MEMORANDUM

Date: May 12, 2014

To: The Honorable Chair and Members
Pima County Board of Supervisors

From: C.H. Huckelberry
County Administrator

Re: **Regional Flood Control District Review of the Kinder Morgan Sierrita Pipeline**

Attached is a May 9, 2014 letter directed to Kinder Morgan's Project Manager, as well as one to their consultant for the design of their 36-inch natural gas pipeline through Altar Valley. Both letters express concerns regarding pipeline design, particularly as it crosses Regional Flood Control District (RFCD) regulated streams and washes within Altar Valley.

The RFCD has raised a number of concerns regarding the depth of burial below scour elevation predictions and the depth of burial below scour extended laterally from the center line of the wash or stream to accommodate stream lateral migration during flood flows. These issues were also raised by the Altar Valley Conservation Alliance in our April 30, 2014 meeting with Kinder Morgan representatives.

RFCD will continue to insist on conservative design principles regarding the burial depth of the pipeline to resist scour elevation and displacement, as well as possible pipeline exposure through lateral erosive migration of natural streams and arroyos.

Finally, the RFCD is requiring Rock Terrace construction along the flanks of the pipeline alignment where the pipeline crosses streams and arroyos to prevent the type of surface erosion and arroyo cutting that has been experienced in other locations in Pima County where pipelines have been constructed through arroyos, streams, or washes.

We will request that our technical concerns and requirements be incorporated in any Federal Energy Regulatory Commission approval of this pipeline project.

CHH/anc

Attachments

c: Allen Fore, Director Public Affairs, Kinder Morgan Energy Partners, LP
Attendees, April 30, 2014 Kinder Morgan Stakeholders Meeting

Pima County Regional
FLOOD CONTROL
DISTRICT

PIMA COUNTY
REGIONAL FLOOD CONTROL DISTRICT
97 EAST CONGRESS STREET, THIRD FLOOR
TUCSON, ARIZONA 85701-1797

SUZANNE SHIELDS, P.E.
DIRECTOR

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May 9, 2014

Mr. Lynn Christensen, P.E., Sierrita Gas Pipeline Project Manager
Kinder Morgan, Inc.
Two North Nevada Avenue
Colorado Springs, Colorado 80903

Subject: Sierrita Gas Pipeline – Summary of Outstanding Issues

Dear Mr. Christensen:

This letter serves as a summary of the Floodplain Use Permit (FPUP) application correspondence, the current status of the FPUP (No. 13-269), and the remaining outstanding issues. The application for the FPUP was filed by Sierrita Pipeline, LLC (Sierrita) in July 2013 for construction of 60 miles of 36-inch natural gas pipeline to run from SW Tucson to the International Boundary near Sasabe, Arizona. At the time of the initial submittal it was mutually agreed that, in order to facilitate permitting of such a complex project, submittals could proceed in a piecemeal or discretized fashion. This includes an initial submittal of hydrology and cross-sections of each of the more than 200 watercourse crossings, a delineation of the existing regulated riparian habitat and determination of the amount disturbance of habitat as a sult of the construction of the pipeline, and justification of the reduction in the default values used to determine maximum anticipated scour depth and the lateral migration distance of each of the watercourses. To date, the Regional Flood Control District (District) has received and commented on two complete submittals in support of this application. A third submittal was received in six separate parts between March 28 and April 29, 2014. The District has commented in writing on parts 1, 2, and 6 of this third submittal in a letter dated April 29, 2014. Review of Part 4 was recently completed, and the review letter is enclosed. The District's review of parts 3 and 5 is in process. Based on the submittals to date, I will summarize the most significant unresolved issues, the details of which can be found in the comment letters:

1. The District agrees that a stable soil sublayer may be the basis for justifying both a reduced scour depth and a reduced potential lateral migration distance. Further, the District agrees to use your proposed methodology to justify the scour/lateral migration potential. However, more information is needed to confirm the presence of these stable sublayers at individual wash crossings, and the degree of erosion resistance afforded by these layers. AMEC proposes to identify stable sublayers by digging test pits at each wash crossing; the District requests that this effort also include the use of the modified slake durability test to measure the sublayer erosivity. To allow adjustments to the pipeline design based on these tests, testing must to be accomplished and results reviewed by the District prior to installation. This effort will continue until consistent erosive resistance of the cemented alluvial fan layer has been established.

