Review of Kimley-Horn Sediment Transport Model of the Agua Fria River

Prepared for:
Flood Control District of Maricopa County

Water • **E**nvironmental • **S**edimentation • **T**echnology

Hydraulics · Hydrology · Sedimentation · Water Quality · Erosion Control · Environmental Services

DRAFT REPORT

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Prepared for:
Flood Control District of Maricopa County

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1. Executive Summary

WEST Consultants, Inc. reviewed the Sediment Transport Model Developed by Kimley-Horn and Associates, Inc. (Kimley-Horn or KH). A number of technical problems were found in the models which warrant revision of the models and the running of the revised models to insure that the problems identified did not result in inaccurate results. Several of the problems were significant and could lead to erroneous conclusions based on the existing model output. While the results of the corrected models may not differ by large amounts after the analysis, it is important to run the corrected models to insure a correct basis for future decisions and to determine the impact of the proposed model corrections. Based on WEST's modeling of a portion of the Agua Fria River it is likely that the model results will not change drastically due to the corrections proposed herein. However, given the scope of decisions that will be based on these results, it is important to be certain of their impact.

Bed samples obtained by Kimley Horn were compared with those obtained by Arizona State University (ASU) in an earlier study of the Agua Fria River. These sample analysis results differed significantly in some areas and new model results were calculated for the river based on the ASU samples. These results showed local variations as large as ±4.5 feet while the overall variation was on the order of 0.1 ft. Additional samples collected by WEST for another project were different from both the ASU and the Kimley-Horn samples for the reach where WEST obtained samples. Given the width of the river, the complexity of bedding and the length of the river, variations can be expected in bed samples. Model results from both the Kimley-Horn and ASU sets of data should be used as a sensitivity analysis to view possible variations in calculated results and to determine their impact on planning decisions for the river.

While problems were found in the models, the problems are more an indication of the difficulty of visualizing the input and results than from poor modeling efforts. The current state of the HEC-6 model leaves much to be desired in terms of visualization of input data and output results. The visualization of input data is of critical importance in modeling efforts

2. Introduction

2.1 Scope

The Flood Control District of Maricopa County (FCDMC) has commissioned WEST Consultants, Inc. (WEST) to review the Kimley-Horn and Associates, Inc. (KHA) Final Sediment Trend Analysis Report for the Agua Fria Watercourse Master Plan dated November 2001. The final report followed the Technical Memorandums that KHA has previously prepared and submitted to the FCDMC and incorporated the November 2001 revisions to the draft report.

2.2 KHA Sediment Analysis

The purpose of the sediment trend analysis performed by KHA was to predict and evaluate the long-term and flood response of the streambed profile of the Agua Fria River based on existing, proposed, and alternative development conditions along and within the river. The study was an integral part of a broader investigation of the Agua Fria River for the Agua Fria Watercourse Master Plan.

The KHA analysis developed several sediment trend models to evaluate the streambed profile response to various conditions. All the models were developed using the U.S. Army Corps of Engineers (COE) library version of HEC-6 computer program from October 1993 with some errors corrected in 1995. The models included an existing river conditions model, full sand and gravel mining model, full encroachment model, and a grade control structure model. From the results and interpretation of the above models, KHA recommended river stabilization measures and policy/procedures for the FCDMC to implement regarding sediment management in the Agua Fria River.

The sediment trend analysis began at the confluence of the Agua Fria River with the Gila River. The upstream limit was approximately at the diversion outlet downstream of New Waddell Dam. The total length of the studied reach of the river was approximately 33.8 miles. KHA has identified several tributaries along the study reach of the Agua Fria River, but only the New River (which joins the Agua Fria south of Glendale Airport) was incorporated into the sediment trend analysis.

The KHA analysis attempted to predict anticipated river channel response to long-term channel forming discharge based on the potential release from the New Waddell Dam under the 100-year flood event (30 days of 9,000 cubic feet per second (cfs) into the Agua Fria River). The short-term event selected to evaluate the river response was the 100-year flood (the peak discharge of 54,400 cfs in the lower Agua Fria River) as developed by the COE.

3. HEC-6 Hydraulic Base Model

KHA initiated the study with the development of an HEC-6 fixed bed model (filename: affbrev.dat) based on the 1996 Flood Insurance Study (FIS) HEC-2 hydraulic model. The fixed bed model was the foundation used to develop the subsequent movable bed models.

For the purpose of this review, WEST first imported the KHA fixed bed model into the HEC-RAS interface and examined the model on a cross-sectional basis. The model consists of 113 cross sections at an average channel distance of 1600 feet (max distance of 5300 feet). There are 9 local tributaries, distributaries or flow adjustments along the course of the model. The downstream elevation boundary condition for the 100-year peak flow was set at 916.83 ft for a flow of 52,000 cfs at the most downstream cross section 0.16. The Manning roughness coefficient ranges from 0.03 to 0.05 for the channel, from 0.04 to 0.15 for the left overbank, and from 0.04 to 0.1 for the right overbank.

Channel encroachments and ineffective flow areas are specified in HEC-6 via the X3 or XL records (note that the X3 record in HEC-6 is **different** than the record of the same name in HEC-2). The X3 record permits the user to select from three different methods to define encroachments for a cross section. Methods 1 and 3 are used in the Agua Fria models (note that only one or the other may be chosen for a particular cross section, but not both). Method 1 restricts the water to the channel, as defined by the bank stations, until the water surface elevation exceeds the bank station elevation. Method 3 contains the water between user-specified left and right limits, until the water surface elevation exceeds user-specified left and right elevations. With the XL record, the modeler specifies left and right limits in the cross section beyond which there is no conveyance, regardless of the water surface elevation.

Scour is allowed in a cross section in HEC-6 when the ground points are below the water surface elevation, within the movable bed limits (defined on the HD record), within the effective flow limits (defined on the X3 record) and within the conveyance limits (defined on the XL record). Deposition is allowed for ground points below the water surface elevation and within the movable bed limits. Deposition is not allowed in ineffective areas defined by X3 records, but can occur in areas with no conveyance as defined by XL records.

The fixed bed model features encroachment limits defined on X3 records, but does not have conveyance limits (XL records) needed to describe the ineffective flow areas where sediment will be allowed to deposit. The fixed bed model was developed for the purpose of calibration to the FIS model. Conveyance limits specified in the movable bed model should also be present in the fixed bed (calibrated) model because the limits affect the channel hydraulics.

The subcritical HEC-RAS run revealed that 86 percent of the cross sections experienced an energy loss greater than 1 foot between one cross section and another. The high percentage of energy loss warnings usually indicates the need for additional cross sections. This is particularly true for cross sections 25.860, 17.638 and 4.094 where the energy equation could not be balanced due to an abrupt velocity variation. Two of these cross sections are very likely supercritical since 4.094 appears to be an existing drop structure and 17.638 is a pit haul road that is modeled as a drop structure. This road will very likely erode away during a high flow event but the retaining of the road is a conservative approach. It is recommended that additional

cross sections be introduced at other locations where an abrupt change in velocity occurs (e.g. cross section 32.998, 30.73, 30.07, 17.638, 15.374, 11.428, etc.).

Significant expansion and contraction of the water surface width was noted at several cross sections (e.g. 1.33, 3.43, 15.374, 25.666, 32.92 as well as others). The expansion ratio should generally be limited to 3:1 (3 streamwise units to 1 lateral unit) and the contraction ratio should generally be limited to 1:1 by setting ineffective flow or conveyance limits (X3 or XL records) where appropriate. The cross sections listed above appear to be in violation of these recommendations.

Discontinuous features in the channel geometry (e.g. structures, high ground) should also be defined by ineffective flow or conveyance limits (X3 or XL records) both upstream and downstream when the influence is seen at the upstream and downstream cross sections. An example of this is a feature at cross section 6.91 which is not seen in either the upstream or downstream cross section (Figure 1). This feature is a protected electrical transmission tower but should appear in the downstream cross section which is only 10 feet below the tower according to the input file. The influence would probably not be noticed upstream (cross section 6.93) where the distance is larger than the diameter of the tower base (e.g. a 1:1 contraction) but should be modeled in cross section 6.89. The influence of this tower may not be extremely important in cross section 6.89 but it appears the cross sections were designed to model the influence of the towers in this reach of the river. Currently however, the influence is limited to only cross section 6.91.

Several cross sections should have encroached areas specified (by X3 record) behind what appear to be levees. For example: cross section 8.105 for both berms/levees (Figure 2); 15.0, 16.506, and 21.157 (Figure 3) for the right levee. The "levees" on the left side of cross section 8.105 appears to be a road embankment and flow in that area should have been set to be ineffective. There is no X3 or XL card for this cross section however. It should also be noted that the cross section geometry appears to be different when a comparison is made between Figure 2 and the same cross section in the Appendix which shows the existing conditions base movable bed model. Similar problems need to be resolved at the other cross sections listed above.

Bank stations need to be revised at some locations to better reflect the channel hydraulics that will later be used for the computation of sediment transport capacity in the movable bed model. They should be identified from planform analysis and field visits and should consistently identify the (continuous) main channel. Generally, channel bank stations define erosion limits in HEC-6. This is because river erosion occurs mainly within the channel, while floodplains are mainly depositional areas. Therefore, the effort should be made to describe the channel by the appropriate specification of the bank stations. This is particularly important for braided systems where usually one channel predominates. An example of this is given in Figure 4 for cross section 2.6 where the right bank should have been specified at station 10580 rather than 10850. Other examples of the same kind can be seen at cross sections 3.27 (Figure 5), 8.992 (Figure 6), and others. Note that this is a conservative approach if scour depths are the critical design considerations (rather than deposition depths).

The bank location problem should be remedied in the model geometry because it will greatly affect sediment transport calculations later in the movable bed models. For the movable bed models (described subsequently), the hydraulic parameters calculated within the defined channel will be used to compute the sediment transport capacity that is then applied over the entire cross section. It is also recommended to increase the resolution of the cross section by adding ground points between the bank stations where necessary, so that the bed can be properly adjusted during the vertical movement computations. When the model can adjust only one or two points within the movable bed limits to satisfy the sediment computations, unrealistic channel shapes may result. The same type of problem may arise when there are wide overbank areas defined by only a few ground points, and additional interpolated points should be added in this situation as well.

At certain cross sections, the bank stations were specified at the channel bottom: e.g. 28.12 (Figure 7), 28.67 (Figure 8), etc. X3 records (with 10 in the first field), used to confine the flow to the channel until the water surface exceeds the bank elevations, are not functional for such cross sections.

The Manning roughness coefficient in the channel ranges from 0.03 to 0.05. At several cross sections (e.g. 21.157, 21.431, 23.974, etc.) there is a sudden change in the channel roughness (from 0.035 to 0.05) but these values appear reasonable in light of areas with much denser vegetation in some areas of the channel and overbanks.

4. HEC-6 Existing Conditions Movable Bed Model

The KHA existing conditions movable bed model (ecafrev.dat) was constructed from the HEC-6 fixed bed model (affbrev.dat) as a basis for subsequent development of other movable bed models (full sand and gravel, encroachment, and grade control). Therefore, this review of the KHA sediment transport analysis concentrates on the features of the existing conditions HEC-6 model.

4.1 Geometry

The existing conditions model was based on the geometry of the fixed bed model with additional cross sections introduced at the locations of existing sand and gravel mines. The horizontal and vertical movable bed limits, additional X3 (encroachment) records, and XL (conveyance limits) records were also specified. Sediment data (inflow loads and bed gradation) and hydrology data (100-year hydrograph) were incorporated as well.

In order to visualize the existing model geometric features, its cross sections were imported into HEC-RAS graphical interface. These cross sections are shown in Appendix A. For convenience, movable bed limits (from HD records) are plotted as **Levee**. Conveyance limits (from XL records and X3.10 records) are shown as **Ineff**ective flow limits, and **Encr**oached regions (from X3 records) are shown as black areas.

The HEC-6 library version used in the KHA study does not have the capability to specify erosion limits independently of conveyance limits (XL records). Therefore, the erosion limits

need to be set up by conveyance limits that restrict erosion within the channel (banks), allowing deposition in the overbanks. An example of this is cross section 12.359 (Figure 9) which seems to be setting an ineffective flow area downstream of the Northern Avenue Bridge.

It was noted that some of the encroachment limits specified on X3 records were different from those used in the fixed bed model (e.g. cross sections 0.63, 21.061, etc.). These changes cause a difference in the hydraulic results between the two models. The modeler should verify that the changes were within acceptable limits. Also, for a few encroachment limits the decimal point was missing (compared to the limits used in the fixed bed model), thus increasing the stationing by an order of magnitude (cross sections 8.198, 14.430 in this model but not in the fixed bed model). These inconsistencies need to be checked and eliminated.

Movable bed limits should be revised at several locations. In areas experiencing mostly erosion, the movable bed should be limited to the "main channel." In areas experiencing mostly deposition, the active flow area should be limited by using XL records, allowing deposition (but not erosion) in the overbanks. The reason for this strategy is that overbank areas are mostly depositional and are not usually lowered by erosion. In the HEC-6**T** model, simulating this situation is made somewhat easier by the availability of the HE record to define erosion limits independent of the conveyance limits specified on the XL records. However, this option is not available in the HEC-6 model. An abrupt change in movable bed widths was also noted at several cross sections: 1.33, 4.3, 8.433, 8.992, 10.343, 11.428, etc. The effort should be made to smoothly transition the changes in width by adding more cross sections at these locations.

Special attention should be paid to braided channels. Although in reality braided systems will avulse, for sediment modeling it is necessary to pick out the "main channel" (Figure 10) whose lateral dimensions will not change radically. Because HEC-6 only computes vertical bed movement and the concern is average bed elevation change, lateral shifting of the main channel is not important for the one-dimensional model (however, model results showing scour in the main channel should be considered to occur anywhere within the braided area for design purposes). An approximate main channel width can be identified using a channel forming discharge and regime theory. A 5- or 10-year event is commonly used in the Southwest for the channel forming discharge. Regime widths corresponding to the discharge can be computed using several equations (e.g., Neill's approach as presented in U.S. Army Corps of Engineers, 1994, or the Julien and Wargadalam (1995) Equation). It is recommended to match this computed width to features in the cross section to identify the movable bed limits for braided channels.

4.2 Sediment Gradation

There is an obvious difference between the sediment sample gradations obtained from the Arizona State University (ASU) study (most collected in 1992) and those collected for the KHA study (collected in 2001). It is not known whether the discrepancies arise from variations in sampling methods or testing, or from remixing of the bed by flows in the river. It is also not known if the sampling sites were at bars or cross-overs or in active or inactive parts of the braided system. Apparently most of the samples from the two studies were collected from the surface (less than 3 feet depth) in the main channel of the Agua Fria River.

Log interpolation of the gradation data allowed Figure 11 through Figure 14 to be prepared, showing the variation of the 85th, 50th, and 15th percentile finer (by weight) grain size with distance along the river. The ASU gradations are coarser than the KHA ones from River Mile (RM) 0 to 16 and 26 to 34 (approximately). The KHA samples are coarser in the range RM 18-25, with the gradations in the remaining areas being roughly equal.

The sensitivity of the existing conditions KHA model (ecafrev.dat) to the sediment gradations was examined. The bed sediment records (PF records) in the KHA model were replaced by records corresponding to the gradations used in the ASU model and this new model was saved with the name ecafasu.dat. Average bed elevations at a discharge of 9,000 cfs after 30 days at that same flow were then compared for the two models (Figure 15 through Figure 21). The average bed elevations at the beginning of the simulations are identical for both models (curve labeled TS1 for Time Step 1). However, the results after 30 days at 9,000 cfs differ.

As might be expected, general results for the new model showed the average bed elevation higher than the KHA existing condition results where gradations were coarser (less erosion) and lower where the gradations were finer (more erosion). Average bed elevations from the new model when compared with those from the KHA model ranged from 4.5 feet higher (cross section 14.43) to 4.3 feet lower (cross section 24.54) with the average difference over the entire river reach being 0.1 feet. Overall, the net effect of the gradation change is very small as shown by the average difference of 0.1 feet. However, for certain reaches, a sustained difference over a long distance yields a considerable difference in sediment volume eroded or deposited. For example, in the reach between RM 21.893 and 23.409 the modified model results show the average bed elevation approximately 2 feet lower than the KHA results over a distance of roughly 1.5 miles. When viewed on a 1-2 mile reach scale, the volume differences can be considerable. This factor should be addressed in terms of model sensitivity since few, if any, significant flows have occurred between the sample periods.

4.3 Hydrology

The hydrology for the movable bed models consists of 30 days of 9,000 cfs (unchanged along the length of the river) followed by a hydrograph representing the 100-year flood event (with one flow change location at the New River confluence). According to the KHA report, the 9,000 cfs discharge is the anticipated 100-year release from New Waddell Dam. Details of development of the 100-year inflow hydrograph are also provided. The KHA report states that "the purpose of running the 9,000-cfs through the river for a long duration is to average out the bed of the river before hitting the river with the 100-year hydrograph and to simulate a "long-term" flow prior to the 100-year flood" (sic).

Although a "warm-up" period at the start of a simulation is normal, it usually consists of only a few time steps at the beginning discharge in order to allow the bed material gradations and bed elevations to become computationally compatible with the flow hydraulics. A common practice is to use an approximate bank-full discharge for several days before beginning the event hydrograph. As a "warm-up" period, 30 days appears excessive. Also, it is not clear why it is desirable to "average out" the bed of the river for a 100-year dam release before simulating a 100-year flood event. A 100-year release does not seem representative of the long-term behavior of the river unless this is also considered to be the channel forming discharge. However, no

indications were given in the report that this was the modeler's intent. In addition, it is expected that simulation of the 100-year hydrograph at the beginning of the time series of flows will give different results than the current model at the end of the series. For example, in a depositional zone, placing the 100-year hydrograph at the beginning of the time series will usually yield "worst-case" scour results when compared to those obtained when the hydrograph is at the end of the time series of flows. A better case needs to be made as to why the current model hydrology is representative of both long-term and single event (100-year) behavior.

4.4 Inflowing Sediment Loads

The KHA report states:

> The development of the inflow curve for the Agua Fria River follows the methodology provided in the materials for the HEC-6 short course given by the Flood Control District in November 1999 and the guidelines published in "Applications of Hec-6 to Ephemeral Rivers of Arizona" (Report Number: FHWA/AZ86/214 prepared by Arizona State University for the Arizona Department of Transportation, January 1986) (sic).

The report does not elaborate on what these methodologies are or how they were implemented. Also a description was not found of how the sediment inflow rating curve was developed for the New River at the confluence with the Agua Fria River.

Although the report states in several places that New Waddell Dam releases are essentially clear water, the inflowing sediment load rating table for the upstream end of the model does not reflect this. The table in the existing conditions model (ecafrev.dat) shows 12,913 tons of sediment per day entering the model for a flow rate of 5,000 cfs with increasing amounts for larger flows. Sediment from all size classes from very fine sands to very coarse gravels are allowed to enter the river model. A sensitivity to inflowing sediment load is carried out with other models (ec10yang.dat and ec50yang.dat), but it is not clear why there should be any inflowing load at all as the most upstream cross section is located immediately below the dam.

5. Other Movable Bed Models

Movable bed models were also developed by KHA for Manning's 'n' value sensitivity (ecval.dat), reduced sediment inflows (ec10yang.dat and ec50yang.dat), full sand and gravel mining activities (sgbase50.dat and sgm1-50.dat), full encroachment to the floodway limits (ench.dat), and proposed grade control (enchgcs.dat). However, these models are all derived from the existing conditions movable bed model (ecafrev.dat) reviewed in the previous section of this report. Because of this, the focus of this review is on the existing conditions model. The problems outlined in the preceding section affect all the movable bed models.

