conditions of maximum scour, the applicant shall either:

a) Demonstrate that the stem wall or cut-off wall is designed in accordance with the latest International Residential (IRC) code Tables R404.1.1(1) through (4). These tables establish minimum wall thickness and vertical reinforcement requirements (if any) for wall heights up to 9 feet. To apply these tables, the wall detail/plans must specify the type of soil being retained, since this determines the unit weight and lateral soil pressure it is necessary for the wall to resist. The IRC presents the properties of soils classified according to the Unified Soil Classification System in Table R405.1, or,
b) Provide a sealed construction detail, prepared by an Arizona registered structural engineer, adding appropriate retaining wall features to the wall foundation.

Pima County Building Codes will ensure that the structural design meets building code requirements.

7) Stem wall, hardscaping and/or retrofit details and specifications shall either be shown on the building plans, or the appropriate Figure(s) referenced on the building plans.

APPROVED BY:

_____ _____

Suzanne Shields, P.E. **Date**
Director and Chief Engineer

Original Policy Approved: 8/31/2009
Date(s) Revised: Figure 014-A Revised 4/9/2015, 5/18/2021

TABLE 014

STEM WALLS

TOE-DOWN DEPTH REQUIREMENTS FOR EROSION PROTECTION OF STEM WALLS WITH A MAXIMUM WIDTH OF 40 FEET
PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT TECHNICAL POLICY TECH-014

ASSUMPTIONS:

1. Structure constructed/installed such that long dimension is generally aligned with the direction of flow;
2. design scour depth at upstream corners applies over entire upstream edge and 10 feet along sides measured from upstream corners
3. manning's roughness coefficient for overbank flow per Table 8.1, SMDDFM = 0.060;
4. hydrodynamic forces negligible below flow velocity of 5 fps

TABLE 014-A - 100-YR NORMAL FLOW VELOCITY FOR BROAD, FLAT FLOODPLAINS USING MANNING'S EQUATION, fps

Flow Depth, ft	slope, ft/ft 0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.5	**0.7**	**1.0**	**1.2**	**1.4**	**1.6**	**1.7**	**1.9**	**2.0**	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**2.6**	**2.7**
1.0	**1.1**	**1.6**	**1.9**	**2.2**	**2.5**	**2.7**	**2.9**	**3.1**	**3.3**	**3.5**	**3.7**	**3.8**	**4.0**	**4.1**	**4.3**
1.5	**1.4**	**2.0**	**2.5**	**2.9**	**3.2**	**3.5**	**3.8**	**4.1**	**4.3**	**4.6**	**4.8**	**5.0**	**5.2**	**5.4**	**5.6**
2.0	**1.8**	**2.5**	**3.0**	**3.5**	**3.9**	**4.3**	**4.6**	**5.0**	**5.3**	**5.5**	**5.8**	**6.1**	**6.3**	**6.5**	**6.8**
2.5	**2.0**	**2.9**	**3.5**	**4.1**	**4.5**	**5.0**	**5.4**	**5.7**	**6.1**	**6.4**	**6.7**	**7.0**	**7.3**	**7.6**	**7.9**
3.0	**2.3**	**3.2**	**4.0**	**4.6**	**5.1**	**5.6**	**6.1**	**6.5**	**6.9**	**7.2**	**7.6**	**7.9**	**8.2**	**8.6**	**8.9**

TABLE 014-B - TOE-DOWN DEPTH REQUIREMENT FOR UPSTREAM EDGE AND AREA WITHIN 10 FEET OF UPSTREAM CORNERS OF A 40 FOOT WIDE (MAX) STEM WALL

Flow Depth, ft	slope, ft/ft 0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.5															
1.0															
1.5															
2.0															
2.5															
3.0															