2. Once the pipeline is installed at crossings where the scour depths have been adjusted (as described above) due to the presence of a stable soil sublayers, the concern arises that the pipeline trench itself will become the weak point and that erosion/scour will initiate at the trench. This concern has been recently validated along the Kinder Morgan pipeline constructed east of Tucson

approximately four years ago. Recent inspections and correspondence with Kinder Morgan staff confirm that that the disturbed backfill placed within a trench dug across a wash into relatively stable sublayers tend to erode by capturing surface flows. This source of erosion may be stopped by use of stabilized backfill material. Similarly, where Sierrita is proposing reductions in the scour depth and lateral bank migration limits due to presence of cemented alluvial fan deposits, stable backfill will prevent turbulent flows along the wash from selectively removing the backfill material. Therefore, the District will require Sierrita to backfill the pipeline trench with stabilized soil up to the top of the cemented alluvial fan layer within both the channel and the limits of their proposed reduced lateral bank migration limits.

3. Throughout the EIS process, a considerable number of comments pertained to the potential for erosion, sediment transport and gully formation along the alignment within the overbank and upland side slopes of the wash crossings. As a result of the District's encouragement, the FEIS now includes rock terraces as a method of erosion control on steep areas of disturbed right-of-way. However, the FEIS does not provide specific locations for their application. The District's authority extends to sediment and erosion control and will require use of rock terraces along the disturbed right-of-way adjacent to the wash crossings where waterbars/slope breakers cannot be properly terminated. The FEIS establishes some general parameters regarding the use of rock terraces and will require the evaluation of their applicability at each watercourse and will require a plan view of the pipeline alignment which sets out anticipated locations for the rock terraces. In addition to erosion control, the District notes added benefits of rock terraces which include restriction of travel along the right-of-way, and the increased potential for restoration of vegetation by capturing runoff and infiltrating it within the right-of-way. These were all identified as issues during the EIS process.

4. Regarding the mitigation of the disturbance of regulated riparian habitat, the District has agreed to the delineations proposed by SWCA and the resulting amount of riparian habitat disturbance presuming the right-of-way is disturbed in its entirety; however, the District is still anticipating a mitigation proposal. Although a fee in lieu of onsite mitigation has been discussed informally, a proposed method of mitigation for this disturbance has not been submitted.

In addition to the issues identified, the review of the two remaining parts of the third submittal, which involves the bank migration of the Altar Wash and its impact on the stability of the pipeline installation at MP 24.6 and defining bank locations along each watercourse crossing from which to offset for lateral bank migration, is ongoing and will be delivered in a timely fashion.

Sincerely,

Eric Shepp, P.E.
Floodplain Administrator

ES/tj

Enclosure

c: Suzanne Shields, P.E., Director and Chief Engineer – Regional Flood Control District
Andy Seiger, P.E., Civil Engineering Manager – Regional Flood Control District
Alex Coronel, P.E., AMEC Environmental and Infrastructure

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May 9, 2014

Mr. Alex Coronel, P.E.
AMEC Environment and Infrastructure
4600 E Washington St, Suite 600
Phoenix, AZ 85034

Re: FPUP No. 13-269 Sierrita Gas Pipeline, Review of Comment Resolution Package 4

Dear Mr. Coronel:

On Friday March 28th, The Pima County Regional Flood Control District (District) received a submittal titled: *Comment Resolution Package Comments 28, 29, 30, 31, and 32 Integration of Geophysical Investigation Sierrita Gas Pipeline*, (comment resolution package 4) prepared by AMEC Environment & Infrastructure, Inc. and dated this same date. The District understands that this submittal is a partial response (first of six separate submittals) to the District's comment letter of Jan 10, 2014 regarding its review of report titled: *Draft Final Scour and Lateral Bank Migration Analysis Sierrita Gas Pipeline*, prepared by AMEC and dated 11/27/13 (Report). The District's review of the submittal produced the comments listed below. These comments must be addressed prior to further action on your application for Floodplain Use Permit, and are numbered to correspond to the numbering in the District's Jan 10, 2014 comment letter.

The comments listed below reference scour characteristics at the pipeline wash crossings which are calculated by AMEC and presented in various tables in AMEC's 11/27/13 Report. To clarify these references, the District notes that scour depths calculated per standard procedures are presented in Table 9 of the Report, titled: *Summary of Final Scour Depth and Recommended Burial Depth – Full Pipeline Alignment*. Lateral bank migration limits calculated per standard procedures are presented in Table 8 of the Report, titled: *Summary of Final Lateral Erosion Limits – Full Pipeline Alignment*. Standard procedures are outlined in the publication: *Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona*, July 1998 (SMDDFM). Both Tables 8 & 9 of the Report contain entries for all 213 wash crossings along the pipeline alignment. A goal of AMEC's Report was to reduce these scour characteristics from the values calculated by standard procedures, where it was possible to justify this reduction by documenting the presence of less erosive layers in the form of cemented alluvial fan deposits located at or near the bottom of the wash at the pipeline crossing. The reduced scour characteristics which the Report is attempting to justify are presented in Table 7A of the Report, titled: *Scour and/or Lateral Erosion Modifications Due to Geotechnical Scour Resistance*. Table 7A contains entries for only 119 wash crossings, since not all of the 213 wash crossings were found per AMEC's investigations to contain cemented alluvial fan deposits located near the bottom of the wash.