6. Summary of Model Review Findings

The KHA series of sediment transport models prepared for the Agua Fria River watercourse master plan have several deficiencies serious enough to warrant correction of the models. These include:

- The hydraulic base model (fixed bed model) used to develop the subsequent movable bed models should be revised. Additional cross sections are necessary at locations with sudden velocity changes, specifically where the energy equation cannot be balanced and no change in flow regime occurs. Abrupt expansion/contraction of the water surface width should be limited to recommended lateral ratios by conveyance limits. Discontinuous features in the channel geometry need to be defined by conveyance limits both upstream and downstream of the flow obstruction. The effective flow area in some cross sections should be restricted to the main channel only. Encroachments added later in the movable bed model should be input to the fixed bed model as well to verify that the river hydraulics are still within acceptable limits of the FIS study results.

- Special attention should be paid to the specification of bank stations in the fixed bed model to better reflect the channel hydraulics that will be subsequently used for the computation of sediment transport capacity in the movable bed models. The banks should be identified and should consistently identify the (continuous) main channel to the extent possible. Another recommended is to increase the resolution of the cross section by adding ground points (both in the channel and the overbanks) where necessary, so that the bed can be properly adjusted during the vertical movement computations.

- The existing conditions (movable bed) model, used to derive other movable bed models, should be revised as well. Because the HEC-6 library version does not have the capability to specify erosion limits independently of conveyance limits, the former needs to be established by conveyance limits that restrict erosion within the channel (banks), allowing deposition in the overbanks. There are some inconsistencies in the specification of encroachment limits (compared to the fixed bed model) that should be verified and corrected where necessary.

- Movable bed limits should be revised at many locations. In areas experiencing mostly erosion, movable bed should be limited to the "main channel." In areas experiencing mostly deposition, the active flow area should be limited by using XL records, allowing deposition (but not erosion) in the overbanks. The effort should be made to smoothly transition the changes in movable bed width by adding more cross sections at particular locations.

- It is not clear why the hydrology used should be considered representative of the long-term behavior of the river.

- The sediment entering the upstream end of the model is at odds with the statement that essentially clear water is released from the dam.

7. References

Julien, P.Y., and Wargadalam, J. (1995). "Alluvial Channel Geometry: Theory and Applications," *Journal of Hydraulic Engineering*, September, pp. 312-325.

U.S. Army Corps of Engineers (1994). "Channel Stability Assessment for Flood Control Projects," *Engineer Manual 1110-2-1418*, October.

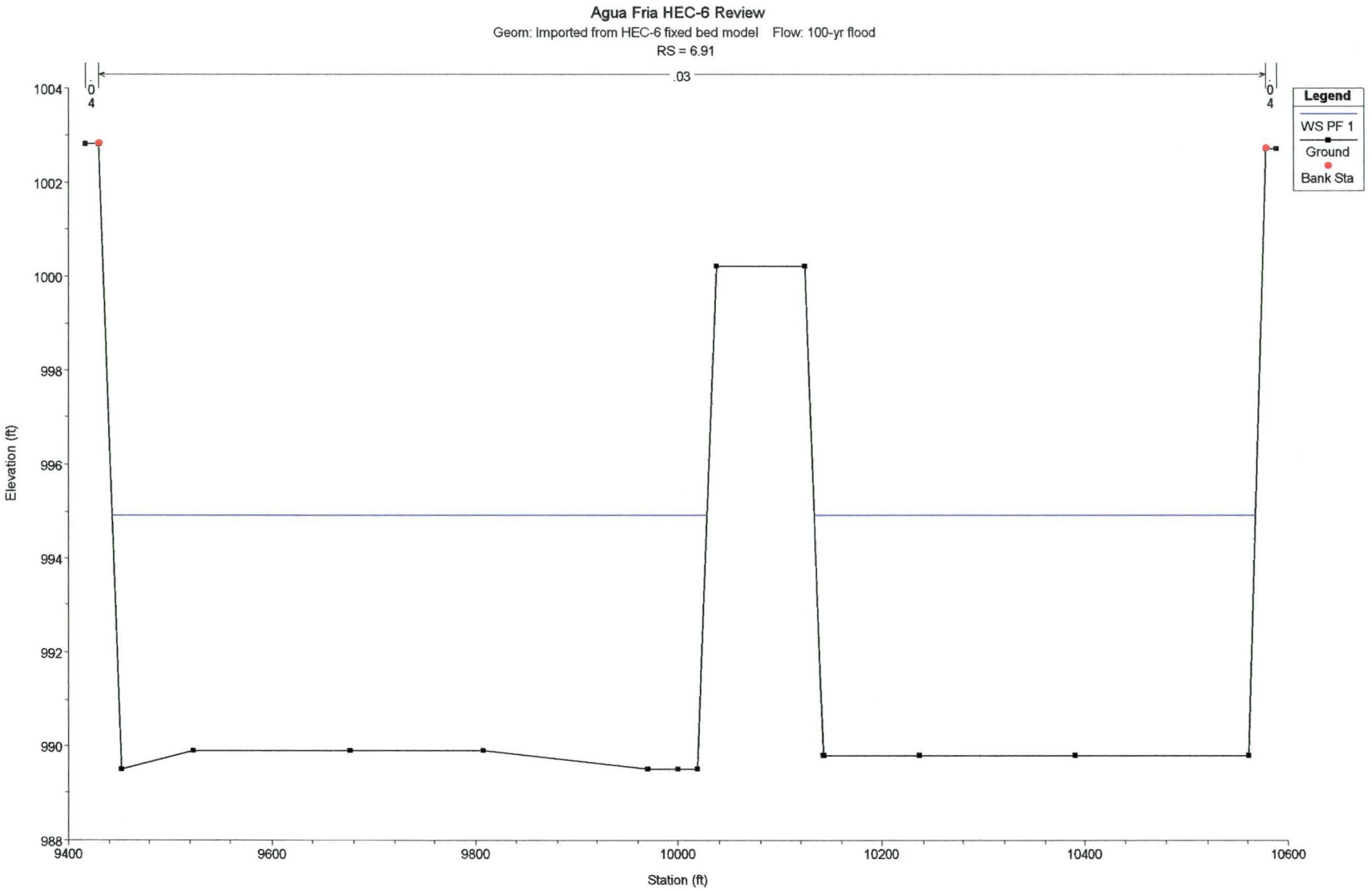


Figure 1. Feature at XSEC 6.91 requiring upstream/downstream ineffective flow limits.

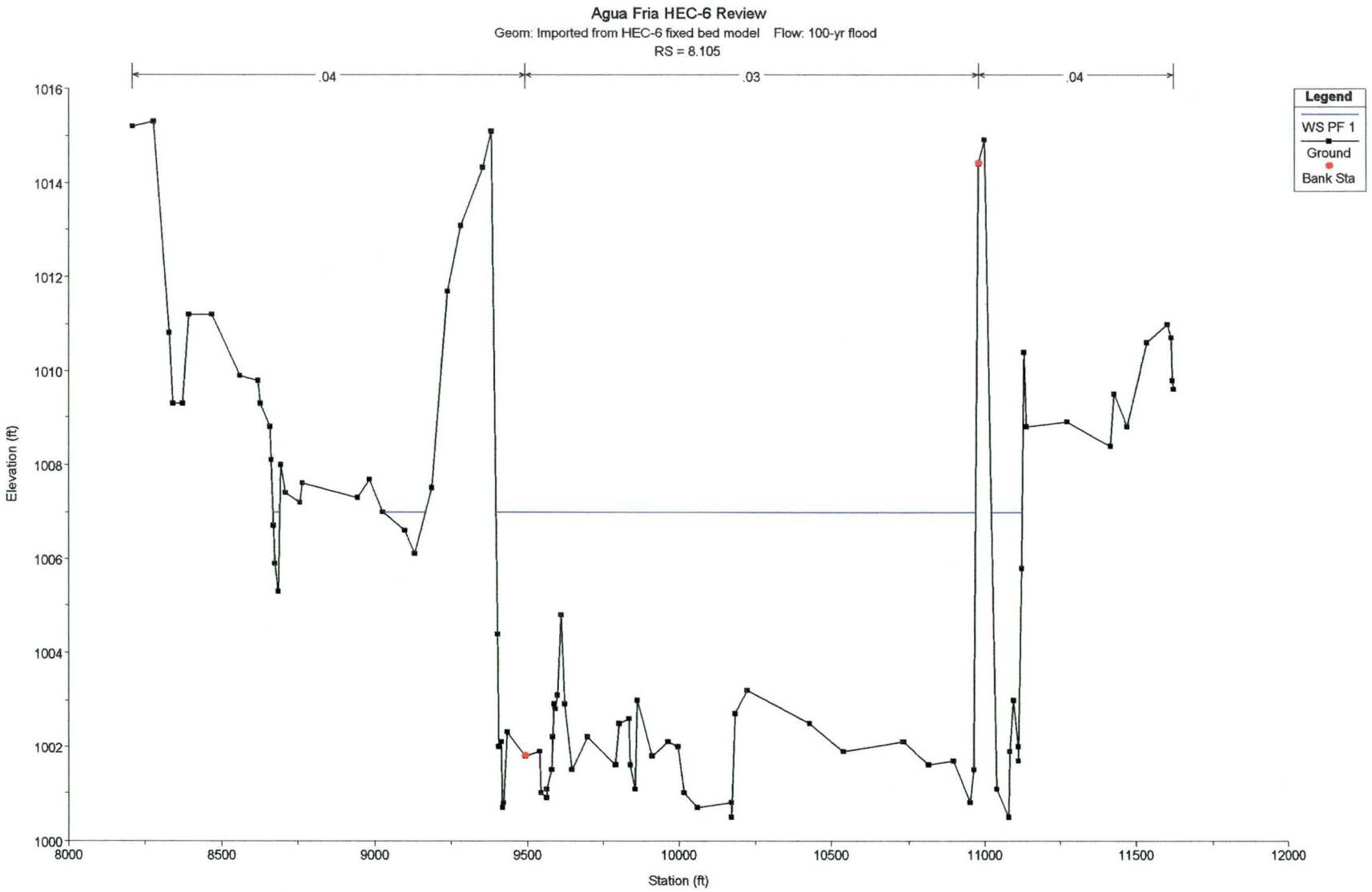


Figure 2. Blocked flow necessary at XSEC 8.105 behind both levees.

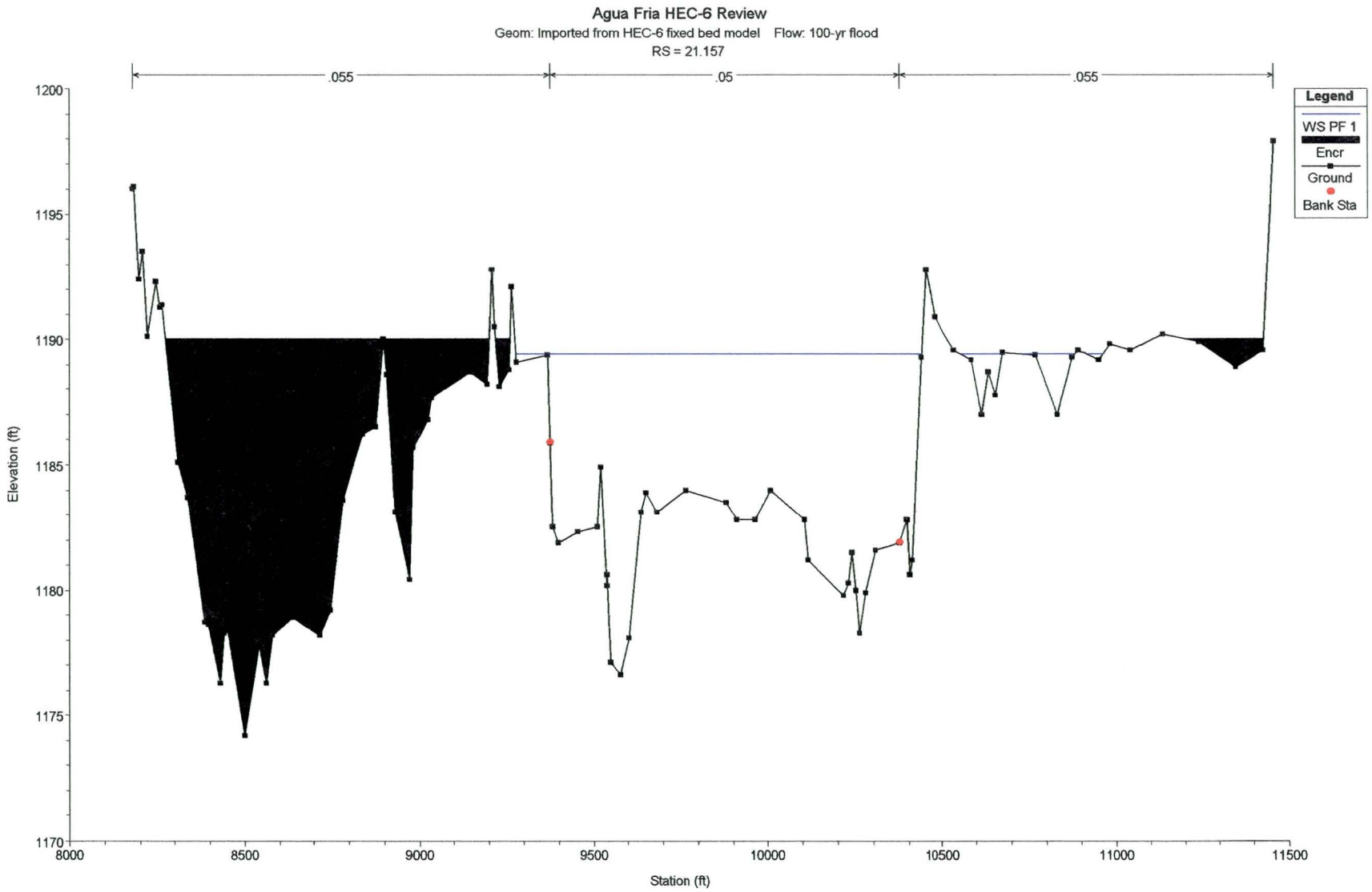


Figure 3. Blocked flow necessary at XSEC 21.157 behind the right levee.

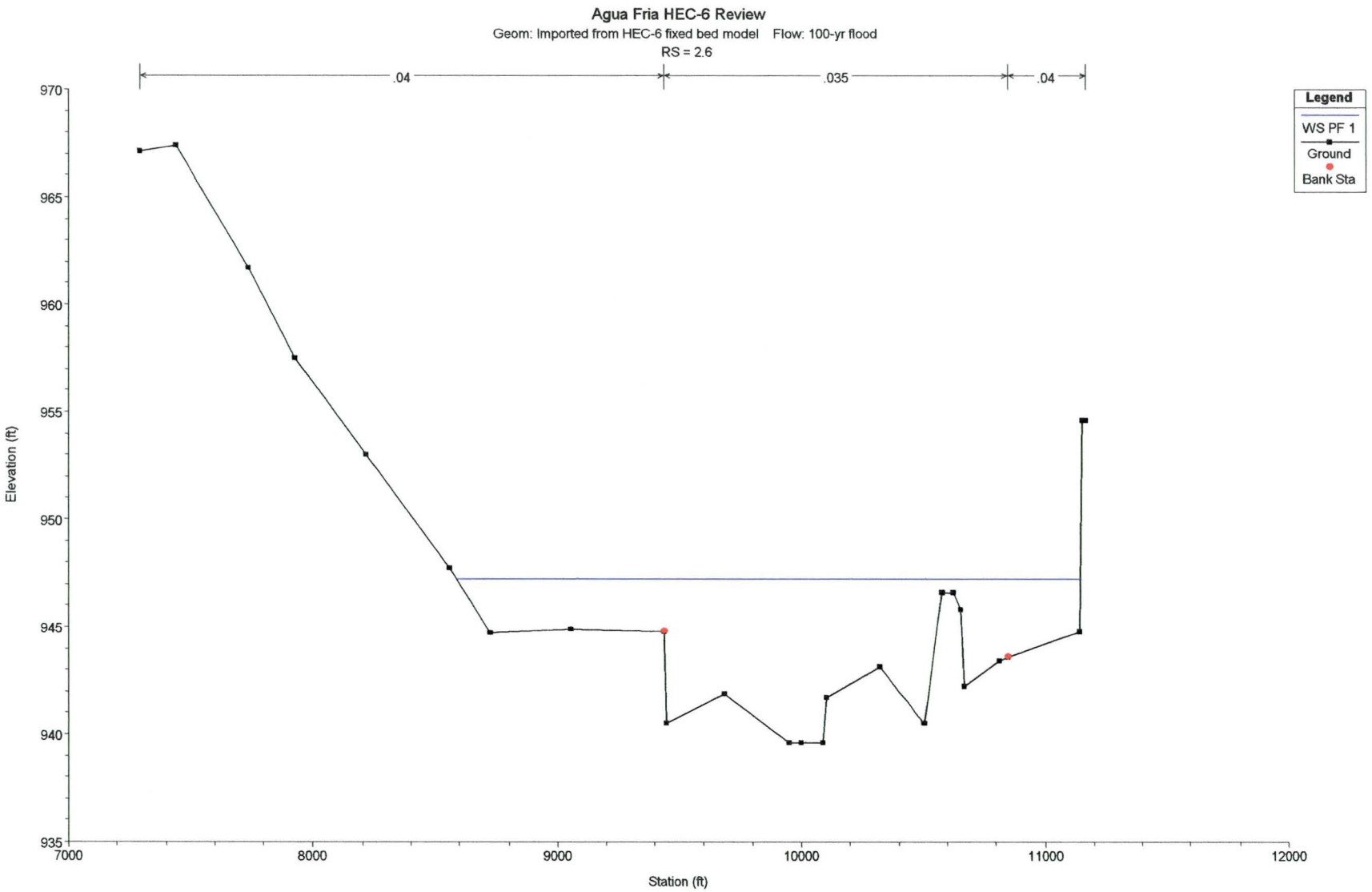


Figure 4. Inappropriate right bank station at XSEC 2.6.