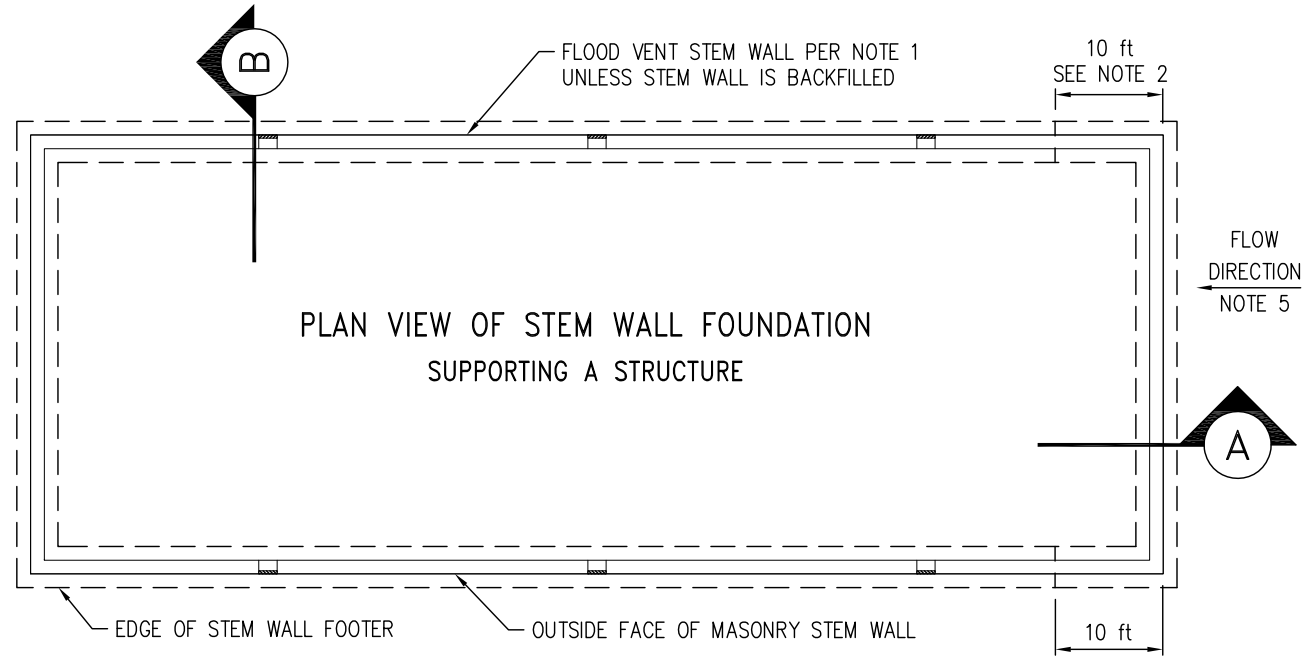
TABLE 014-C - TOE DOWN DEPTH FOR SIDES AND DOWNSTREAM EDGE OF STEM WALLS, EXCEPT FOR AREA WITHIN 10 FEET OF UPSTREAM CORNERS

Flow Depth, ft	slope, ft/ft 0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.5															
1.0															
1.5															
2.0															
2.5															
3.0															

DV^2 Greater than 18		= 18 inches deep		= 24 inches deep		= 36 inches deep		= 48 inches deep		= Engineered foundation required.

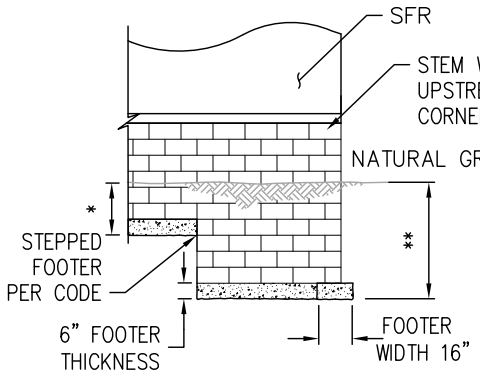
NOTES

1. VENT OPENINGS IN STEM WALL:
   - PROVIDE 1 SQUARE INCH OF NET OPEN VENT AREA FOR EACH SQUARE FOOT OF BUILDING FLOOR SPACE
   - PLACE BOTTOM OF VENTS 1 FOOT (MAX) ABOVE NATURAL GRADE.
   - ALL SCREENS AND LOUVERS MUST AUTOMATICALLY OPEN TO ALLOW UNOBSTRUCTED FLOW OF FLOOD WATERS, OR OTHERWISE MAY BE SCREENED WITH ½–INCH MIN SCREEN.
   - DISTRIBUTE REQUIRED VENTS UNIFORMLY ON AT LEAST TWO OPPOSING WALLS.
2. FOOTER DEPTH FROM TABLE 014–B, SHALL APPLY ALONG ENTIRE UPSTREAM END, AND ALONG UPSTREAM–MOST 10 FEET OF BOTH SIDES OF STEM WALL. FOOTER DEPTH FOR REMAINING STEM WALL FROM TABLE 014–C.
3. FOR MONOPOUR FOUNDATIONS, POUR FOUNDATION DOWN TO DEPTH FROM TABLE 014B–C AND 014–C.
4. FOUNDATION ELEMENTS LOCATED WITHIN THE PERIMETER OF STEM WALL SHALL NOT BE REQUIRED TO BE PLACED BELOW MAXIMUM ANTICIPATED SCOUR DEPTH. LOCATION OF, AND STRUCTURAL CHARACTERISTICS OF INTERIOR FOUNDATION ELEMENTS SHALL BE DETERMINED BY OTHERS.
5. STRUCTURAL FOOTER CHARACTERISTICS SUCH AS WIDTH, THICKNESS, REINFORCING, ETC. ARE MINIMUM ALLOWED AND ARE SUBJECT TO BUILDING CODE REVIEW.
6. LONG DIMENSION OF STRUCTURE TO BE ORIENTED PARALLEL TO DIRECTION OF FLOW.
7. MATERIALS: CONCRETE 3000 psi; MORTAR TYPE M, N, OR S PER ASTM C270; GROUT SHALL BE COARSE AGGREGATE PER ASTM VC476; REBAR 60 KSI; CMU ASTM C–90 TYPE I OR TYPE II.