28. In this comment, the District requested additional information regarding extrapolation of the results of AMEC's geophysical investigation along the pipeline alignment between MP 0.0 and MP 9.0.

    Partially Addressed. From AMEC's response the District understands that the subsurface characteristics along this reach were inferred from field inspection, published geologic maps, and two boreholes located in the vicinity of the Central Arizona Project (CAP) canal (approx. MP 1.0). The District further understands that based on this information, the reach between MP 0.0 and MP 0.4 is classified in the Report as Scour Resistance Category AE, and the reach between MP 0.4 and MP 9.0 is classified as Scour Resistance Category F. The District accepts this information.

    Because Resistance Category F represents areas where no reduction of scour characteristics is justified due to consolidated layers being more than 20 feet below the bottom of the wash, this information should preclude

adjustment of scour depth and lateral migration limits at wash crossings along the pipeline alignment between MP 0.4 and MP 9.0. However, Table 7A of the Report shows adjustment of scour characteristics for wash crossings along this reach (specifically subbasins with FID 14, 15, 18, 25, 27, 34, and 91). Please address this discrepancy, and update Tables 8 and 9 of the Report accordingly.

29. In this comment, the District requested additional information regarding AMEC's application of seismic surveying to identify layers exhibiting calcareous cemented deposits consistent with Stage II – II+ carbonate accumulation.

Partially Addressed. The District appreciates that AMEC staff applied significant experience to this identification effort, and understands the additional geological explanation provided. Yet, in lieu of the pre-design sampling and testing effort suggested by the District, the District will accept a procedure similar to that presented at the end of AMEC's response. This procedure will involve excavation of test pits or trenches at the Table 7A wash crossings to verify the presence of Stage II - II+ calcic cementation, and to quantify the resistance to erosion of this layer. The District suggests quantification of erosion resistance by the modified slake durability test mentioned in previous responses from AMEC. Documentation and reporting for this procedure should be under seal of an Arizona-registered civil engineer or engineering geologist. Application of the modified slake durability test to the consolidated alluvial fan deposits identified in the test pits should continue until both the District's and AMEC's engineer/geologist agree that consistent erosion resistance of this layer has been demonstrated. Please indicate your concurrence with this modified procedure, which is outlined below:

1) Excavate test pits at Table 7A wash crossings, with this excavation timed to allow adjustment of the pipeline design at the wash crossing (if necessary) in consult with the District prior to construction of the pipeline at the subject wash crossing;
2) Document findings consisting of test pit locations, descriptions of earth materials and depths of changes, features of cementation stage including results of the modified slake durability test in the form of measured Geotechnical Scour Number, effort expended by the backhoe or track hoe based on the sound of the engine as it excavates, and photographs of the exposure;
3) Compare cemented conditions encountered in test pits at each Table 7A wash crossing to projected conditions used to reduce calculated scour depths and lateral bank migration limits as presented in Table 7A of the Report.
4) Summarize findings in a daily report that includes photographs; Summarize findings weekly in compilation of daily reports with tables documenting actual conditions and updating Table 7A in the AMEC Report; and Daily and weekly reports will be submitted to Sierrita Gas Pipeline with copies to the District. AMEC anticipates weekly discussions with the District to review progress and findings and to answer any questions.

30. In this comment, the District requested sampling and testing to verify erosion resistance of layers identified as calcareous cemented deposits consistent with Stage II – II+ carbonate accumulation.

Partially Addressed (see comment no. 29 above). AMEC's response cites previous AMEC jobs where seismic velocity has been correlated with degree of calcic cementation, and where degree of calcic cementation has been correlated with unconfined compressive strength (unsaturated). Based on this, the District accepts that a seismic velocity of 2500 ft/s is appropriate for a sublayer exhibiting the stated degree of

calcic cementation. The problem remains to determine the degree of erosion resistance that will be provided by the cemented alluvial fan deposits within the affected wash crossings in the Altar Valley.