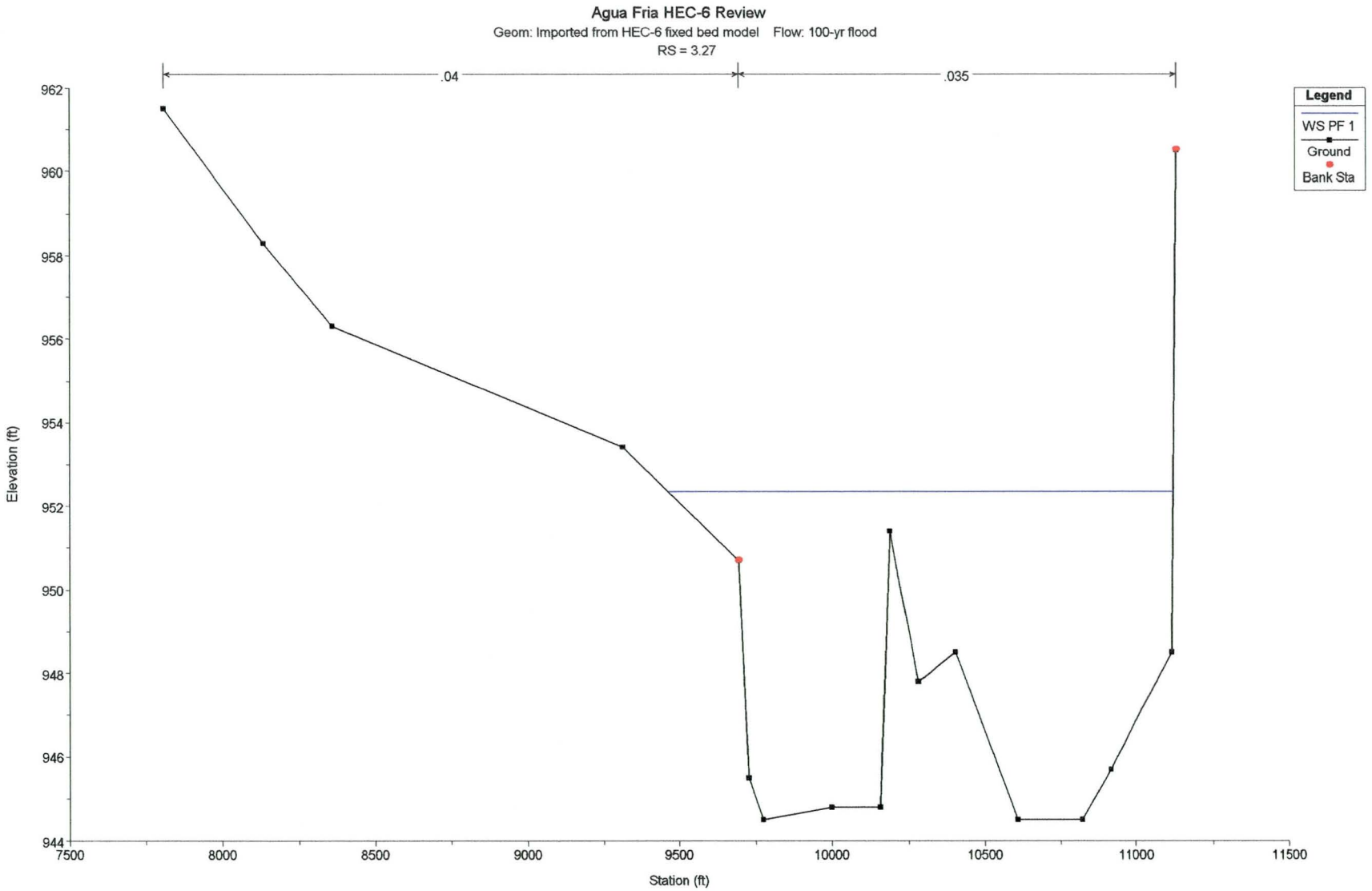


Figure 5. Inappropriate left bank station at XSEC 3.27.

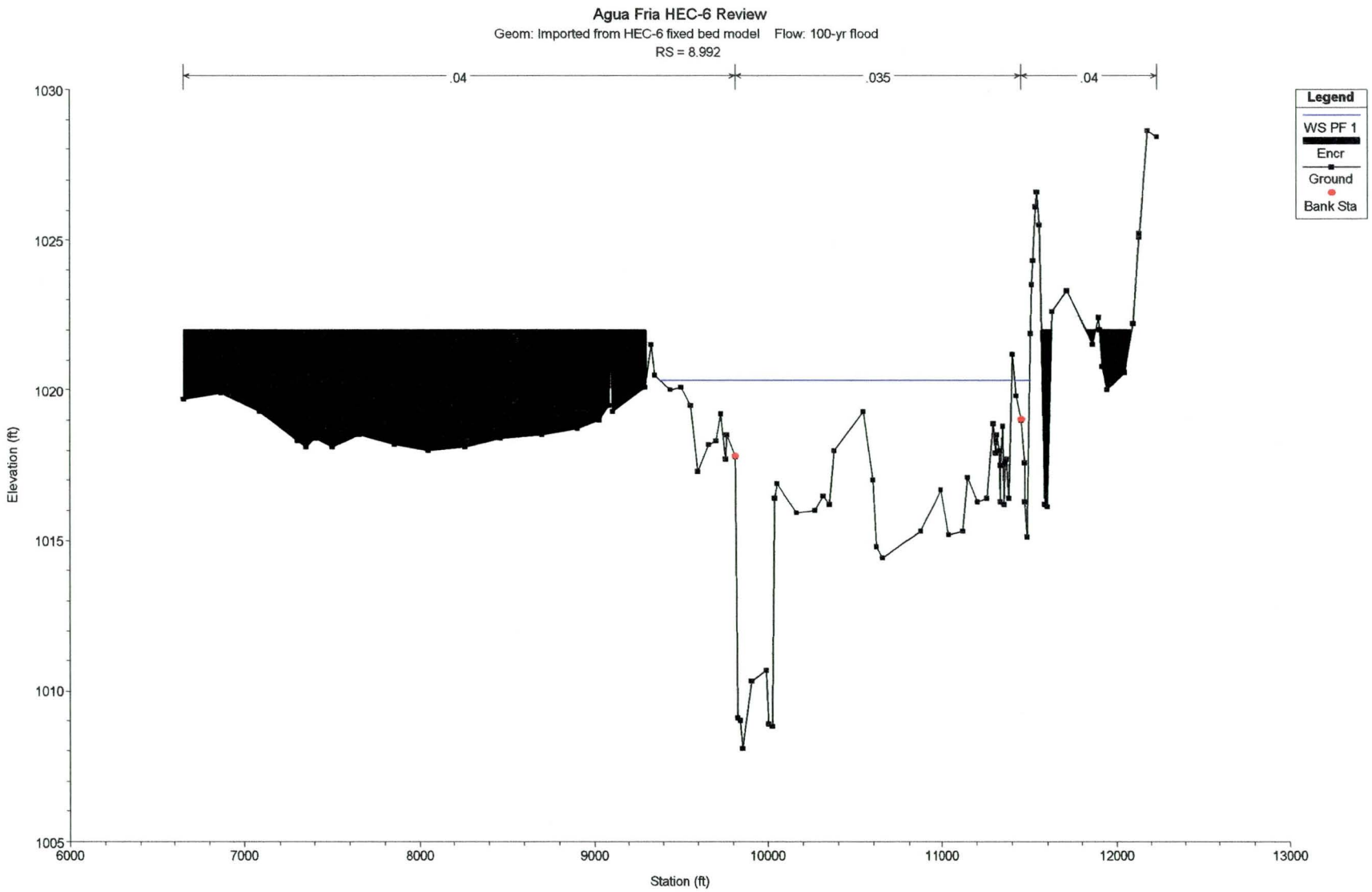


Figure 6. Inappropriate right bank station at XSEC 8.992.

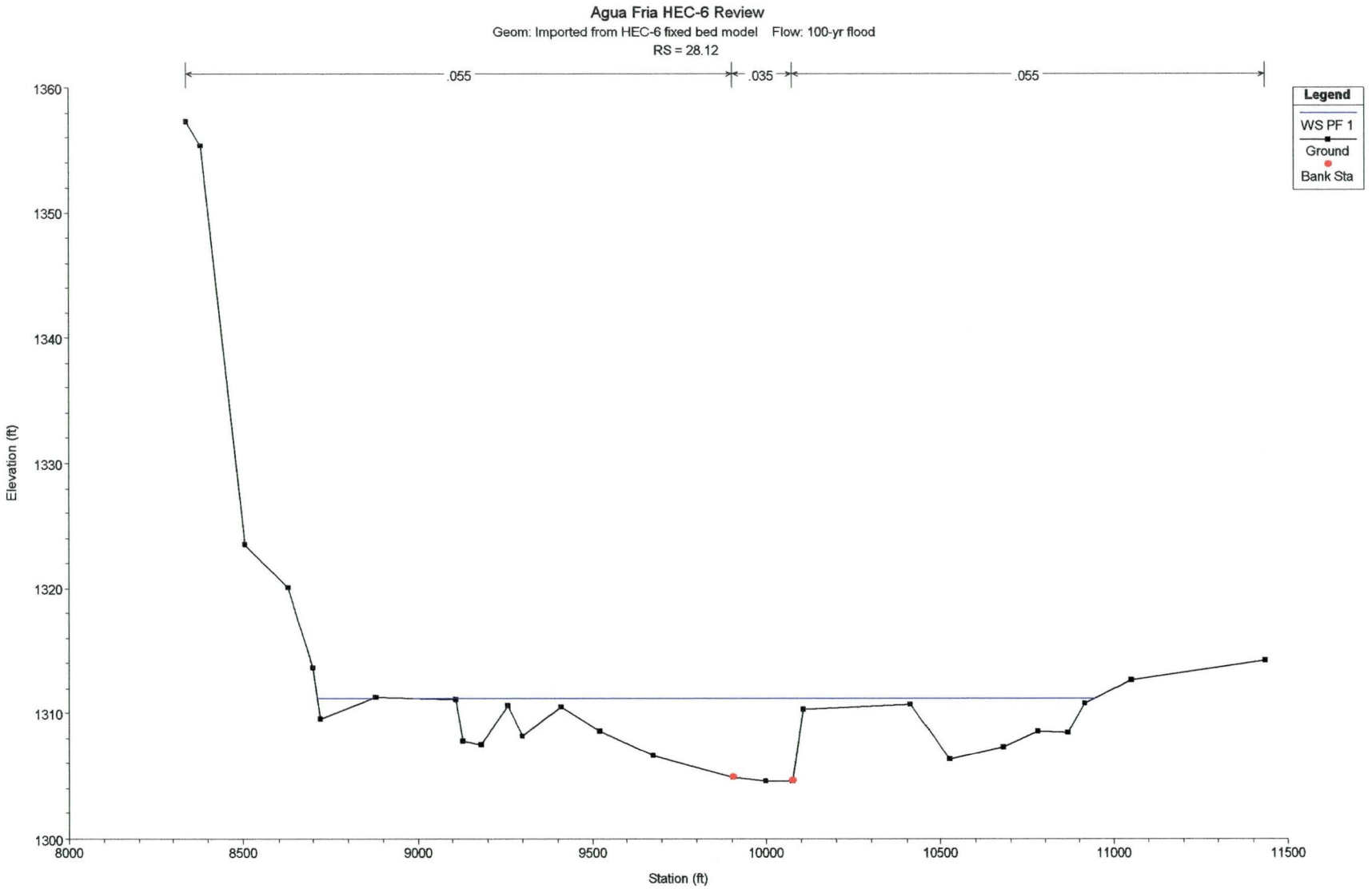


Figure 7. Bank stations on the channel bottom at XSEC 28.12.

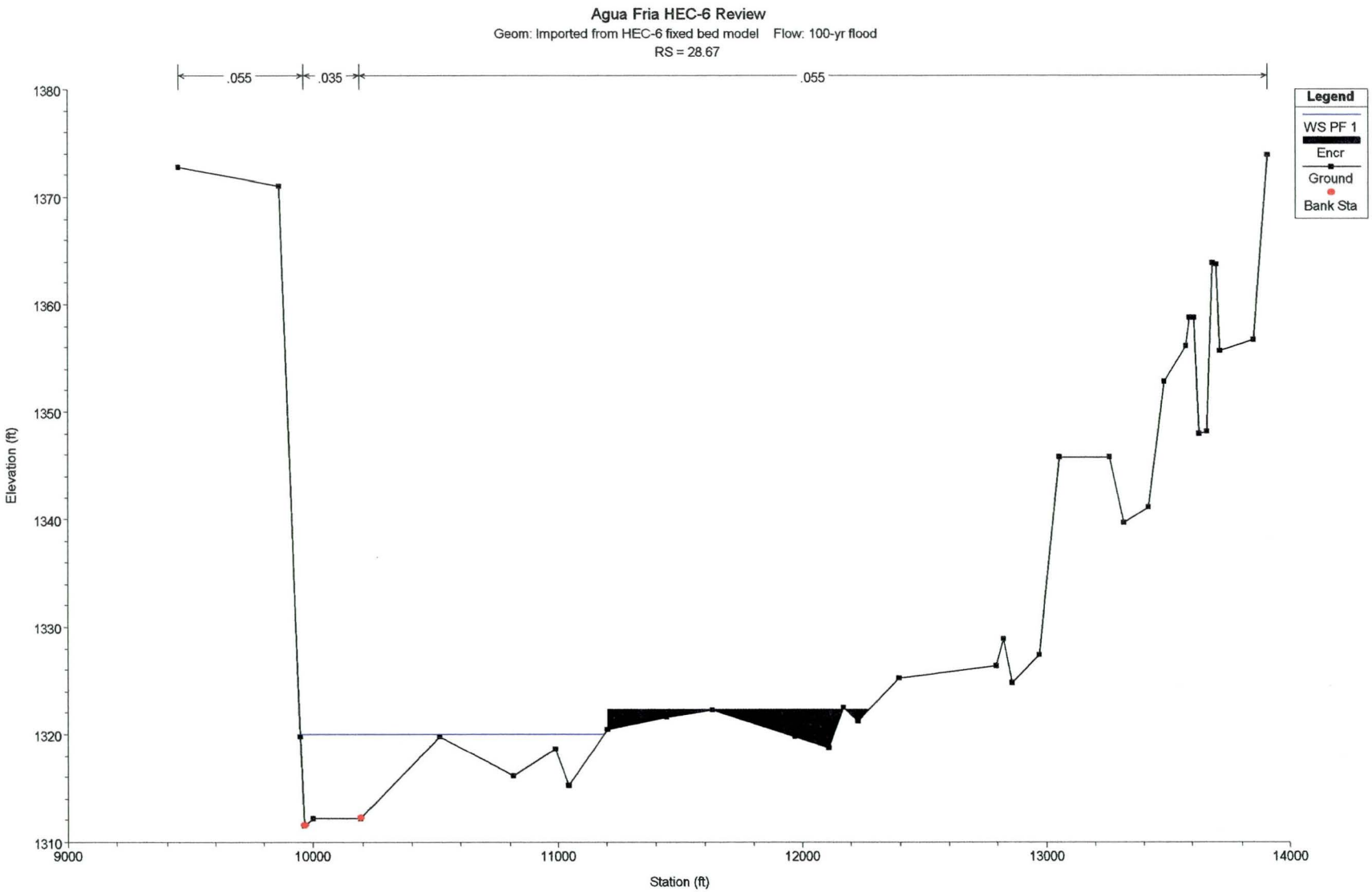


Figure 8. Bank stations on the channel bottom at XSEC 28.67.

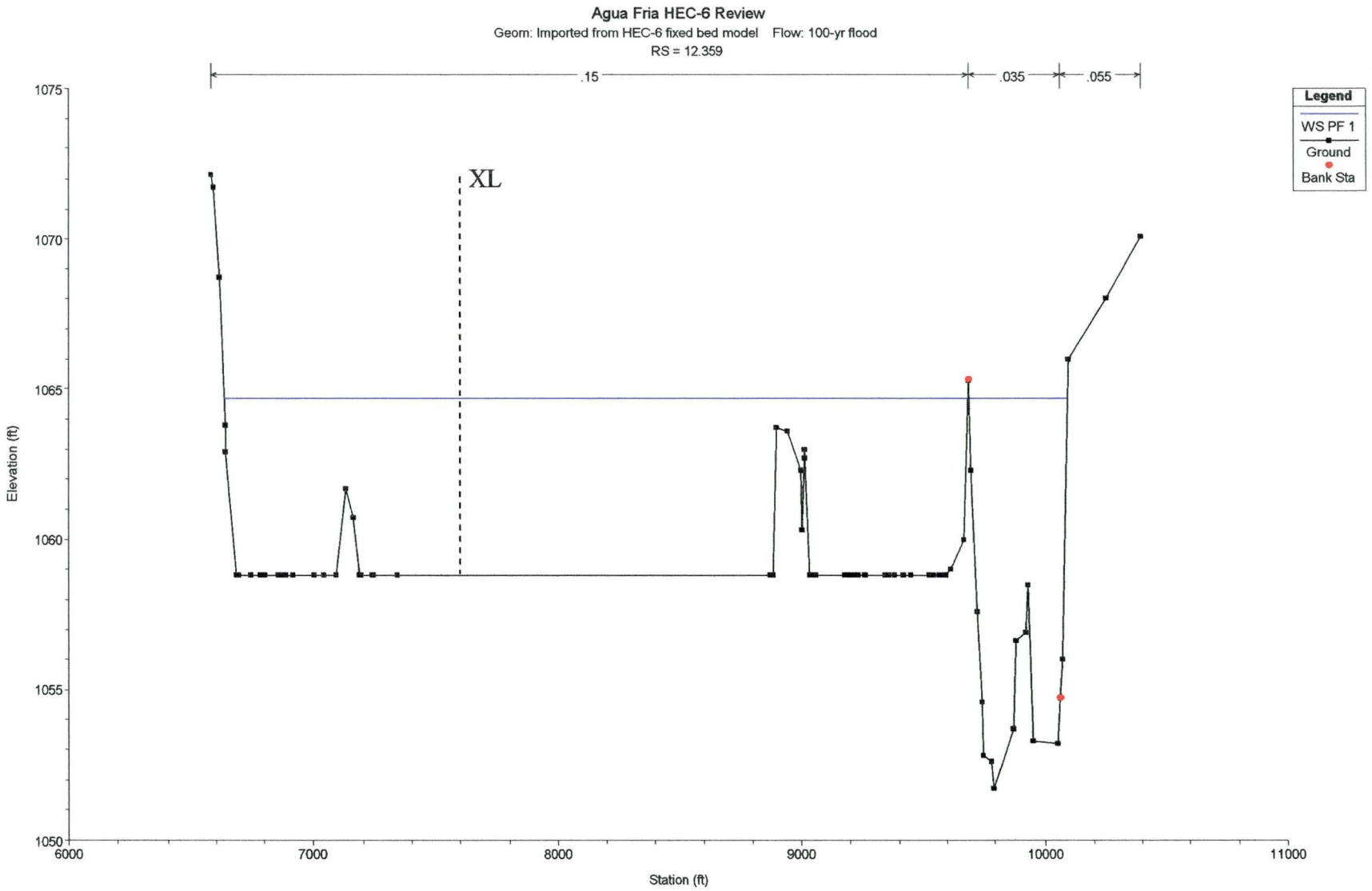


Figure 9. Inappropriate left conveyance limit (XL) at XSEC 12.359.

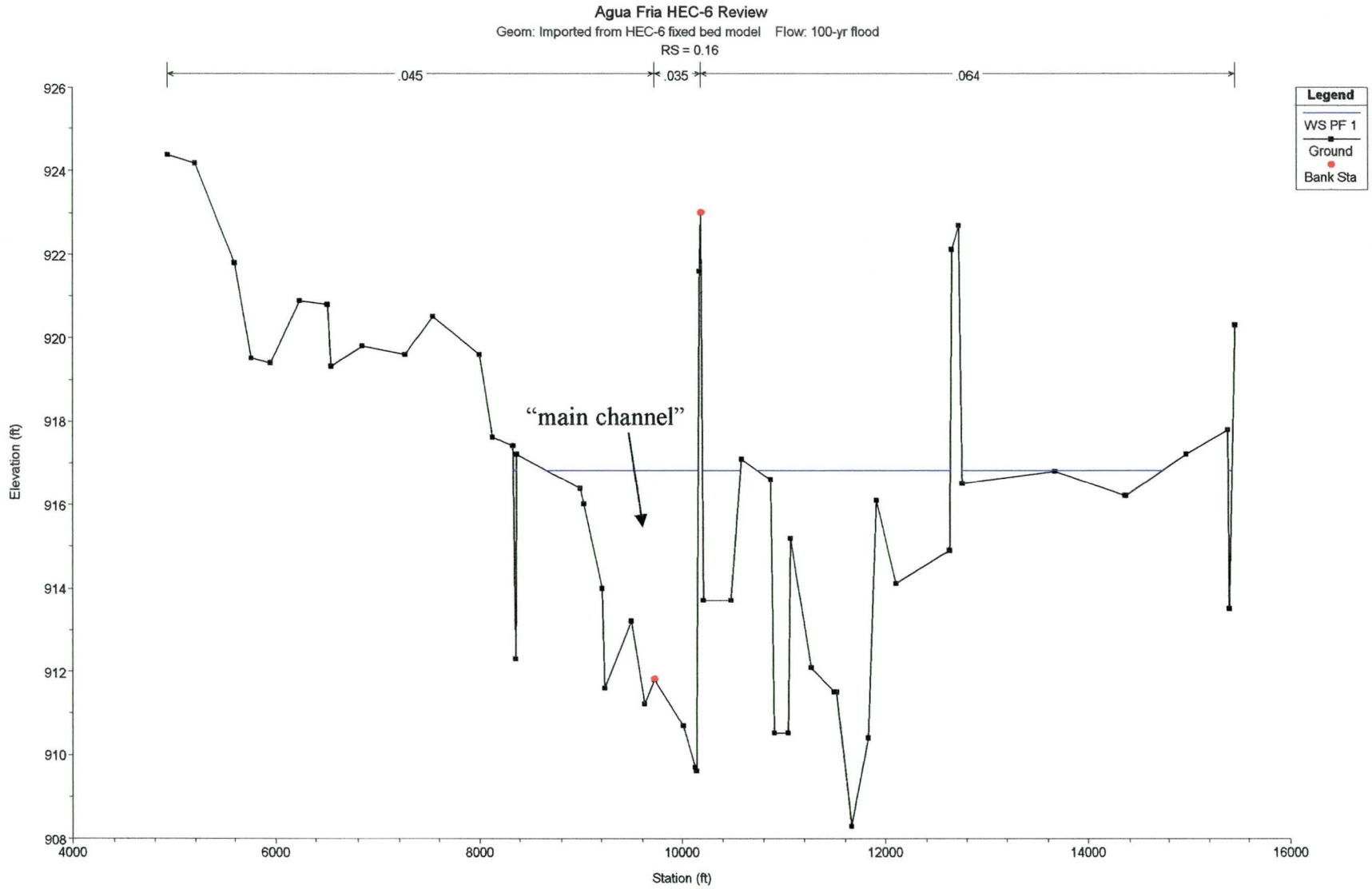


Figure 10. Braided channel at XSEC 0.16.