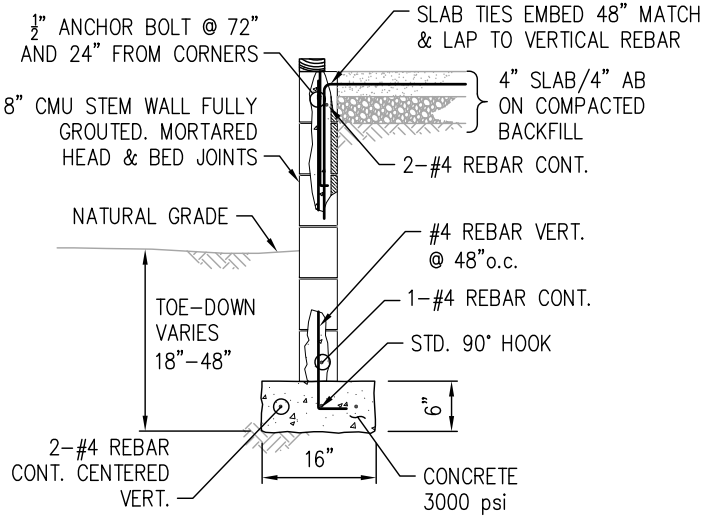
ABBREVIATIONS:

SEE FIGURE 014–B OR 014–C

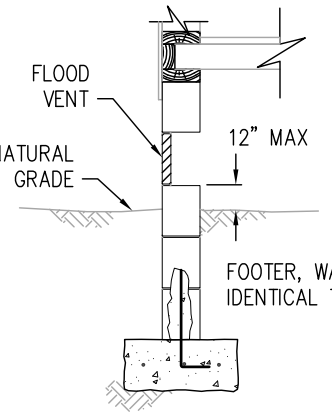


* TOE–DOWN DEPTH FROM TABLE 014–C
** TOE–DOWN DEPTH FROM TABLE 014–B

A SECTION
SCALE: N.T.S.



B SECTION BACKFILLED
SCALE: N.T.S.



B SECTION VENTED
SCALE: N.T.S.

Registered Professional Engineer (Civil)
CERTIFICATE No. 15610
Suzanne J. Shields
Date Signed
ARIZONA, U.S.A.