Although AMEC does not prefer the tractive power approach to judge erosivity of cemented alluvial fan deposits, it remains an approved method for both Pima County and the State of Arizona. An alternative method may be proposed by AMEC, but it must measure the erosivity of the Altar Valley deposits and demonstrate that the measured level of erosivity will insure a sound foundation within the wash crossings for the pipeline during passage of the 1 percent chance event. The District agrees that this method may be based on cumulative stream power evaluated over the base flood. A generalized hydrograph representative of the drainage basins in the Altar Valley may form the basis of this justification. In order to prevent loss of less than 1 foot of cemented alluvial fan deposits during passage of a single 100-year event, the District proposes that this layer should have a Geotechnical Scour Number from the modified slake durability test of less than or equal to 0.100 ft/(ft-lb/s/ft^2).

In the District's response presented in comment no. 29 above, the District discusses modifications to the procedure proposed by AMEC which will address both comments 29 and 30. Under this modified procedure the foundation soils within each Table 7A wash crossing will be inspected, and the presence, depth, and erosivity of the cemented alluvial fan deposits will be evaluated prior to construction. The pipeline construction at each Table 7A wash crossing may proceed based on this evaluation. This modified procedure will continue until both the District's and AMEC's engineer/geologist agree that consistent erosion resistance of this layer has been demonstrated.

31. In this comment, the District requested additional justification for the proposed practice, within the limits of the reduced lateral migration limits, of bringing the pipeline closer to the ground surface within the overbank area.

Partially Addressed. AMEC's response uses geologic observations to argue that in general the wash bottoms of the Table 7A washes have already cut into the cemented alluvial fan deposits, and that therefore the top of this layer within the overbank of the wash will generally be at or above the level of the bottom of the wash. This condition then justifies raising the pipeline closer to the overbank surface within the reduced lateral migration distance. The District accepts this explanation and concurs that the scour depth for the pipeline may be raised as proposed in the overbank, within the limits of the reduced lateral migration limits listed in Table 7A, provided:

1) The presence, depth, and erosion resistance of the cemented alluvial fan deposits at the Table 7A wash crossing is verified prior to construction by the procedure presented in comments no. 29 and 30 above.

2) The pipeline is embedded in this layer and backfilled to the top of the layer with stabilized material as presented under heading: *Additional Considerations for Scour Mitigation* in Appendix H of the Report, and as further clarified in Section 4.2.1.1. of the *Final Environmental Impact Statement for the Sierrita Pipeline Project* (March 2014). This embedment and stabilized backfill would apply within the channel of the wash, and within the reduced lateral migration limits. If the top of cemented soil is encountered deeper than the reduced scour depth presented in Table 7A, but shallower than the scour depth calculated by standard procedures and presented in Table 9 of the Report, then the reduced scour depth in Table 7A is increased to the observed depth of the cemented soils, and the reduced lateral migration limit presented

in Table 7A is validated provided the pipeline is embedded into this cemented layer and backfilled with stabilized soil to the top of the layer. If the cemented soils are encountered deeper than the scour depth calculated by the standard procedure and presented in Table 9 of the Report, then there is no cemented layer in which to embed the pipeline and the scour depth and lateral migration limits as presented in Tables 9 and 8, respectively, shall apply.

Please indicate AMEC's concurrence with the provisions listed in 1) and 2) above, and provide general material specifications for the stabilized soil which AMEC proposes to use as stable backfill over the pipe when it is embedded into the cemented alluvial fan deposits.

In addition, some entries presented in Table 7A of the Report appear to be inconsistent with AMEC's response to this comment. For instance, Table 7A on page 20 of the Report presents data for subbasin with FID no. 185 showing Scour Resistance Category C within the main channel and the ROB. The District interprets this to mean that the top of the cemented alluvial fan deposits are 8 feet or more below the bottom of the wash and also below ground within the ROB. If this is the case, then AMEC's argument that the wash bottom is already cut into the cemented alluvial fan deposits may not be valid at this wash crossing. Application of the procedure described in comments 29, 30, and 31 will insure the pipeline is never-the-less embedded in this cemented layer and backfilled with stabilized material, within both the channel and the overbank areas.

32. In this comment, the District requested additional justification for the proposed reduction in the lateral migration distance at wash crossings based on presence of cemented alluvial fan deposits.

    Addressed. Based on AMEC's response to comment no. 31, the District understands that where cemented alluvial fan deposits exist within the wash crossings, the wash will generally be cutting into these deposits and therefore the top of the deposit within the overbank will be at or above the bottom of the wash. In this case, the District accepts this explanation and concurs that the lateral migration distance may be adjusted as proposed provided that, within the limits of the adjusted lateral migration distance, the pipeline is embedded within the cemented alluvial fan deposit, and backfilled to the top of the cemented alluvial fan deposits with stabilized soil, as presented in comment no. 31 above.