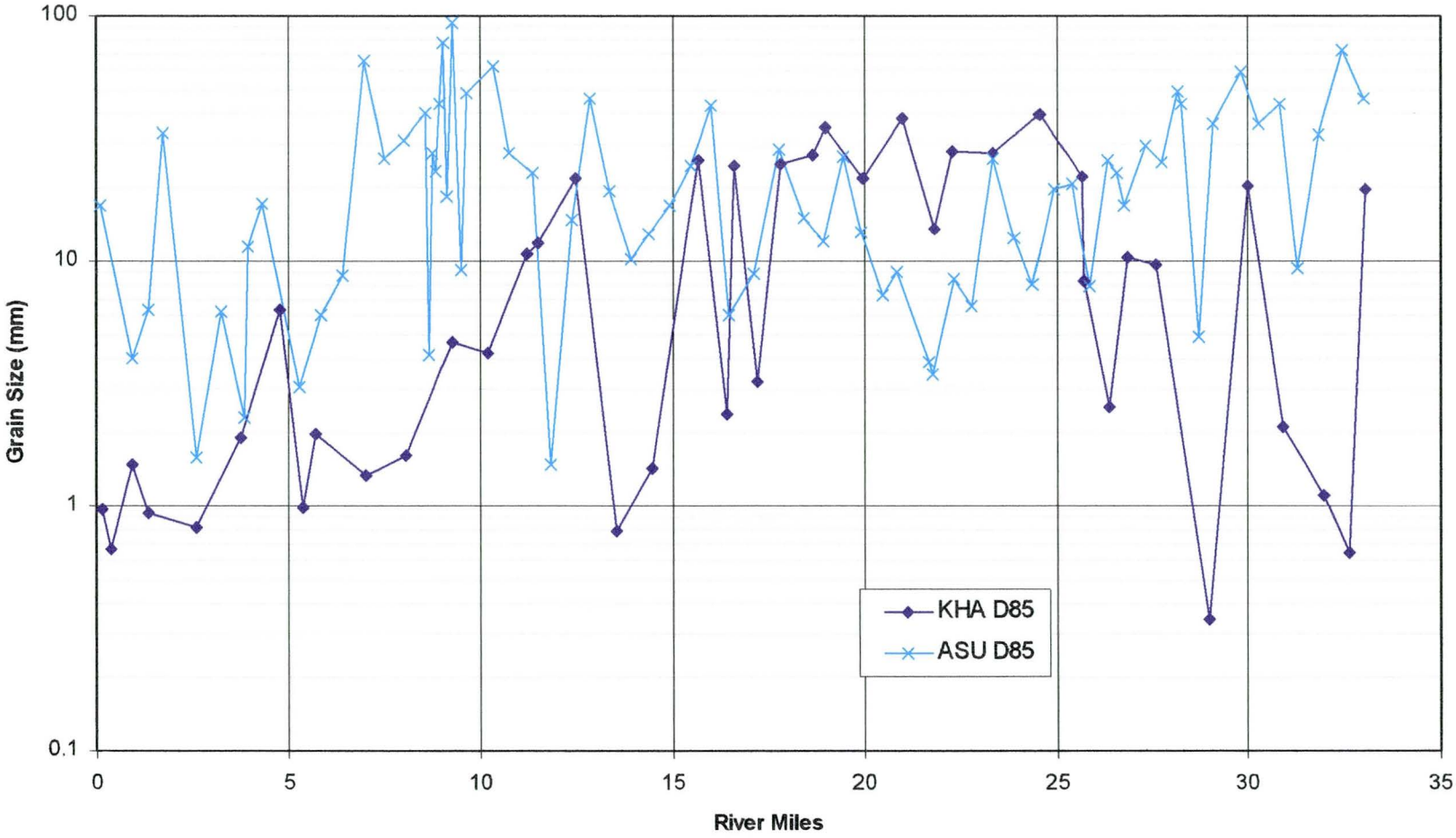


Figure 11. Sediment Gradation Comparison for D_{85}.

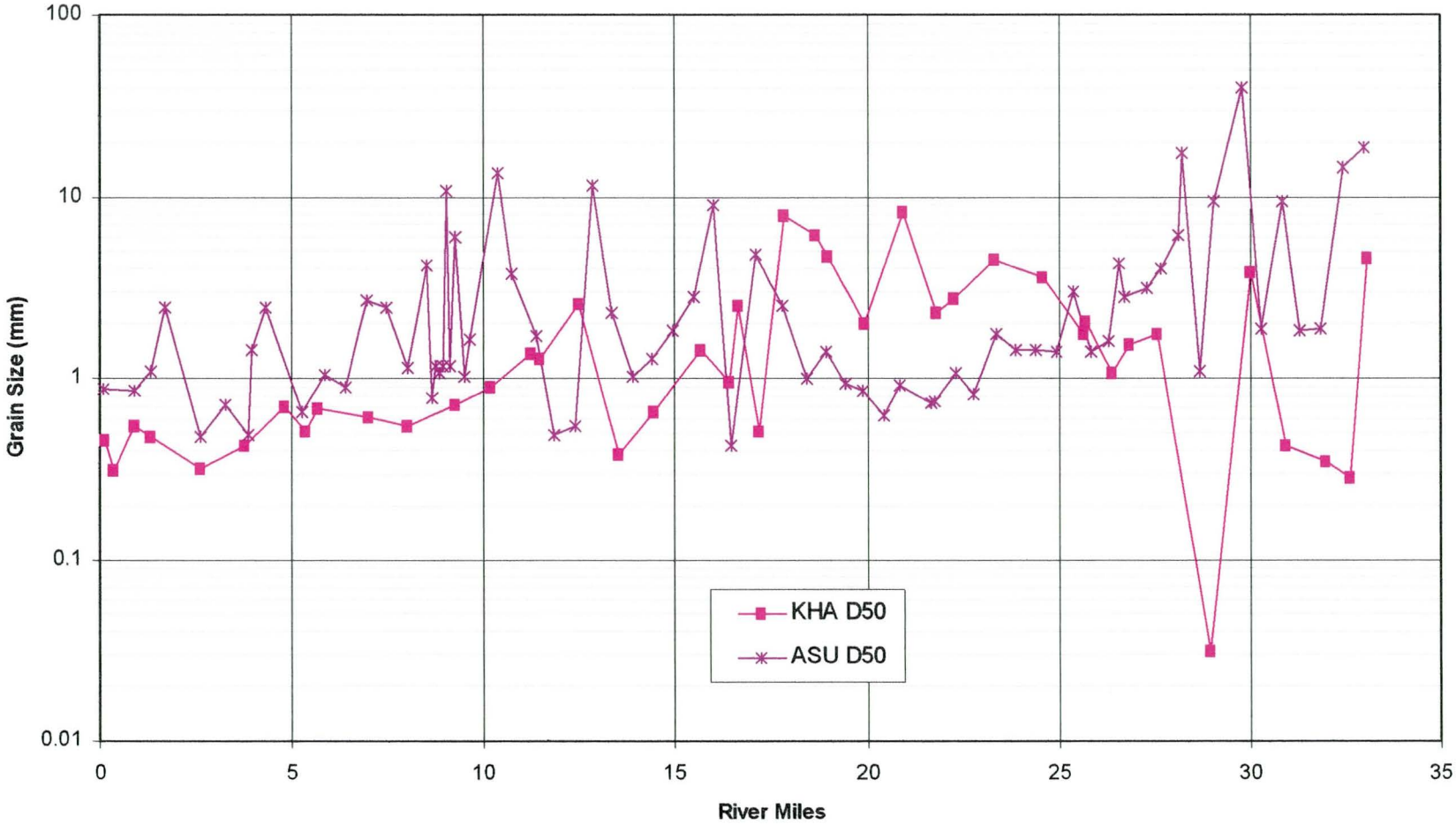


Figure 12. Sediment Gradation Comparison for D_{50}.

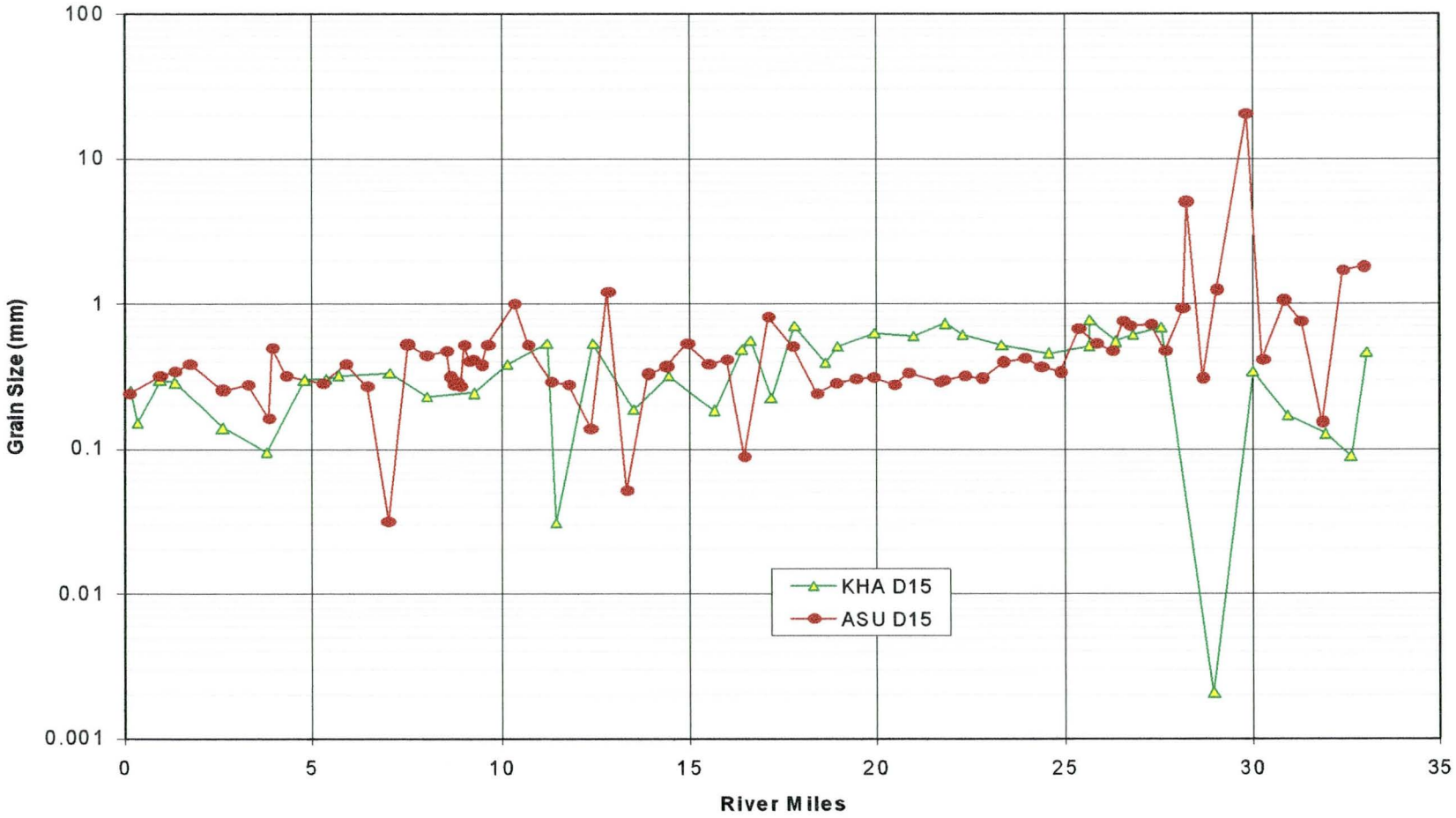


Figure 13. Sediment Gradation Comparison for D_{15}.

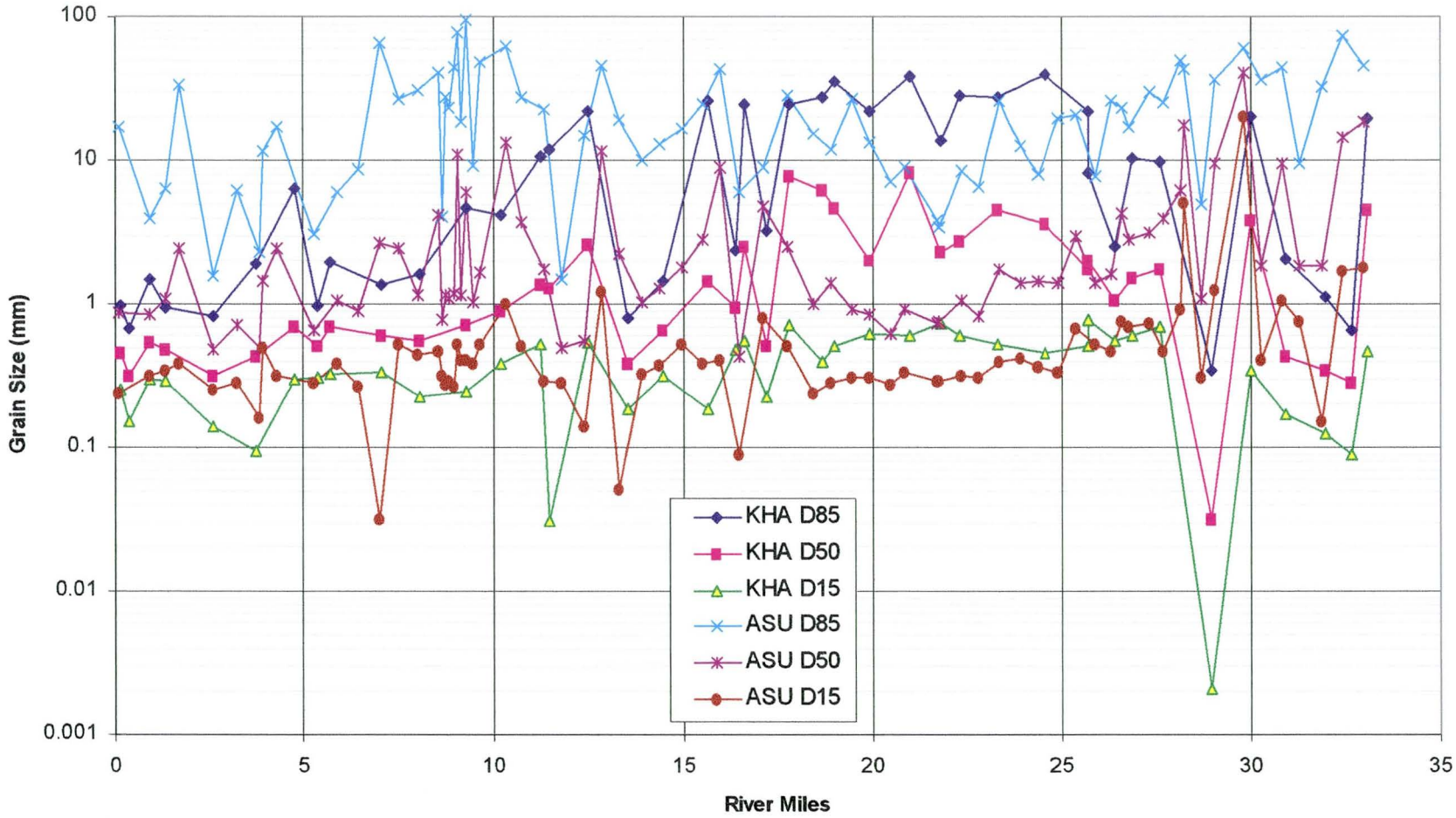


Figure 14. Overall Sediment Gradation Comparison.

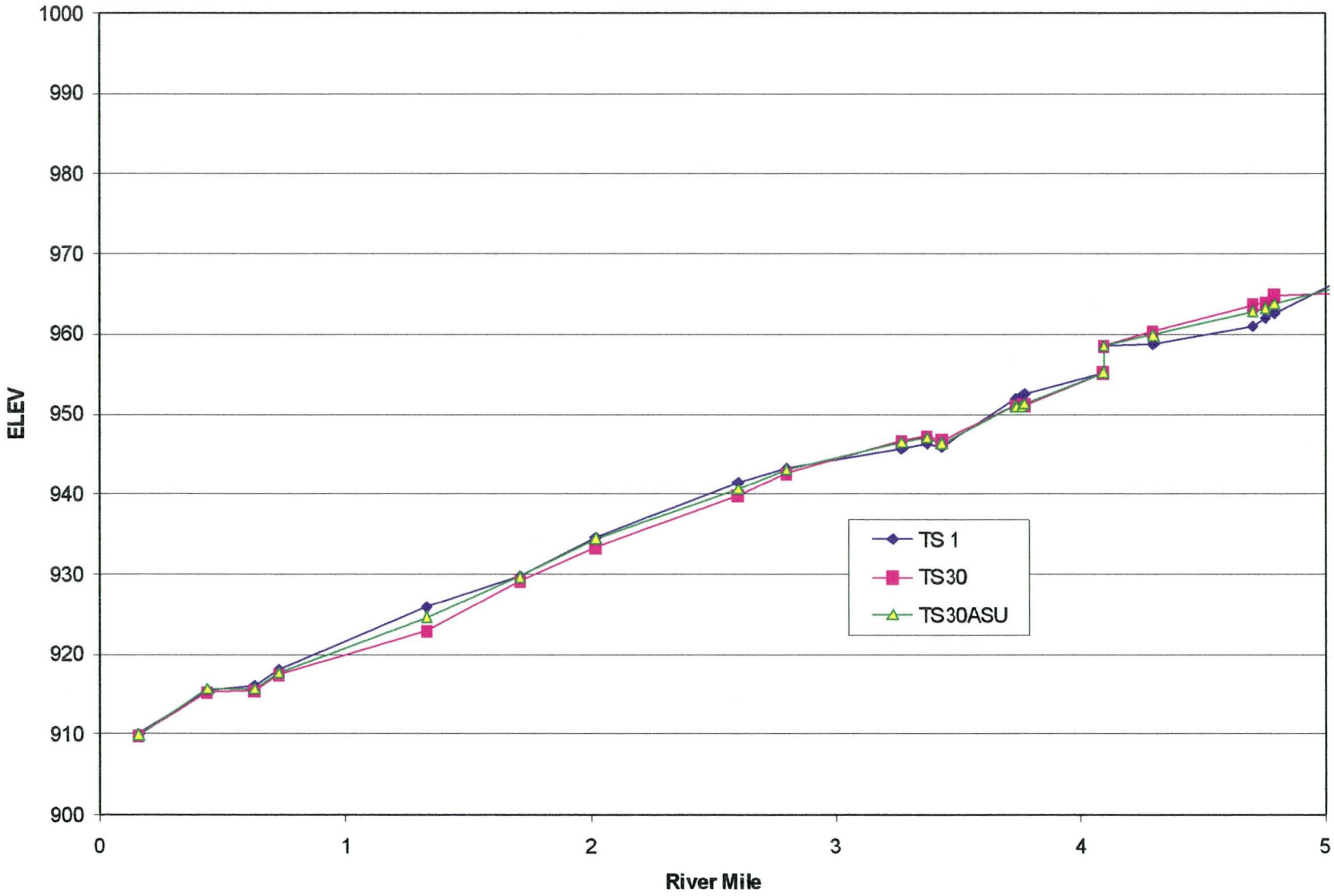


Figure 15. Average Bed Elevation RM 0.0 to RM 5.0.