PIMA COUNTY
FLOOD CONTROL

FIGURE 014–A
EROSION PROTECTION OF LOAD BEARING PERIMETER STEM WALL IN FLOODWAY FRINGE AREAS

SCALE: None | DRAWN BY: sak | DATE: Aug. 2019

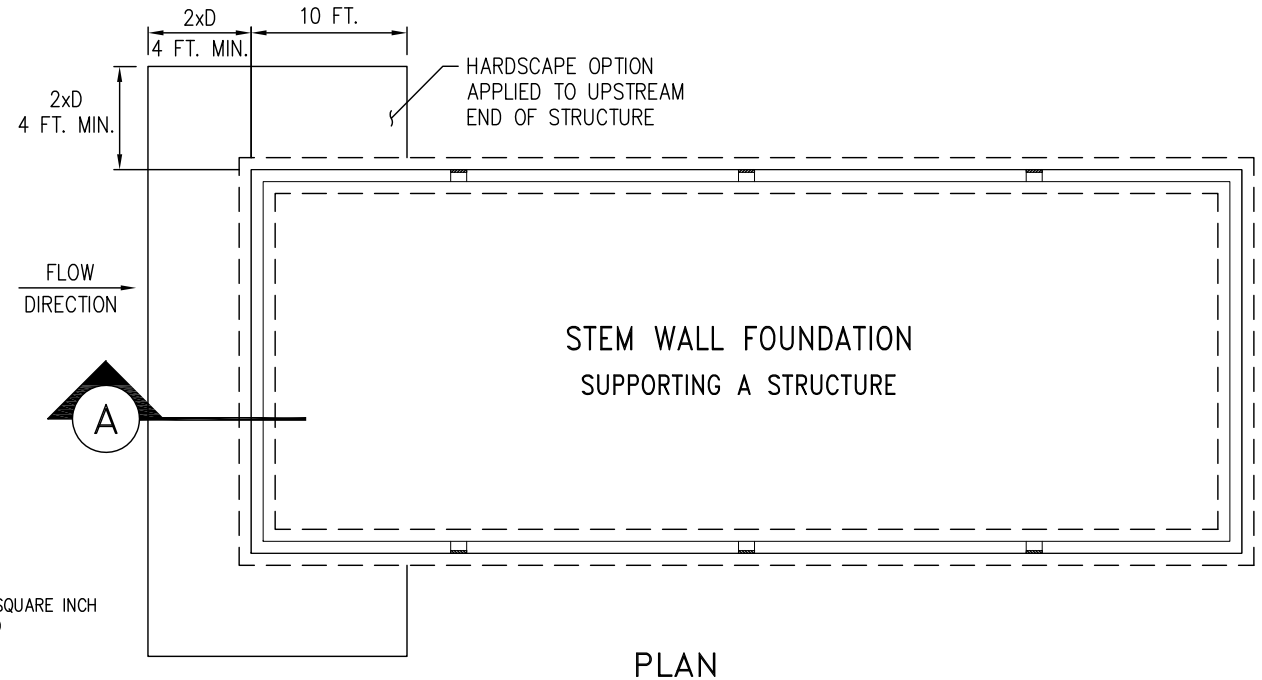
THE SEAL of PIMA COUNTY ARIZONA

NOTES

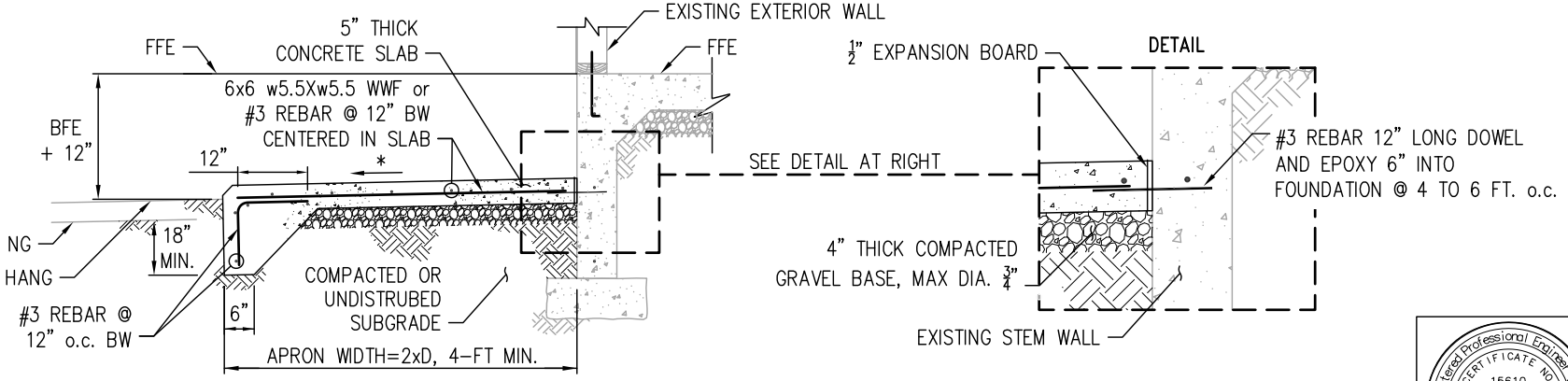
1. GRAVEL BASE AND SUBGRADE COMPACTED TO 95% STANDARD PROCTOR DENSITY.
2. VERIFY THAT HOLES FOR DOWEL BAR ARE CLEAN AND DRY PRIOR TO PLACING BONDING MATERIAL.
3. SHIFT DOWEL HOLE LOCATIONS IF EXISTING REINFORCING STEEL IS ENCOUNTERED.
4. PLACE SCORED EXPANSION JOINTS $\frac{1}{4}$ INCH DEEP EVERY 6 FEET OF LENGTH.
5. THIS OPTION FOR FOUNDATION EROSION PROTECTION MAY NOT BE USED WITH POST-STRESSED FOUNDATION DESIGN.
6. MATERIALS: CONCRETE 3000 PSI, REBAR 60 ksi, GRAVEL BASE PC/DOT SSPI SECTION 303.
7. TOE-DOWN FROM TABLE 014-B.
8. LONG DIMENSION OF STRUCTURE TO BE PARALLEL TO FLOW.
9. STRUCTURAL FOUNDATION CHARACTARISTICS (WIDTH, DEPTH, THICKNESS, REBAR) SUBJECT TO BUILDING CODE REVIEW.