New Comments

33. Based on Pima County comments to the DEIS for the project, Rock Terraces were added to the *Final Environmental Impact Statement* as a form of side slope erosion control under Section 4.2.2, Environmental Analysis- Soils - Flash Flooding and Channel Scouring. Pima County intended that Rock Terraces would be used under certain conditions to prevent discharge of sediment to the wash from excessive rill / gully erosion of disturbed ROW adjacent to washes. Pima County Floodplain Ordinance requires minimization of off-site (i.e., beyond limits of ROW) adverse impacts in the form of gully formation due to diverting surface runoff off the ROW.

    The Rock Terrace is a rock-lined or rock-filled berm with a level crest oriented perpendicular to the slope gradient across a sloped segment of disturbed ROW. The Rock Terrace will intercept and store both runoff and sediment from the disturbed, up-slope area. The District intends that a Rock Terrace be designed to store a minimum of 10-years sediment accumulation in order to allow stable vegetation to establish on the Terrace. Initially, impounded runoff will leave the Terrace via infiltration and evapotransporation. Outflows will occur

from the Rock Terrace during an event less frequent than the 10-year event, or from any event which occurs after the Rock Terrace has filled with sediment. Outflows will be distributed (i.e., not concentrated) within the ROW downstream of the Rock Terrace by overflow over the horizontal rock-lined crest of the Terrace. Upslope distance should be governed by rules similar to permanent slope breakers (P. E-13 of the FEIS):

> f. "Construct and maintain permanent slope breakers in all areas, except cultivated areas and lawns, unless requested by the landowner, using spacing recommendations obtained from the local soil conservation authority or land managing agency.
>
> In the absence of written recommendations, use the following spacing unless closer spacing is necessary to avoid excessive erosion on the construction right-of-way:
>
> | Slope (%) | Spacing (feet) |
> |---|---|
> | 5 - 15 | 300 |
> | >15 – 30 | 200 |
> | >30 | 100" |

The height of the Rock Terrace will be determined by the required volume of sediment storage. The District proposes the following sediment storage volume requirement, based on application of the USLE, PC-Hydro, and normal flow assumptions to the disturbed upslope area, and utilizing standard hydrologic / hydraulic / soil parameters. An alternative volume may be determined through valid technical analysis approved by the District.

Slope (%)	Volume (ft^3/acre)
5-10	2,150
10-15	3,940
15-20	6,080
20-25	8,590
25-30	11,460
30-35	14,690
35-40	18,290

The District will require, through specific conditions to the Floodplain Use Permit, that Rock Terraces be utilized where waterbars / slope breakers cannot be terminated in a manner which will minimize gully formation beyond the ROW. At a minimum, the District observes that terminating a waterbar / slope breaker within erodible soil at the following locations promotes gully formation:

a. Termination at a location where the natural surface contours concentrate the released flows within a natural flowpath which is in equilibrium with its natural undisturbed upland area, or within a geographic feature which is not currently a significant flow path but will become one upon receiving flows from a waterbar; and

b. Termination at a location where the natural surface gradient is greater than the longitudinal slope within the waterbar (District uses 7% maximum grade along the waterbar).

Both terminations listed above must be avoided where the specified feature is located within a radial distance from the point of termination which is necessary for the released flows to decelerate and spread out without concentrating. This radial distance shall be 80 feet per acre of ROW tributary to the waterbar, or as otherwise determined through valid technical analysis approved by the District.

The FEIS states that Sierrita has agreed to include Rock Terraces as one form of erosion control. However, the FEIS continues on P. 4-19 that Sierrita is to file a revised version of its Plan (i.e., Plan, Procedures, Reclamation Plan, and Post-Construction Vegetation Monitoring Document) that identifies rock terraces as a measure to control erosion. Please provide the District a copy of this revised Plan, and please include the above design and application information, or provide technical justification for alternative design and application. Also please provide a location map of the pipeline alignment indicating the planned locations of these Rock Terraces.

34. Please provide a table listing the name, function, placement, construction materials and a sketch for each of the permanent erosion control features described in the FEIS. Some features described in the DEIS (e.g. J-hook p. 4-19, section 4.2.2) are not described in a substantive way.

Failure to submit the requested information within 90 days may result in your application becoming void. If you have any questions or if you would like to schedule a meeting, please contact me at 724-4600.

Sincerely,

Andrew Seiger, Civil Engineering Manager
Floodplain Management Division

(AS/ads)

Cc: Eric Shepp, Manager, Floodplain Management Division, Regional Flood Control District
Patricia Gilbert, Principal Hydrologist, Floodplain Management Division, Regional Flood Control District
Sherry Ruther, Environmental Planning Manager, Development Services