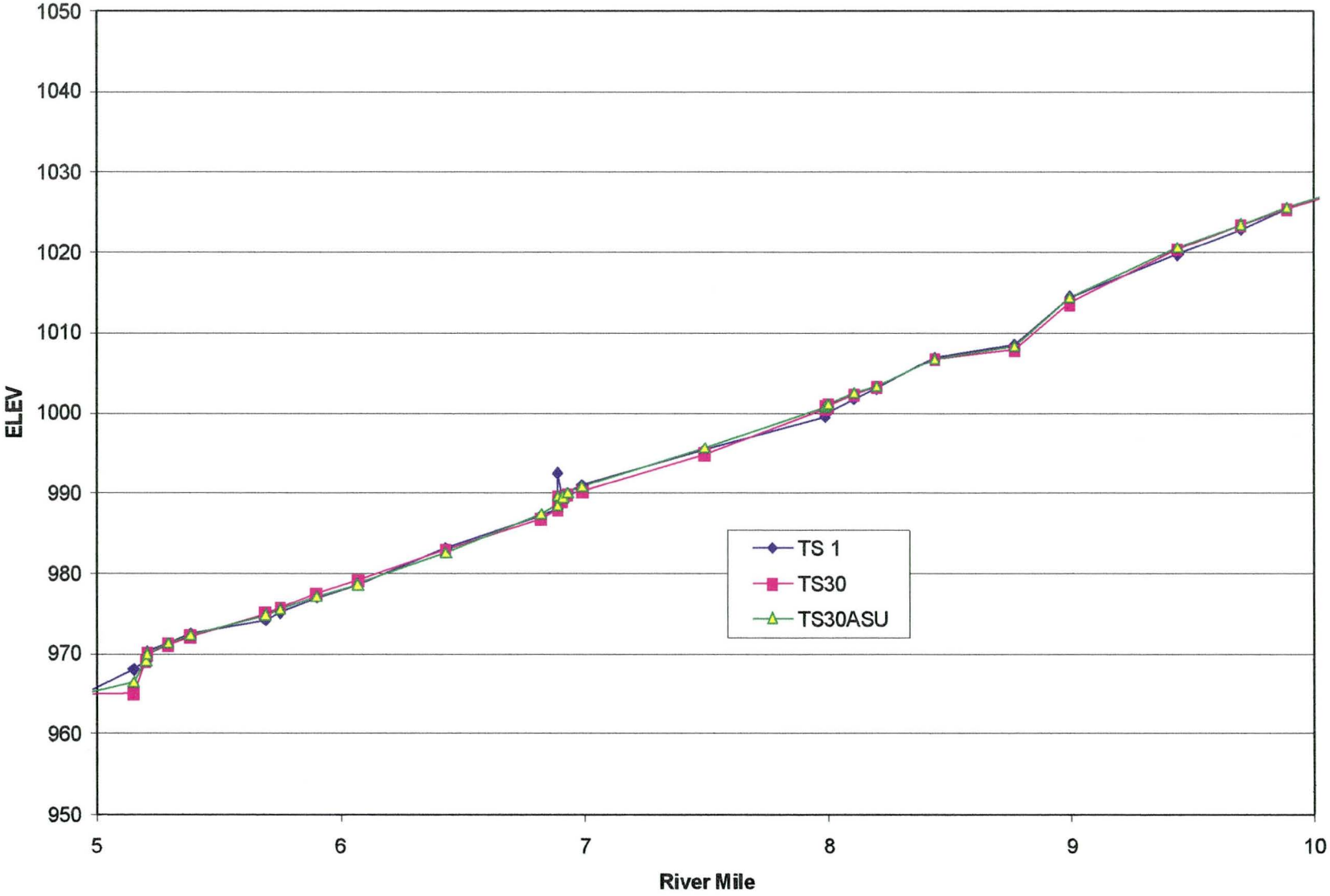


Figure 16. Average Bed Elevation RM 5.0 to RM 10.0.

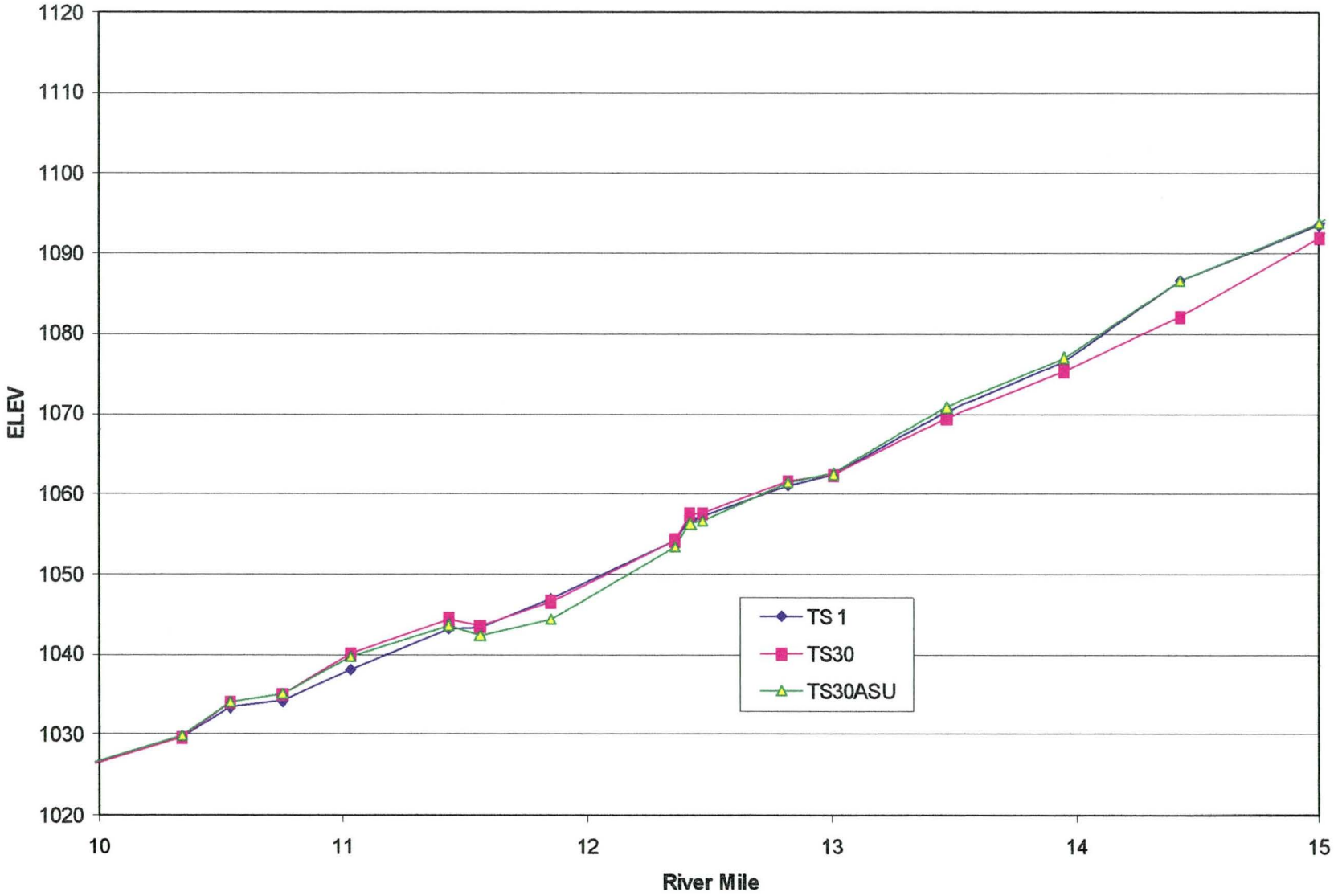


Figure 17. Average Bed Elevation RM 10.0 to RM 15.0.

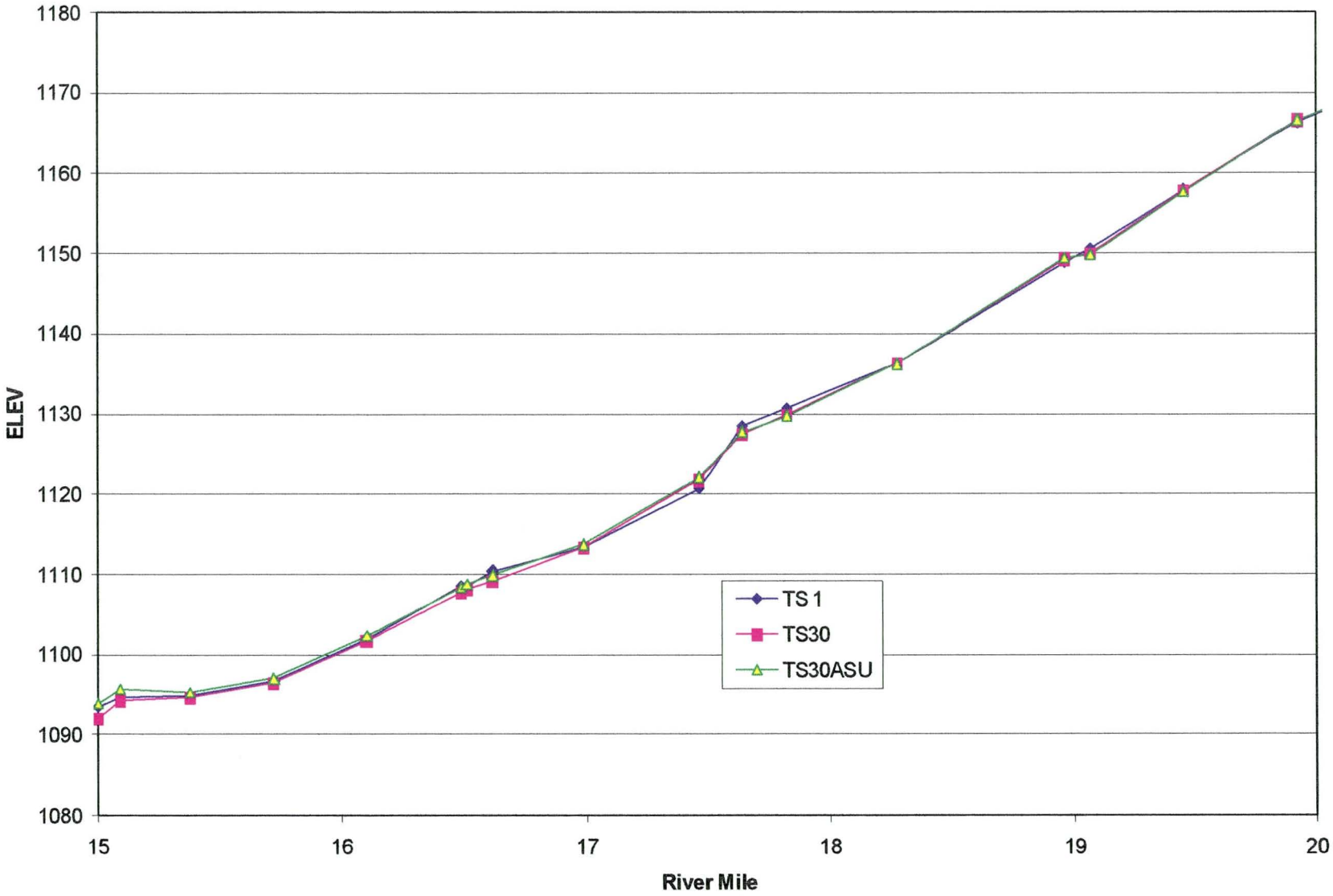


Figure 18. Average Bed Elevation RM 15.0 to RM 20.0.

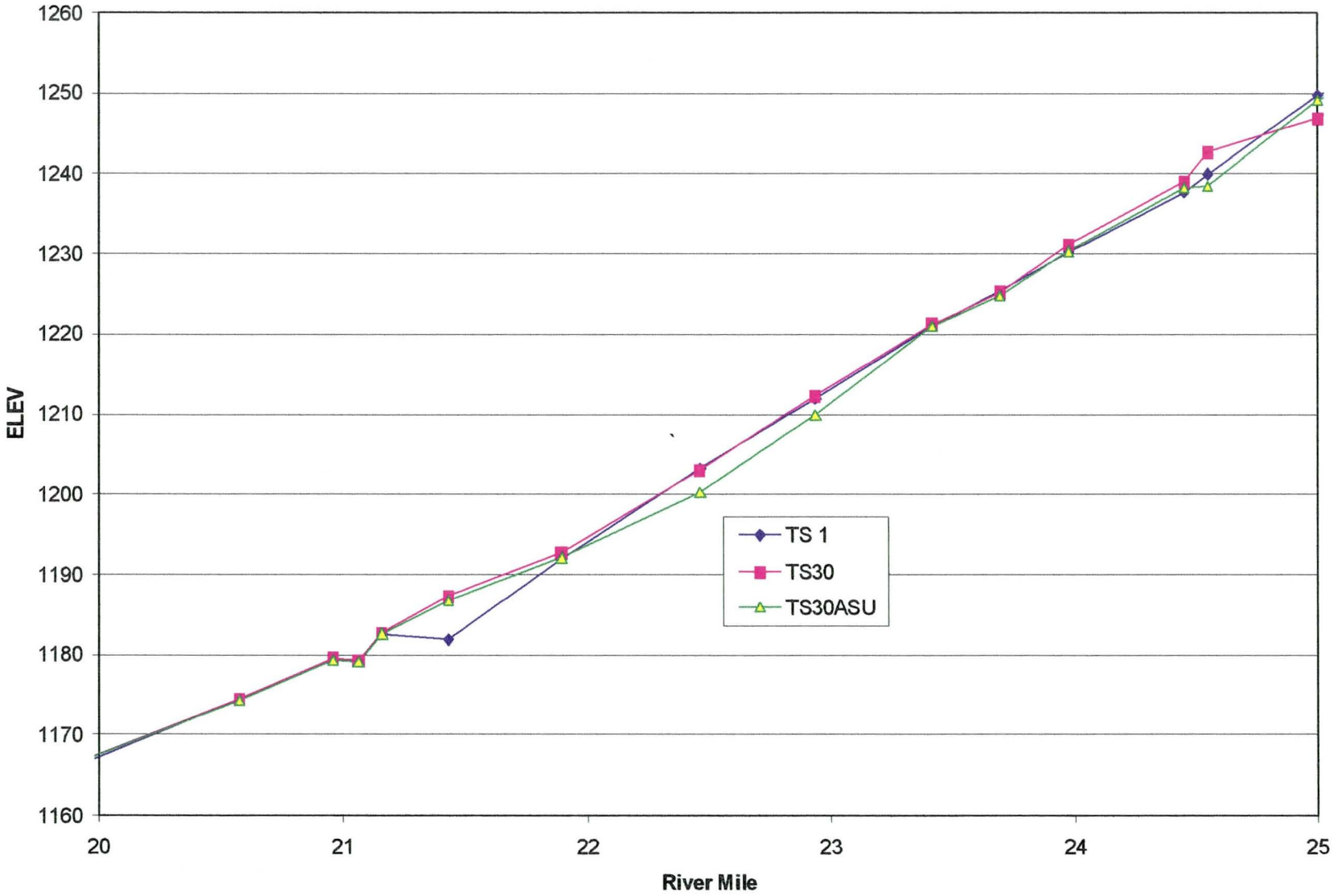


Figure 19. Average Bed Elevation RM 20.0 to RM 25.0.

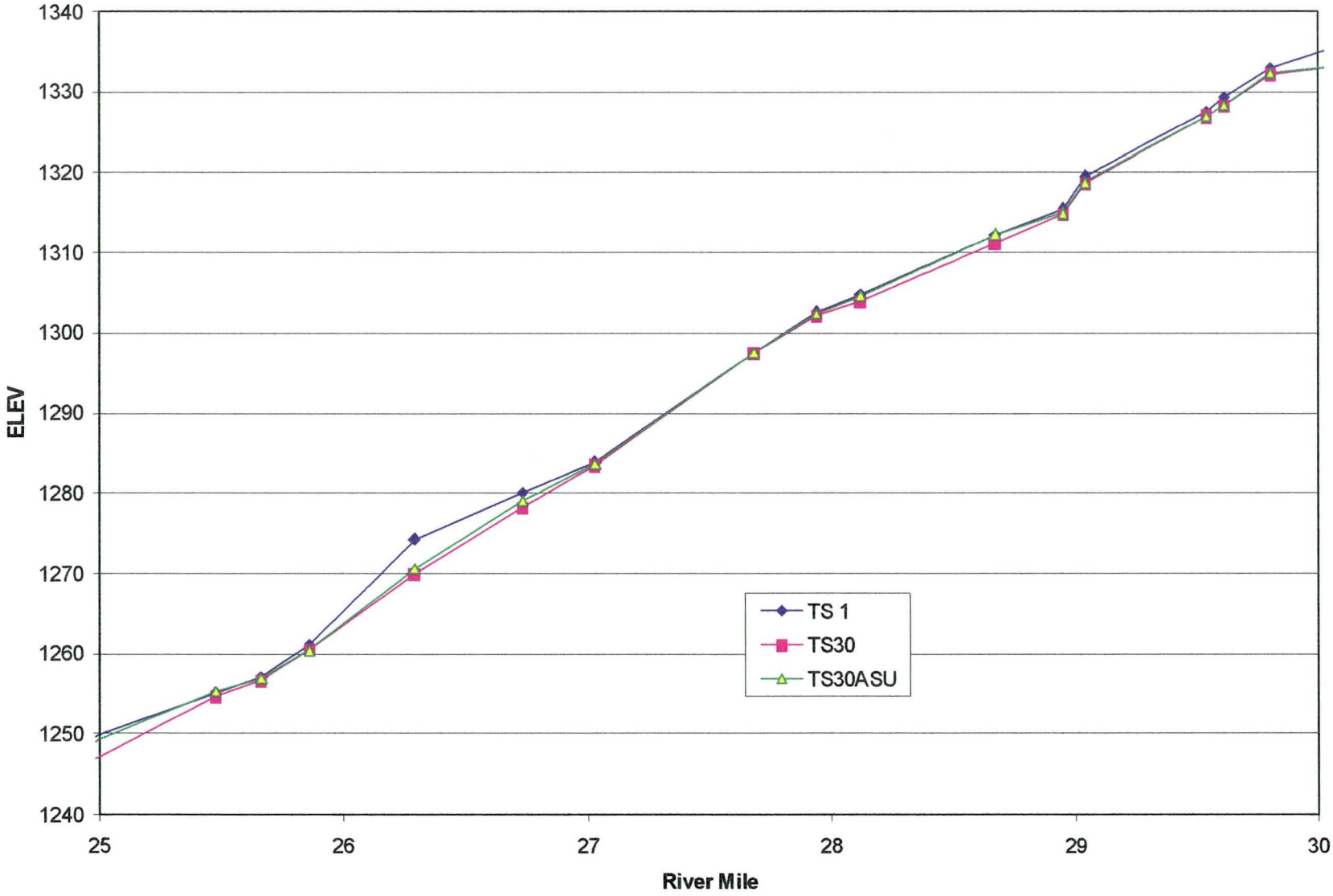


Figure 20. Average Bed Elevation RM 25.0 to RM 30.0.