ABBREVIATIONS

BW	= BOTH WAYS	ksi	= KILOPOUND PER SQUARE INCH
BFE	= BASE FLOOD ELEVATION	NG	= NATURAL GROUND
CMU	= CONCRETE MASONRY UNIT	N.T.S.	= NOT TO SCALE
D	= TOE-DOWN DEPTH	o.c	= ON CENTER
d	= DEPTH OF EXISTING FOOTER	SSPI	= PC/DOT STANDARD SPECIFICATIONS for PUBLIC IMPROVEMENT
FFE	= FINISH FLOOR ELEVATION	WWF	= WELDED WIRE FABRIC
HANG	= HIGHEST ADJACENT NATURAL GRADE		



PLAN
SCALE: N.T.S.



A HARDSCAPE OPTION
SCALE: N.T.S.

* SLOPE: $\frac{1}{8}$" TO $\frac{1}{4}$" PER FT.

Registered Professional Engineer (Civil)
CERTIFICATE NO. 15610
Suzanne J. Shields
Date Signed .....
ARIZONA, U.S.A.

PIMA COUNTY
FLOOD CONTROL

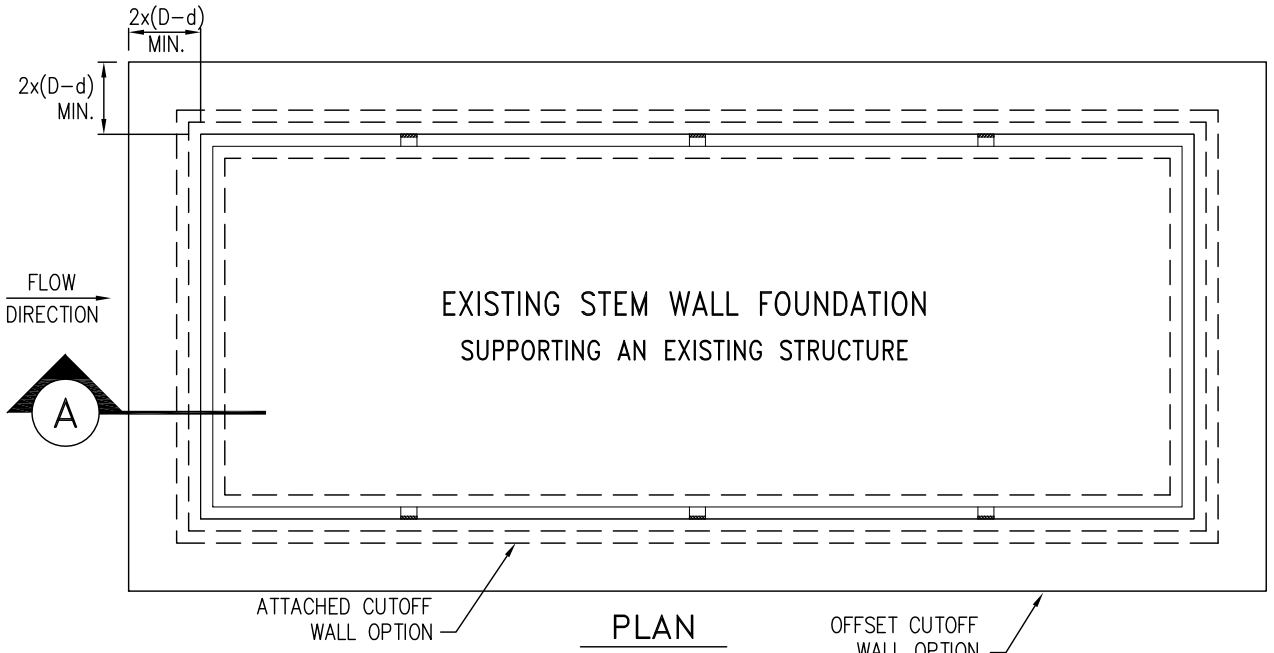
FIGURE 014-B
HARDSCAPE OPTION FOR EROSION PROTECTION FROM ABUTMENT SCOUR OF LOAD BEARING PERIMETER STEM WALL IN FLOODWAY FRINGE AREAS