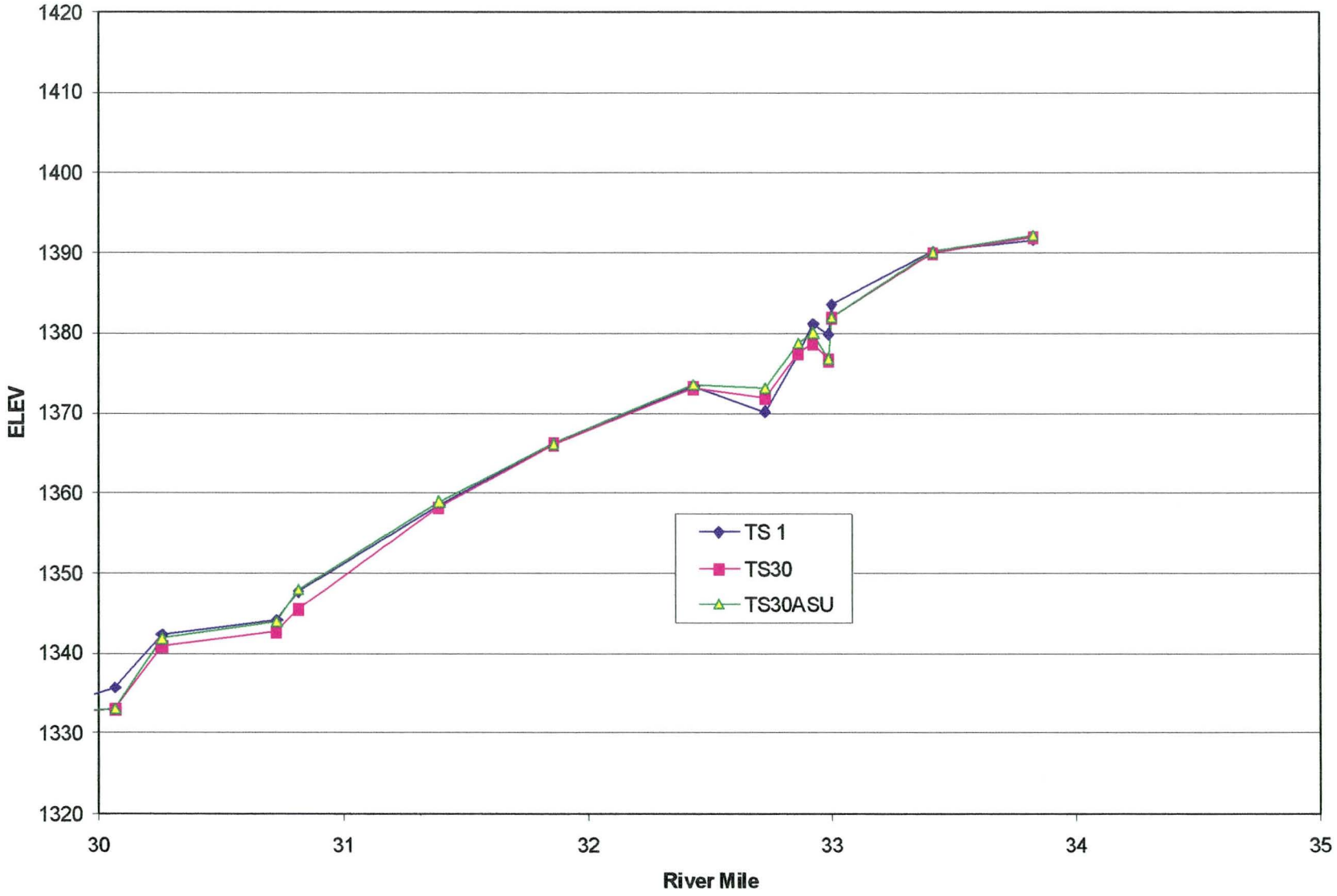
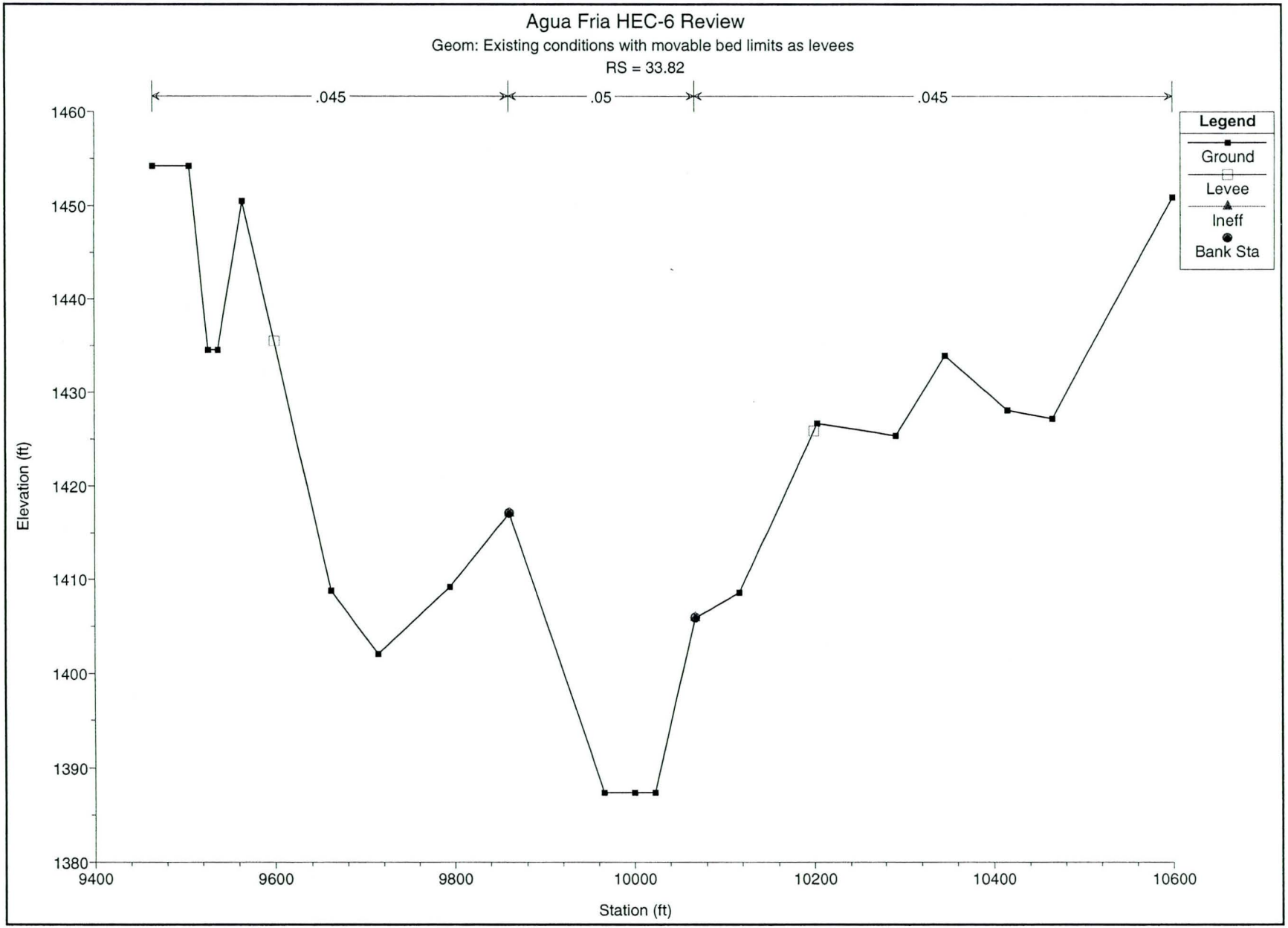
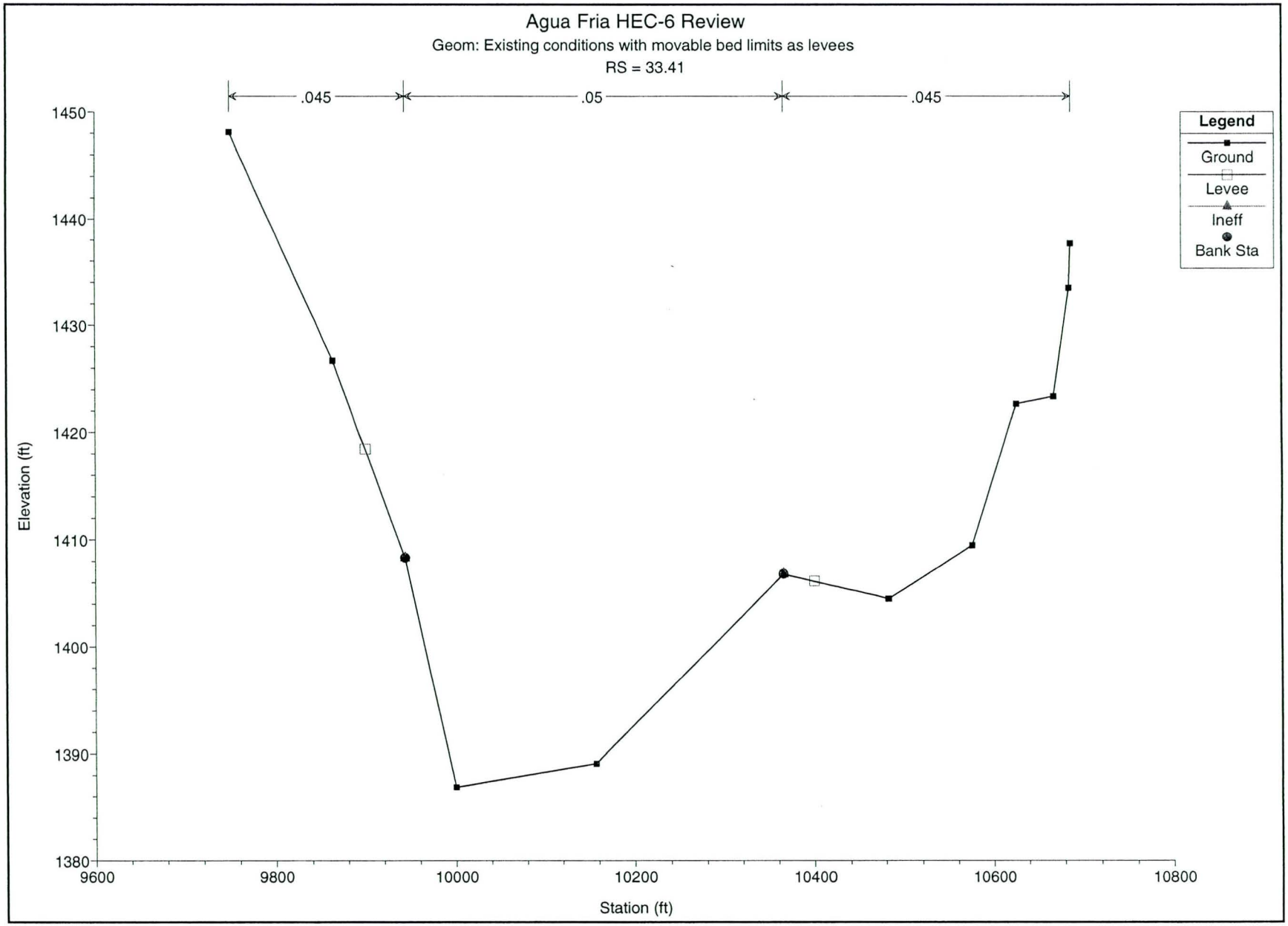
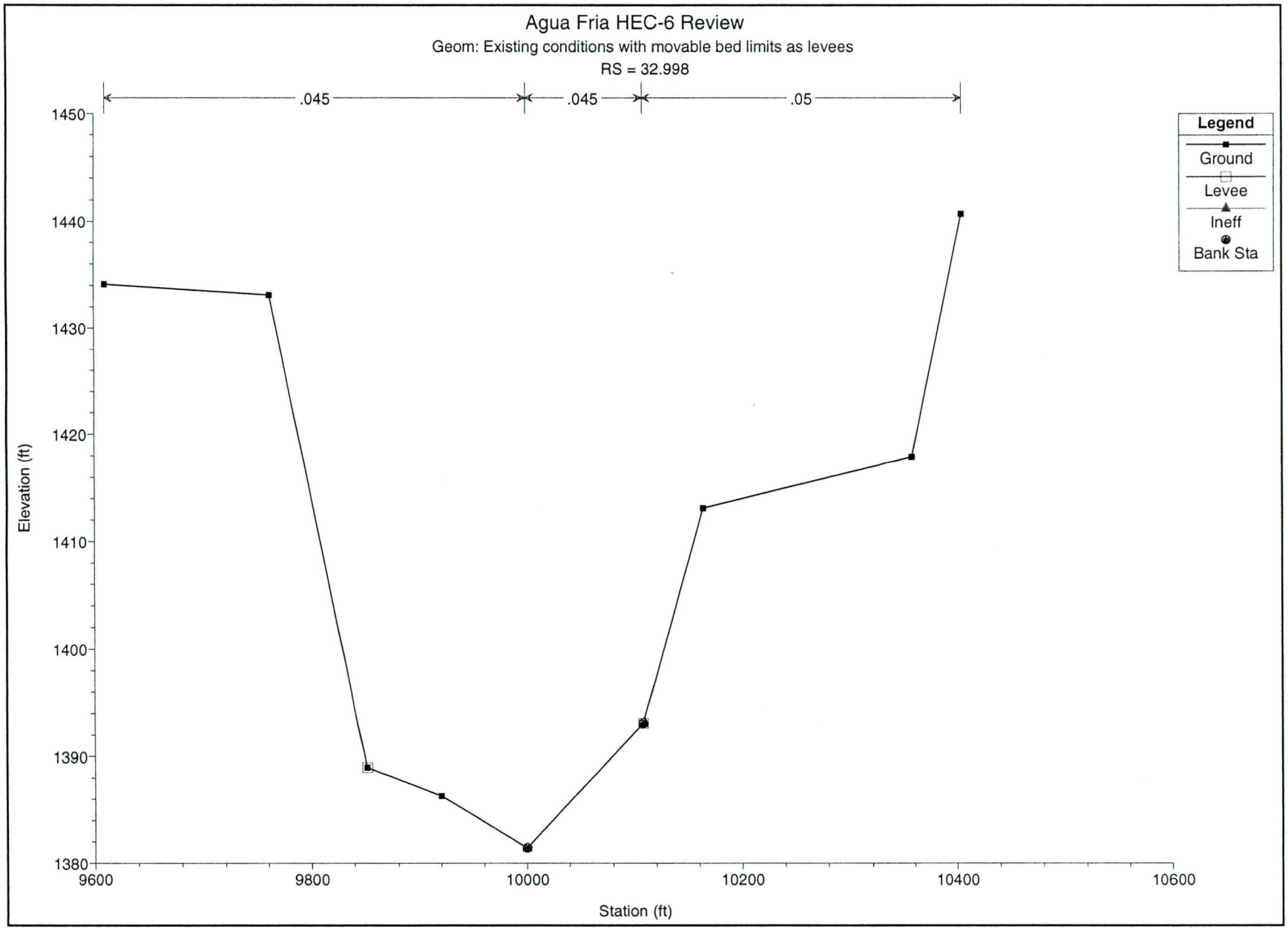


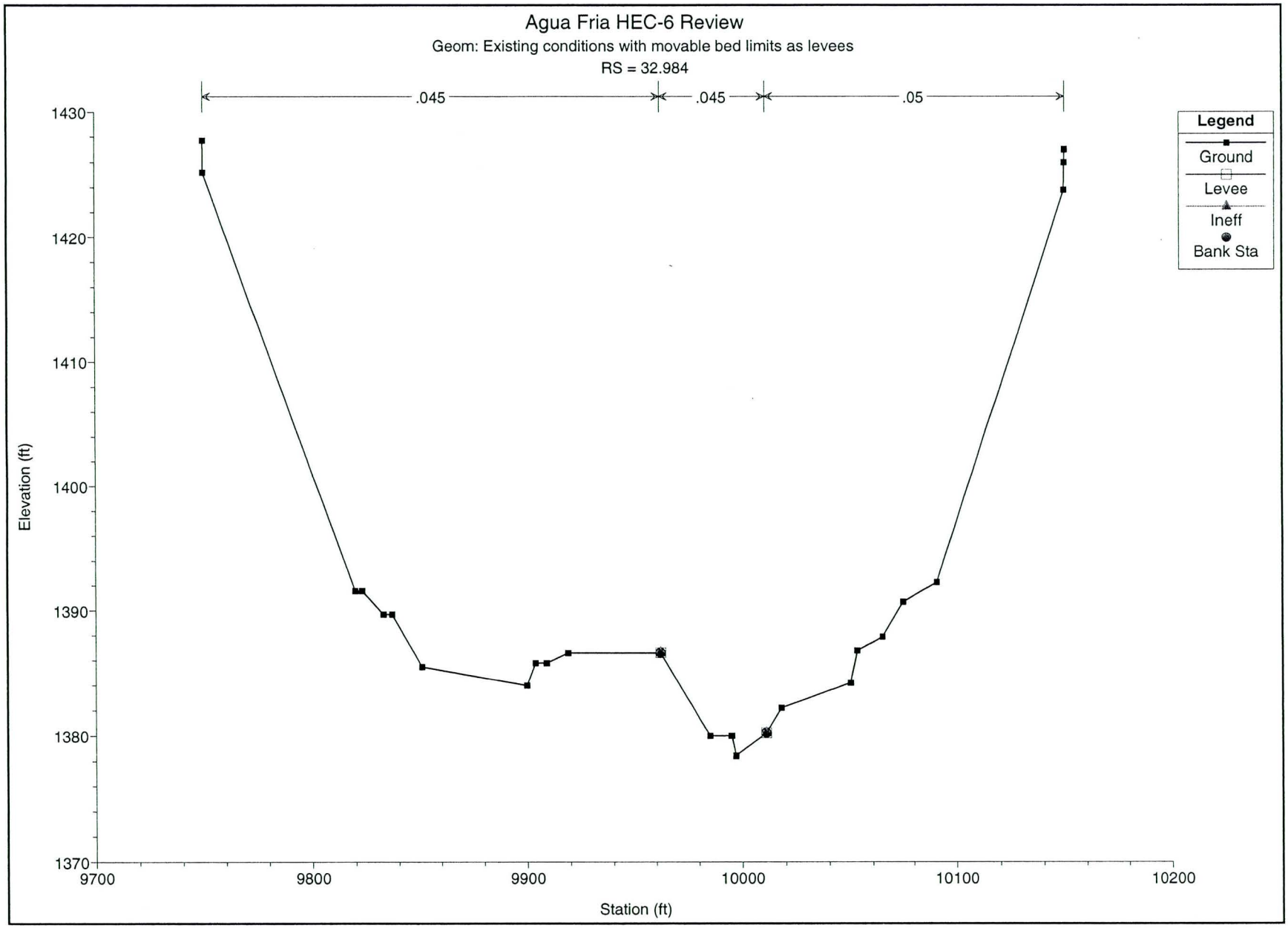
Figure 21. Average Bed Elevation RM 30.0 to RM 33.0.

APPENDIX A


Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 33.82
.045
.05
.045
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1460
1450
1440
1430
1420
1410
1400
1390
1380
9400
9600
9800
10000
10200
10400
10600
Station (ft)


Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 33.41
.045
.05
.045
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1450
1440
1430
1420
1410
1400
1390
1380
9600
9800
10000
10200
10400
10600
10800
Station (ft)


Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 32.998
.045
.045
.05
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1450
1440
1430
1420
1410
1400
1390
1380
9600
9800
10000
10200
10400
10600
Station (ft)


Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 32.984
.045
.045
.05
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
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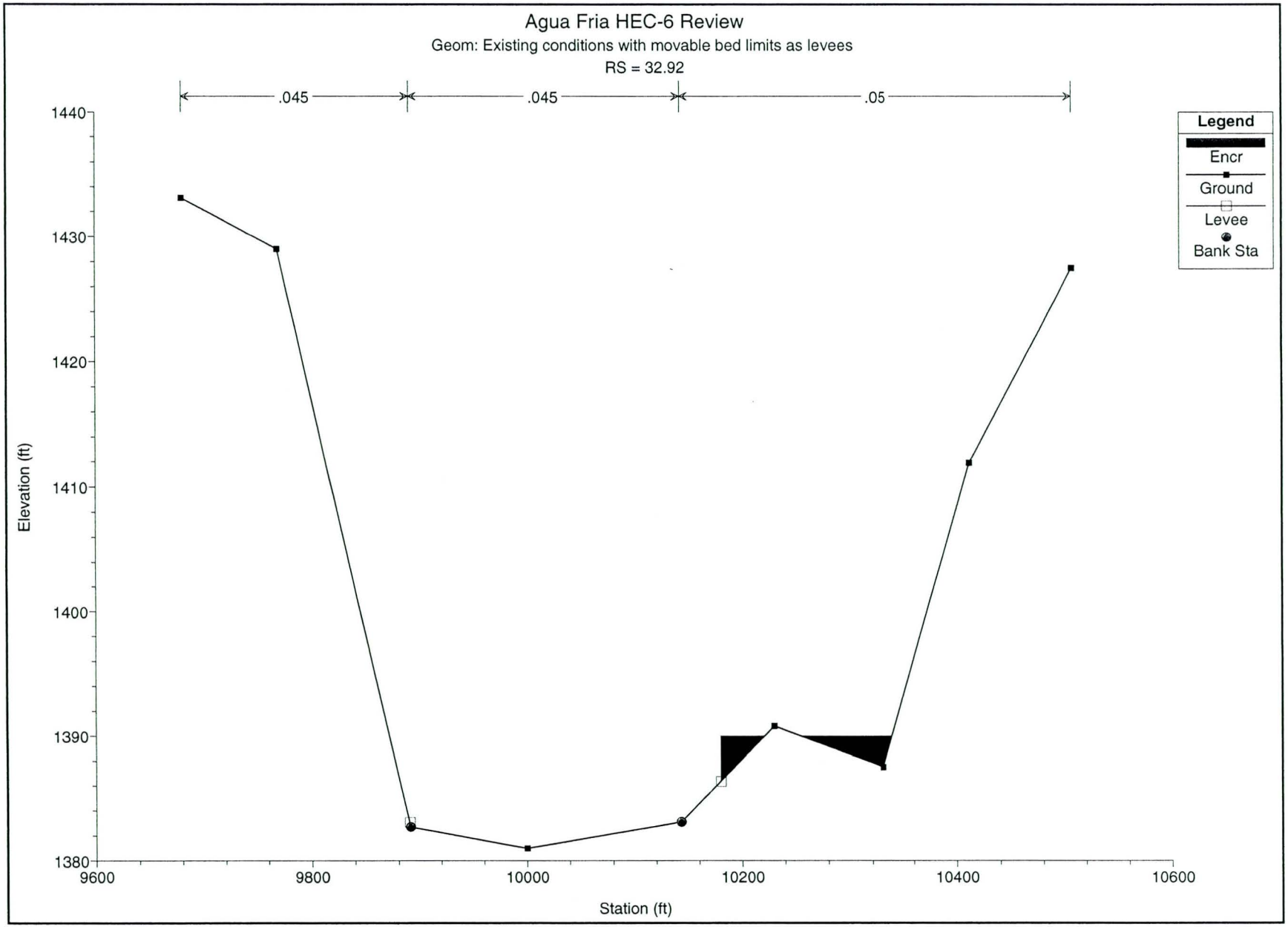
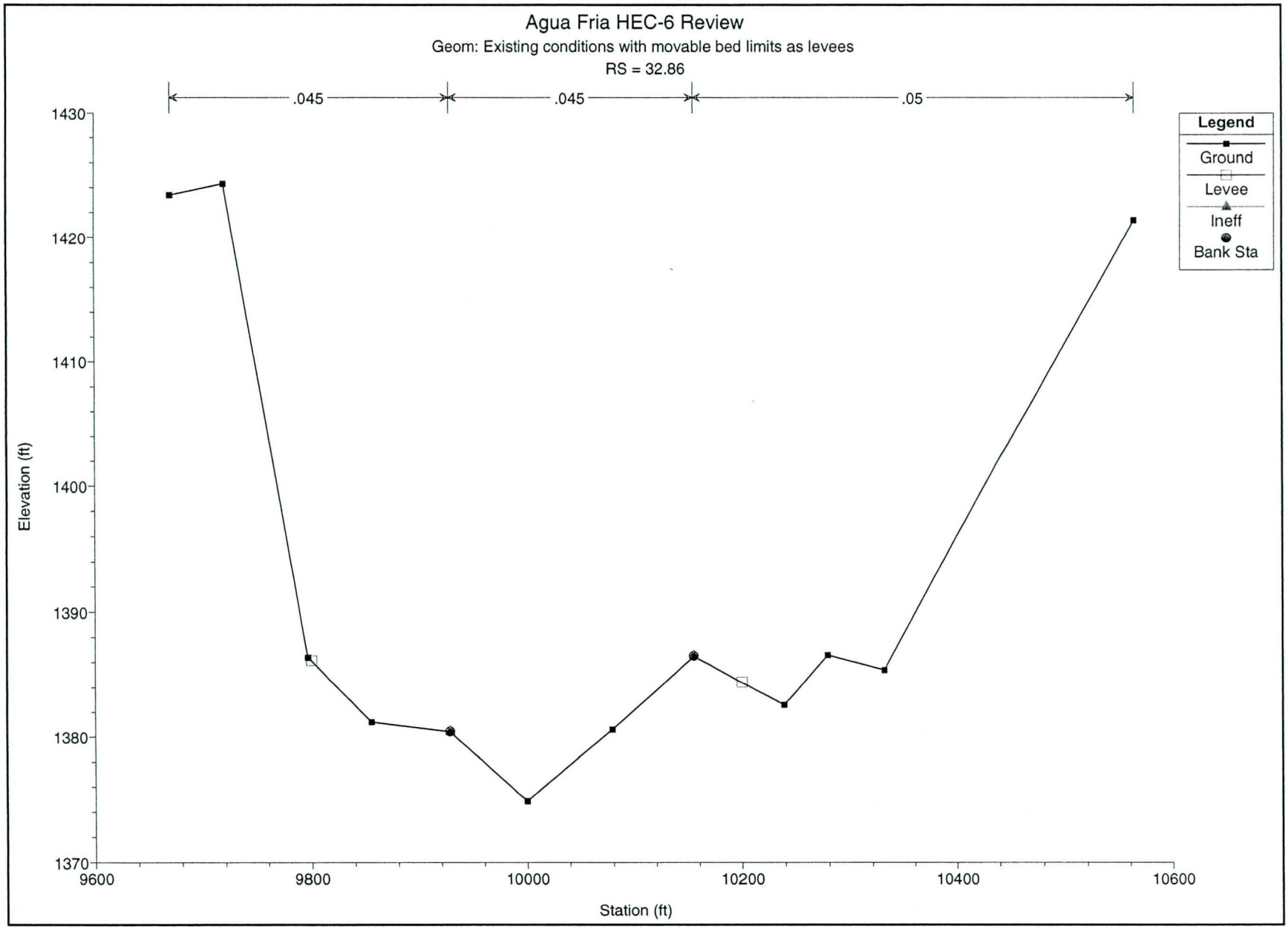
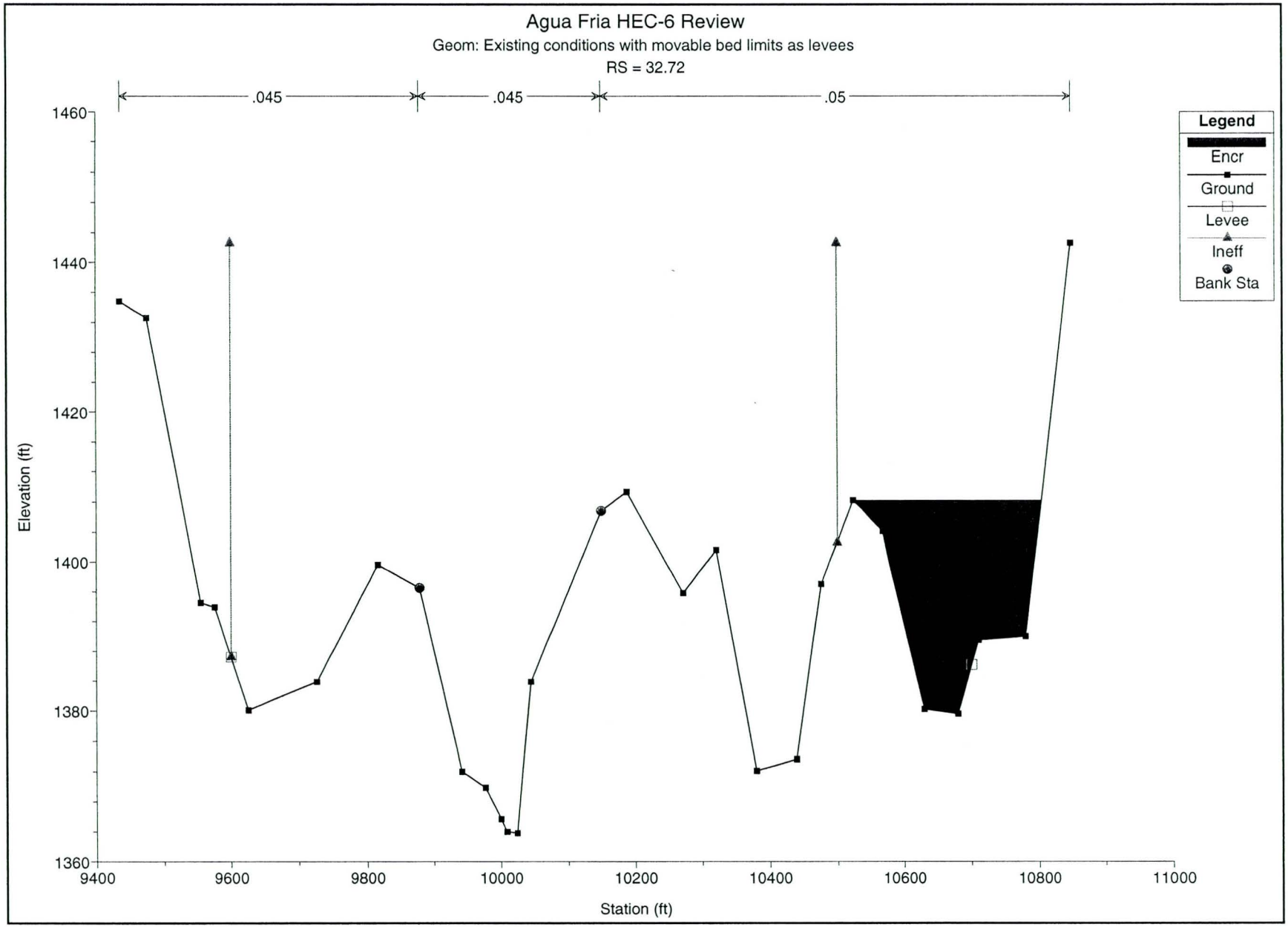
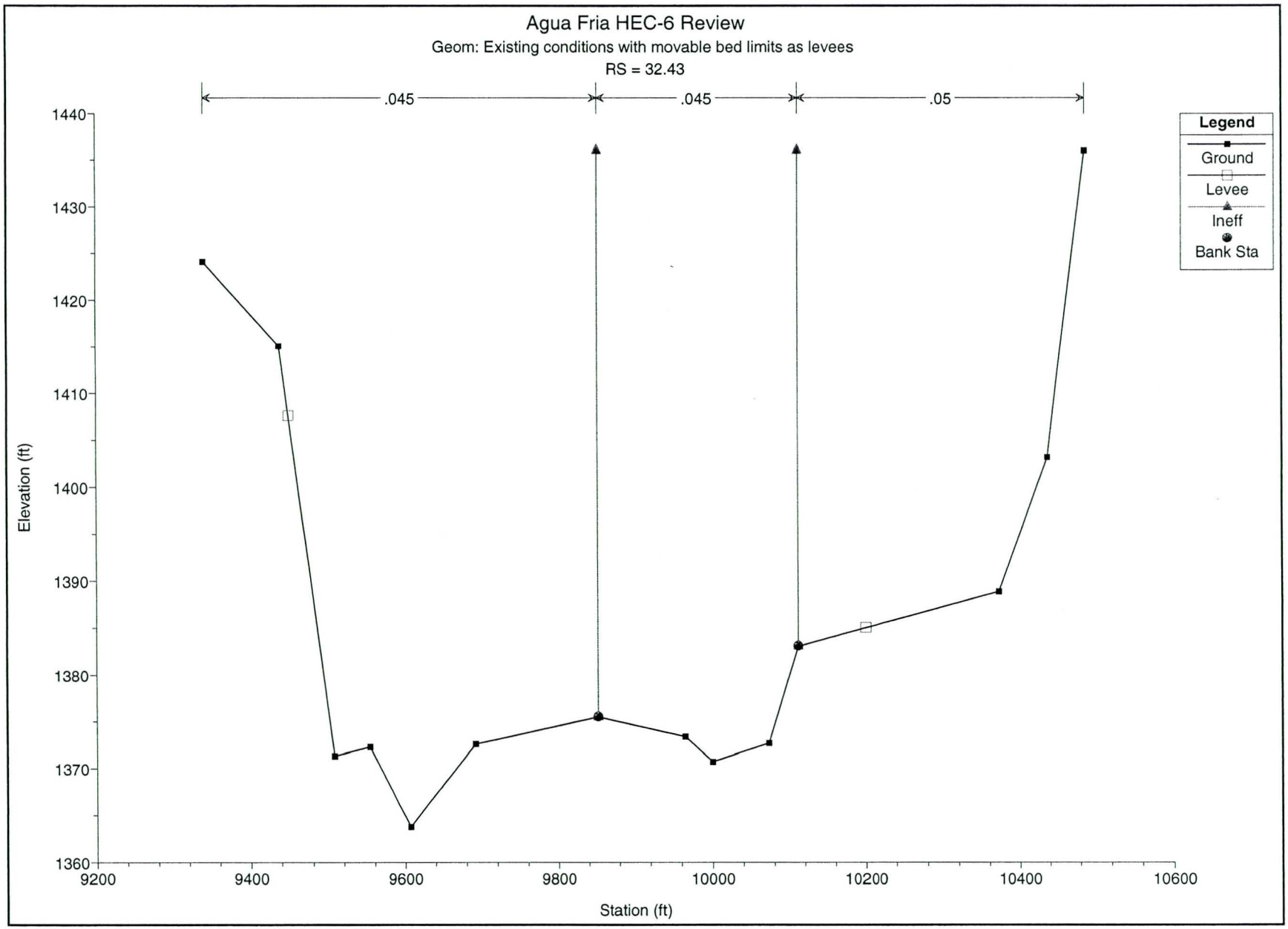
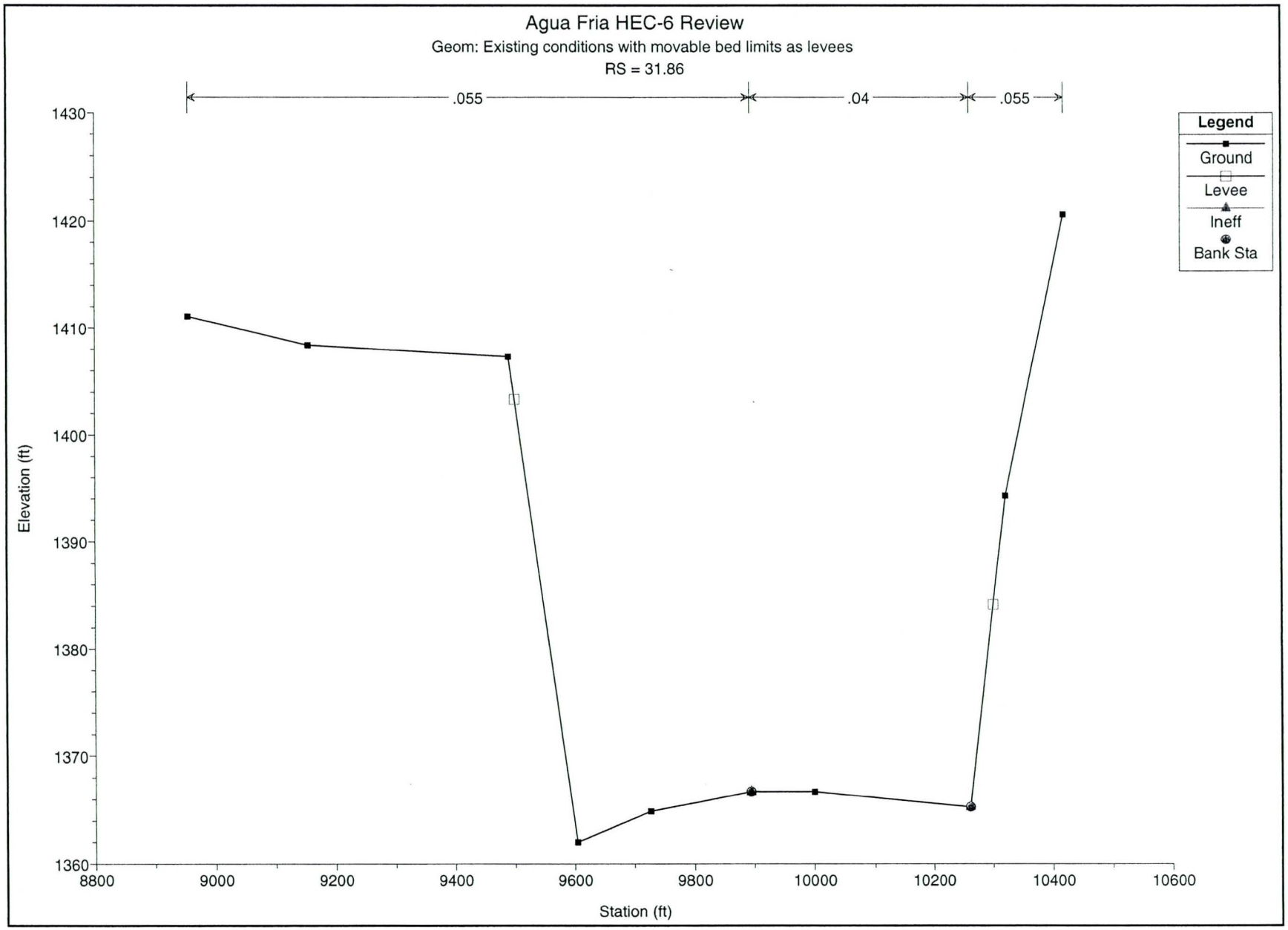
1370
9700
9800
9900
10000
10100
10200
Station (ft)