SCALE: None | DRAWN BY: sak | DATE: July 2019

THE SEAL of PIMA COUNTY ARIZONA

NOTES

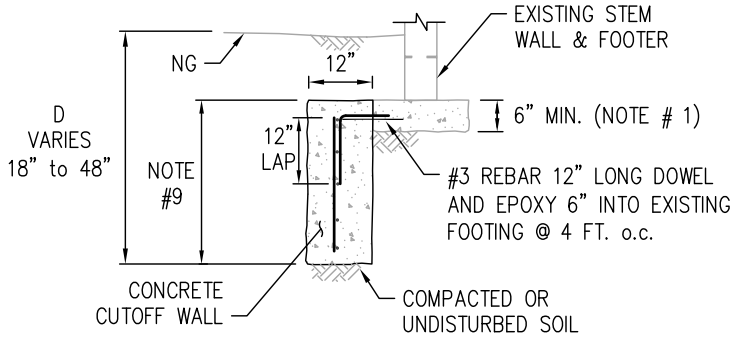
1. FOR ATTACHED CUTOFF WALL OPTION, THICKNESS OF EXISTING FOOTING MUST BE 6" MIN. AND TOP OF FOOTER MUST BE WITHIN 12" OF SURFACE.
2. VERIFY THAT HOLES FOR DOWEL BARS ARE CLEAN AND DRY PRIOR TO PLACING EPOXY.
3. SHIFT DOWEL HOLE LOCATIONS IF EXISTING REINFORCING STEEL IS ENCOUNTERED.
4. DRILL DOWEL HOLES IN EXISTING FOUNDATION PRIOR TO EXCAVATION OF TRENCH BELOW BOTTOM OF FOOTER.
5. MATERIALS: CONCRETE 3000 PSI, REBAR 60 ksi, GRAVEL BASE SSPI SECTION 303.
6. REBAR, WWF TO BE CENTERED IN SLAB AND/OR CUTOFF WALL.
7. 6x6 W5.5xW5.5 WWF OR #3 REBAR @ 12" o.c. BW.
8. #3 REBAR @ 6" o.c. OR #4 @ REBAR 12" o.c. BW, TYP.
9. CUTOFF WALL HEIGHT AS NECESSARY TO ACHIEVE SCOUR DEPTH.
10. TOE-DOWN FROM TABLES 014-B & 014-C.



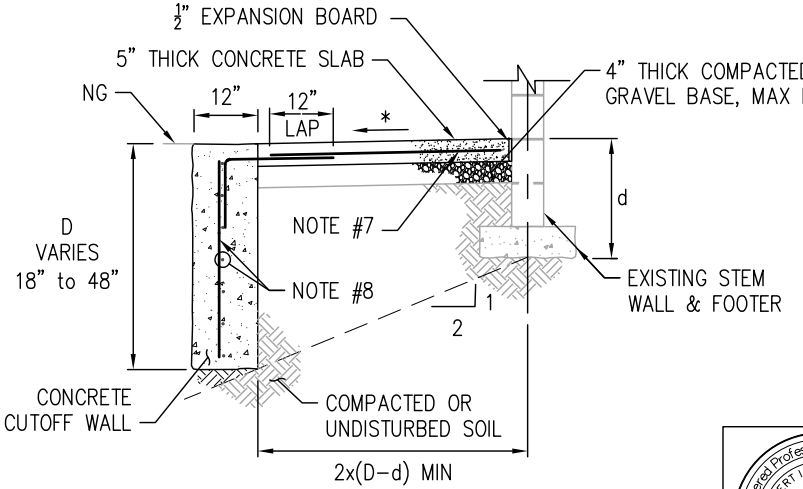
PLAN
SCALE: N.T.S.

ABBREVIATIONS

BW	= BOTH WAYS	ksi	= KILOPOUND PER SQUARE INCH
BFE	= BASE FLOOD ELEVATION	NG	= NATURAL GROUND
CMU	= CONCRETE MASONRY UNIT	N.T.S.	= NOT TO SCALE
D	= TOE-DOWN DEPTH	o.c	= ON CENTER
d	= DEPTH OF EXISTING FOOTER	SSPI	= PC/COT STANDARD SPECIFICATIONS for PUBLIC IMPROVEMENT
FFE	= FINISH FLOOR ELEVATION		
HANG	= HIGHEST ADJACENT NATURAL GRADE	WWF	= WELDED WIRE FABRIC



A ATTACHED CUTOFF WALL OPTION
SCALE: N.T.S. APPLICATION LIMITED TO SITES WHERE TRENCH WALLS WILL STAND VERTICAL AND NOTE 1



A OFFSET CUTOFF WALL OPTION
SCALE: N.T.S.

* SLOPE: ⅛" TO ¼" PER FT.

Registered Professional Engineer (Civil) CERTIFICATE NO. 15610 Suzanne J. Shields Date Signed ARIZONA, U.S.A.

THE SEAL of PIMA COUNTY ARIZONA

PIMA COUNTY
FLOOD CONTROL

FIGURE 014-C
RETRO FIT OPTION FOR EROSION PROTECTION OF LOAD BEARING PERIMETER STEM WALL IN FLOODWAY FRINGE AREAS

SCALE: None DRAWN BY: sak DATE: July 2019

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT
TECHNICAL POLICY

POLICY NO.: Technical Policy, TECH-014 **EFFECTIVE DATE: August 31, 2009**
~~Figure 014-A Revised April 9,~~

~~2015~~**REVISED DATE:** 4/~~16~~**5/18/2021**

POLICY NAME: Erosion Protection of Stem Wall Foundations in ~~Floodway Fringe Areas~~Regulatory Floodplains

PURPOSE: To clarify 16.20.020.C.4 of the Ordinance regarding the specifications for building construction and materials in order to establish consistent permitting requirements that are sufficiently protective of the structure elevated on stem walls for the flood and erosion hazards that have been identified without the need for site-specific engineering.

BACKGROUND:
The Floodplain ~~and Erosion Hazard~~ Management Ordinance (Ordinance) provision 16.20.020.C.4 requires that an applicant submit specifications for building construction when requested by the Chief Engineer. Historically, this placed the burden on the District to identify when the foundation design considerations would be required, and when found necessary, this requirement was often objectionable to the applicant due to the unanticipated cost and time associated with the evaluation, design, and approval of the foundation.

In order to more consistently implement this provision, reduce engineering costs and review times, and sufficiently protect the structure from flood and erosion hazards, the District has developed this policy which establishes minimum toe-down depths for stem wall foundations. The toe-down depths have been developed using standard engineering practice including use of the following:

1) The City of Tucson Drainage Standards Manual, specifically Chapter 6, which provides methods to determine maximum anticipated erosion/scour depths. The scour equation in Chapter 6 includes the effects of local scour due to obstructions of flow, such as a structure. The applicable portions of the scour equation ~~will be~~are used in estimating maximum anticipated scour. However, Equation 6-3 of the Manual is an additive equation that establishes maximum anticipated scour based on a variety of scour components. Since some of these components are not applicable for structures in broad floodplains, this policy may establish design criteria that is not as restrictive as the equation.

2) FLO-2D - The District commenced an evaluation of the flooding effects on stem wall foundation using FLO-2D modeling. This analysis provided significant insights regarding the flow of water around structures, demonstrating that an increased level of protection at the upstream corners should be provided.

In addition, in order to efficiently and effectively address the need for minimum erosion protection standards across a wide variety of flow regimes, the District has chosen to apply minimum standards categories using ranges of flow depths and flow velocities. The criteria from these publications and calculations are used as the basis for this policy.

In part to address the issue of constructing scour protection for existing foundations, and also to provide additional construction options for owners/applicants, the District created additional standard details in 2019. These details cover the construction of concrete cut-off walls to protect existing foundations and the use of hardscaping adjacent to new or existing structures to protect the structure from scour.

POLICY:

Applicants may choose to use to use the standard details in lieu of providing a site-specific engineered foundation to address flood and scour hazards for structures, provided the floodplain conditions are within the foundation matrices that are a part of this policy. Deviation from the standard details and stipulations of this policy may require a site-specific engineering analysis and/or foundation design. This policy may be used to calculate stem wall foundation toe-down depths or establish specifications for other protective measures as detailed in Figures 014-A, 014-B and 014-C of this policy, as long as the following conditions are met:

1) The structure does not encroach into an Erosion Hazard ~~Setback~~Area, a study area that establishes a requirement for an engineering analysis or an area that the District has determined that, due to unusual conditions, engineering is required. If a structure is proposed in these areas, an engineering analysis to specify foundation construction characteristics will be required and will supersede this policy.

2) The obstructive width of the structure is 40 feet or less. ~~The attached~~ Table 014 has been developed for a structure that is 40 feet wide and may be used for structures that are 40 feet wide or less. Structures wider than 40 feet will require an engineering analysis to determine the foundation construction characteristics.

3) The structure shall be oriented with the long axis parallel to the direction of flow. This will minimize the flow obstruction and reduce the potential scour depths.

4) Stem wall foundation scour protection shall be constructed in accordance with ~~the attached~~ Table 014, which prescribes protection at specific locations:
    a) When the structure is surrounded by floodwaters:
        i) A toe-down depth is prescribed along the entire upstream edge of the structure and at least 10 feet along the sides of the structure extending from the upstream corners,
        ii) A second toe-down depth is prescribed along the remaining perimeter of the structure.
    b) When the ~~fill pad~~structure is not surrounded by floodwaters:
        i) A toe-down depth is prescribed along the upstream edge and at least 10 feet along the side(s) of the structure that are located within the 100-year floodplain,
        ii) A second toe-down depth is prescribed along the remaining perimeter of the structure that is located within the 100-year floodplain,
        iii) The portions of the structure that are not exposed to floodwaters do not require erosion protection.

5) Foundation scour protection for a stem wall foundation shall be accomplished- by one of the following methods:

a) Extending the bottom of the foundation footer down to the toe-down depth specified by Table 014. Toe-down depth shall be referenced to natural grade beneath the perimeter of the foundation. This scour protection is detailed in Figure 014-A.
b) Foundation scour protection from local (abutment) scour at the upstream end of an obstruction may be accomplished by the hardscaping option detailed in Figure 014-B. Protection of the remainder of the perimeter of the foundation from general scour shall utilize a foundation footer as detailed in Figure 014-A.

c) Existing structures built without consideration for foundation erosion protection may have foundations retrofitted for erosion protection as shown in Figure 014-C.

6) If the stem wall or cut-off wall, extended to the toe-down depth specified in Table 014, has the potential to retain more than 4 feet of fill ~~after accounting for the anticipated~~ under conditions of maximum scour, the applicant shall either:

a) Demonstrate that the stem wall or cut-off wall is designed in accordance with the latest International Residential (IRC) code Tables R404.1.1(1) through (4). These tables establish minimum wall thickness and vertical reinforcement requirements (if any) for wall heights up to 9 feet. To apply these tables, the wall detail/plans must specify the type of soil being retained, since this determines the unit weight and lateral soil pressure it is necessary for the wall to resist. The IRC presents the properties of soils classified according to the Unified Soil Classification System in Table R405.1, or,
b) P~~p~~rovide a sealed construction detail, prepared by an Arizona registered structural engineer, ~~for the retaining wall~~adding appropriate retaining wall features to the wall foundation.

Pima County Building Codes will ensure that the structural design meets building code requirements.

~~5)~~7) Stem wall, hardscaping and/or retrofit details and specifications shall either be shown on the ~~site plan~~building plans, or the appropriate Figure(s) referenced on the ~~site~~ building plans.

APPROVED BY:

Suzanne Shields, P.E. **Date**
Director and Chief Engineer

Original Policy Approved: 8/31/2009
Date(s) Revised: Figure 014-A Revised 4/9/2015, 5/18/2021

TABLE 014

STEM WALLS

TOE-DOWN DEPTH REQUIREMENTS FOR EROSION PROTECTION OF STEM WALLS WITH A MAXIMUM WIDTH OF 40 FEET
PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT TECHNICAL POLICY TECH-014

ASSUMPTIONS:

1. Structure constructed/installed such that long dimension is generally aligned with the direction of flow;
2. design scour depth at upstream corners applies over entire upstream edge and 10 feet along sides measured from upstream corners
3. manning's roughness coefficient for overbank flow per Table 8.1, SMDDFM = 0.060;
4. hydrodynamic forces negligible below flow velocity of 5 fps

TABLE 014-A - 100-YR NORMAL FLOW VELOCITY FOR BROAD, FLAT FLOODPLAINS USING MANNING'S EQUATION, fps

Flow Depth, ft	slope, ft/ft 0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.5	**0.7**	**1.0**	**1.2**	**1.4**	**1.6**	**1.7**	**1.9**	**2.0**	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**2.6**	**2.7**
1.0	**1.1**	**1.6**	**1.9**	**2.2**	**2.5**	**2.7**	**2.9**	**3.1**	**3.3**	**3.5**	**3.7**	**3.8**	**4.0**	**4.1**	**4.3**
1.5	**1.4**	**2.0**	**2.5**	**2.9**	**3.2**	**3.5**	**3.8**	**4.1**	**4.3**	**4.6**	**4.8**	**5.0**	**5.2**	**5.4**	**5.6**
2.0	**1.8**	**2.5**	**3.0**	**3.5**	**3.9**	**4.3**	**4.6**	**5.0**	**5.3**	**5.5**	**5.8**	**6.1**	**6.3**	**6.5**	**6.8**
2.5	**2.0**	**2.9**	**3.5**	**4.1**	**4.5**	**5.0**	**5.4**	**5.7**	**6.1**	**6.4**	**6.7**	**7.0**	**7.3**	**7.6**	**7.9**
3.0	**2.3**	**3.2**	**4.0**	**4.6**	**5.1**	**5.6**	**6.1**	**6.5**	**6.9**	**7.2**	**7.6**	**7.9**	**8.2**	**8.6**	**8.9**

TABLE 014-B - TOE-DOWN DEPTH REQUIREMENT FOR UPSTREAM EDGE AND AREA WITHIN 10 FEET OF UPSTREAM CORNERS OF A 40 FOOT WIDE (MAX) STEM WALL

Flow Depth, ft	slope, ft/ft 0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.5															
1.0															
1.5															
2.0															
2.5															
3.0															

TABLE 014-C - TOE DOWN DEPTH FOR SIDES AND DOWNSTREAM EDGE OF STEM WALLS, EXCEPT FOR AREA WITHIN 10 FEET OF UPSTREAM CORNERS

Flow Depth, ft	slope, ft/ft 0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030
0.5															
1.0															
1.5															
2.0															
2.5															
3.0															

DV^2 Greater than 18		= 18 inches deep		= 24 inches deep		= 36 inches deep		= 48 inches deep		= Engineered foundation required.