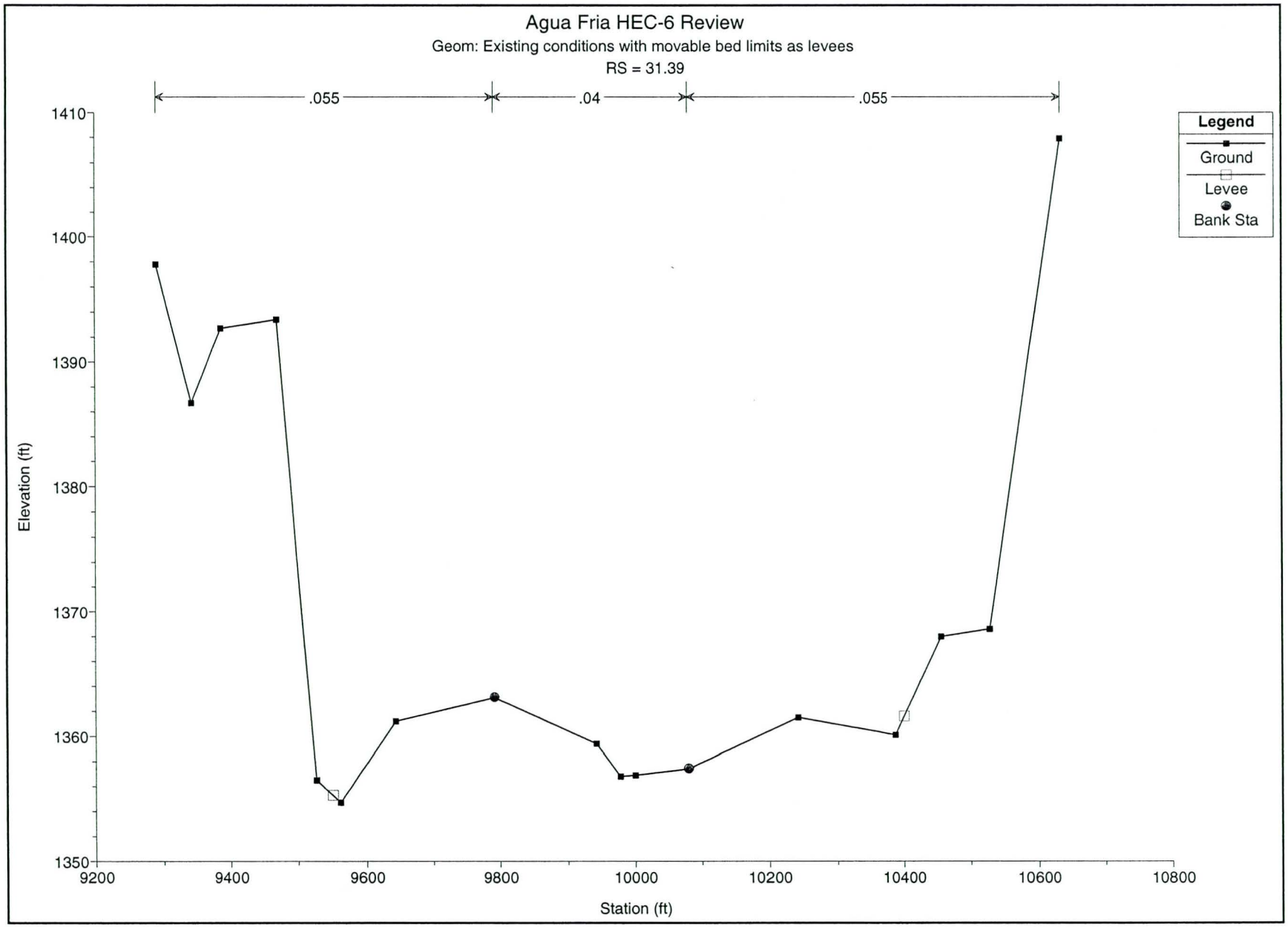

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 32.92
.045
.045
.05
Legend
Encr
Ground
Levee
Bank Sta
Elevation (ft)
1440
1430
1420
1410
1400
1390
1380
9600
9800
10000
10200
10400
10600
Station (ft)

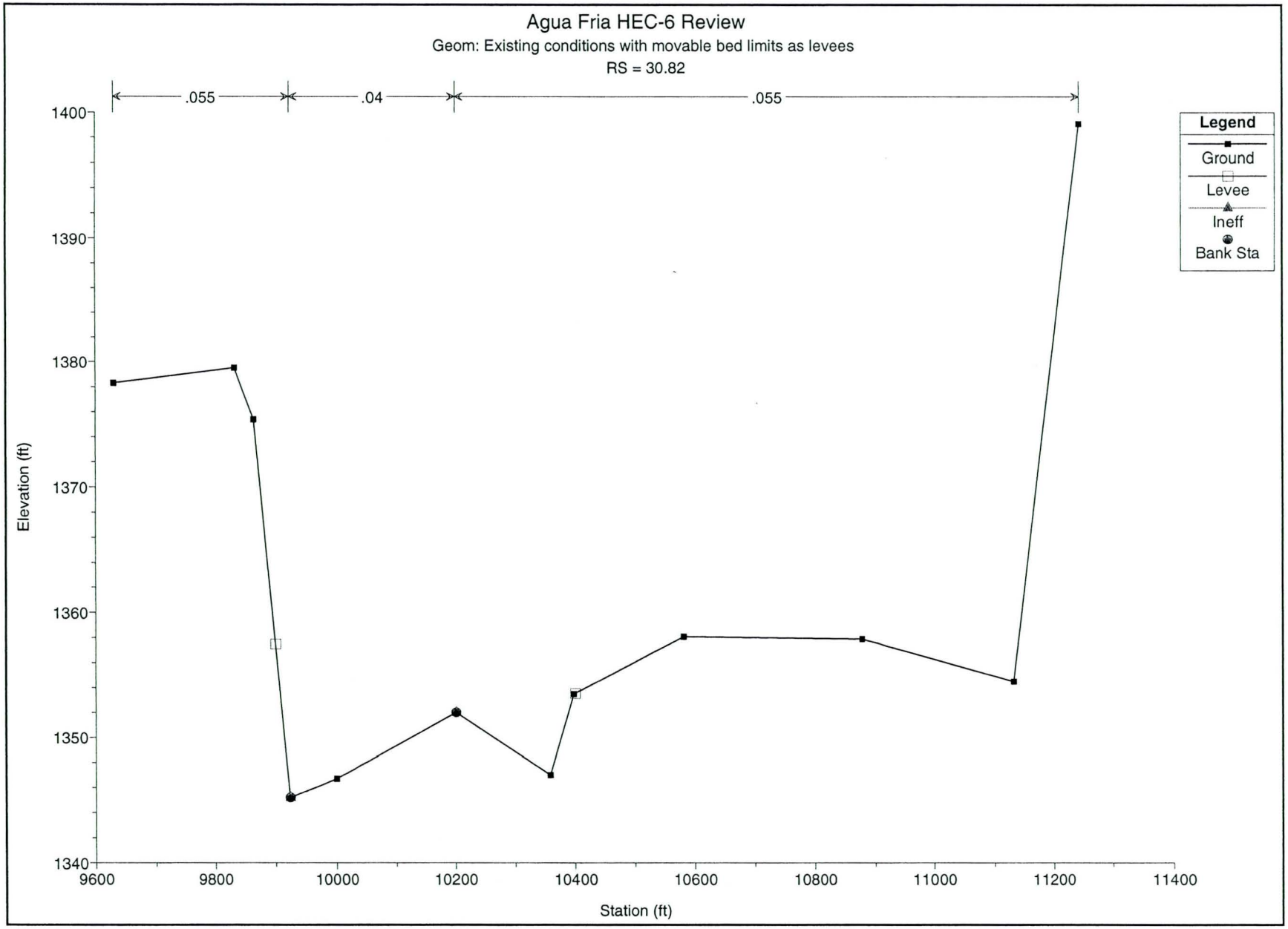

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 32.86
.045
.045
.05
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1430
1420
1410
1400
1390
1380
1370
9600
9800
10000
10200
10400
10600
Station (ft)

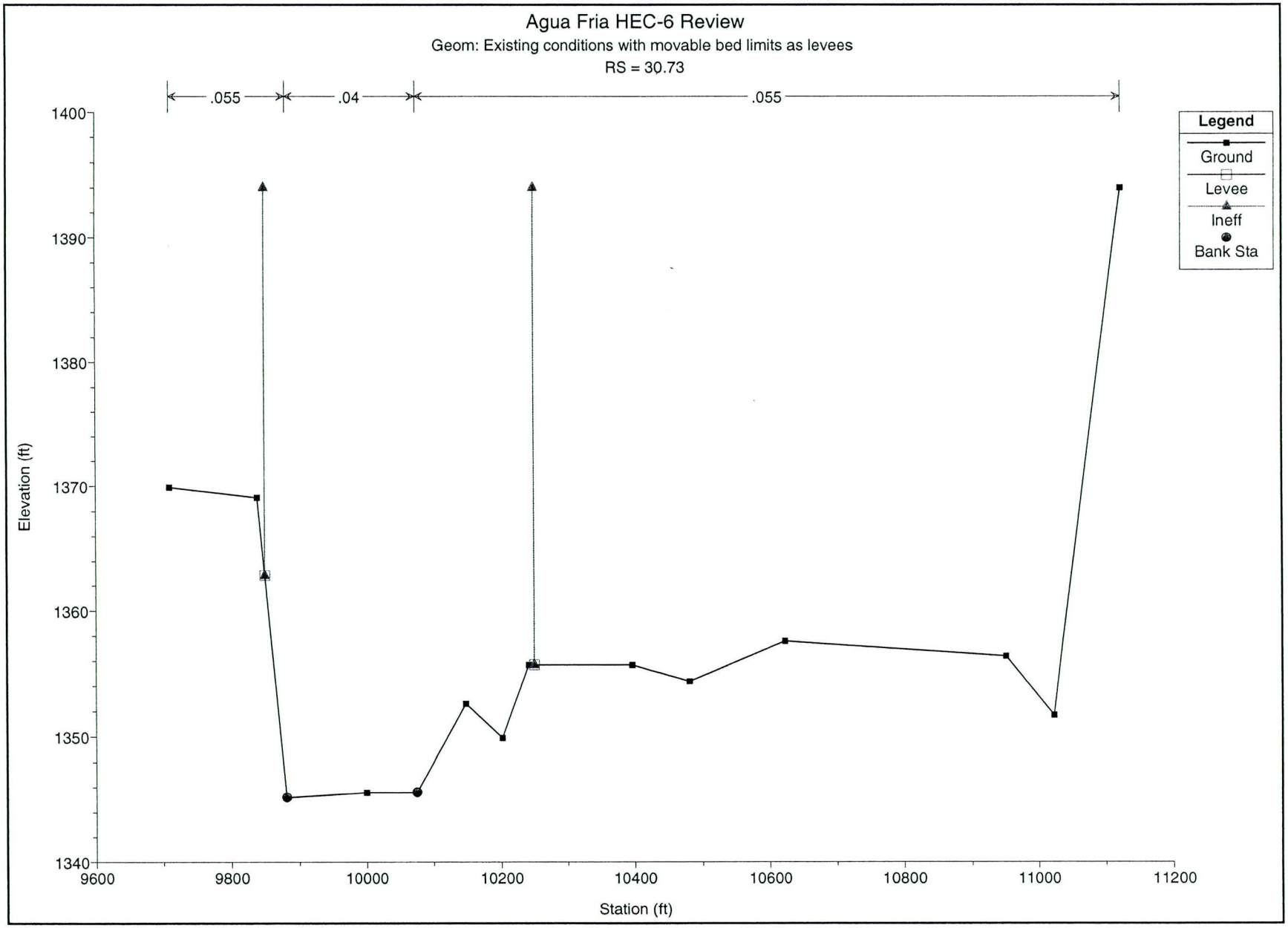

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 32.72
.045
.045
.05
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1460
1440
1420
1400
1380
1360
9400
9600
9800
10000
10200
10400
10600
10800
11000
Station (ft)

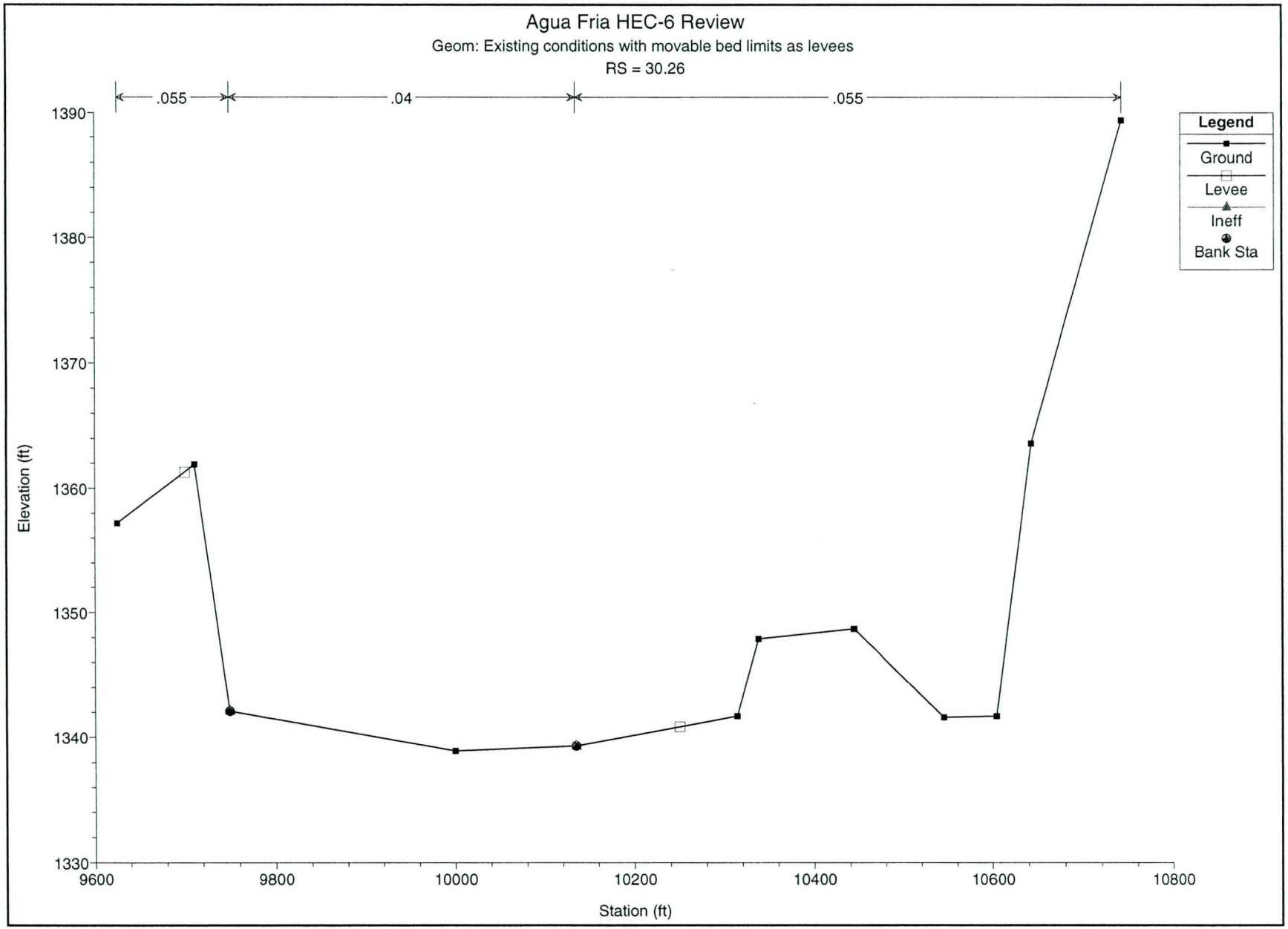

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 32.43
.045
.045
.05
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1440
1430
1420
1410
1400
1390
1380
1370
1360
9200
9400
9600
9800
10000
10200
10400
10600
Station (ft)

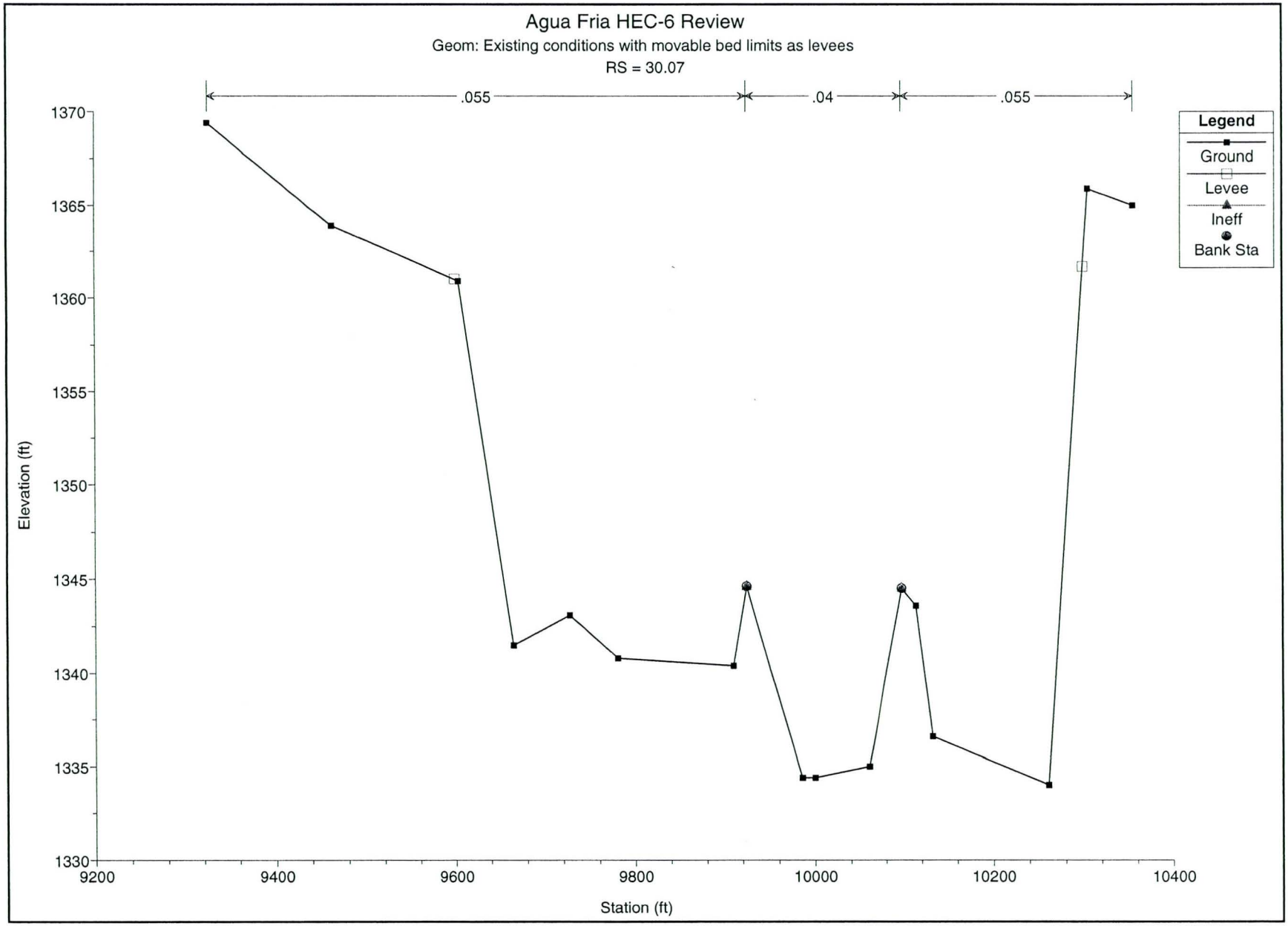

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 31.86
.055
.04
.055
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1430
1420
1410
1400
1390
1380
1370
1360
8800
9000
9200
9400
9600
9800
10000
10200
10400
10600
Station (ft)

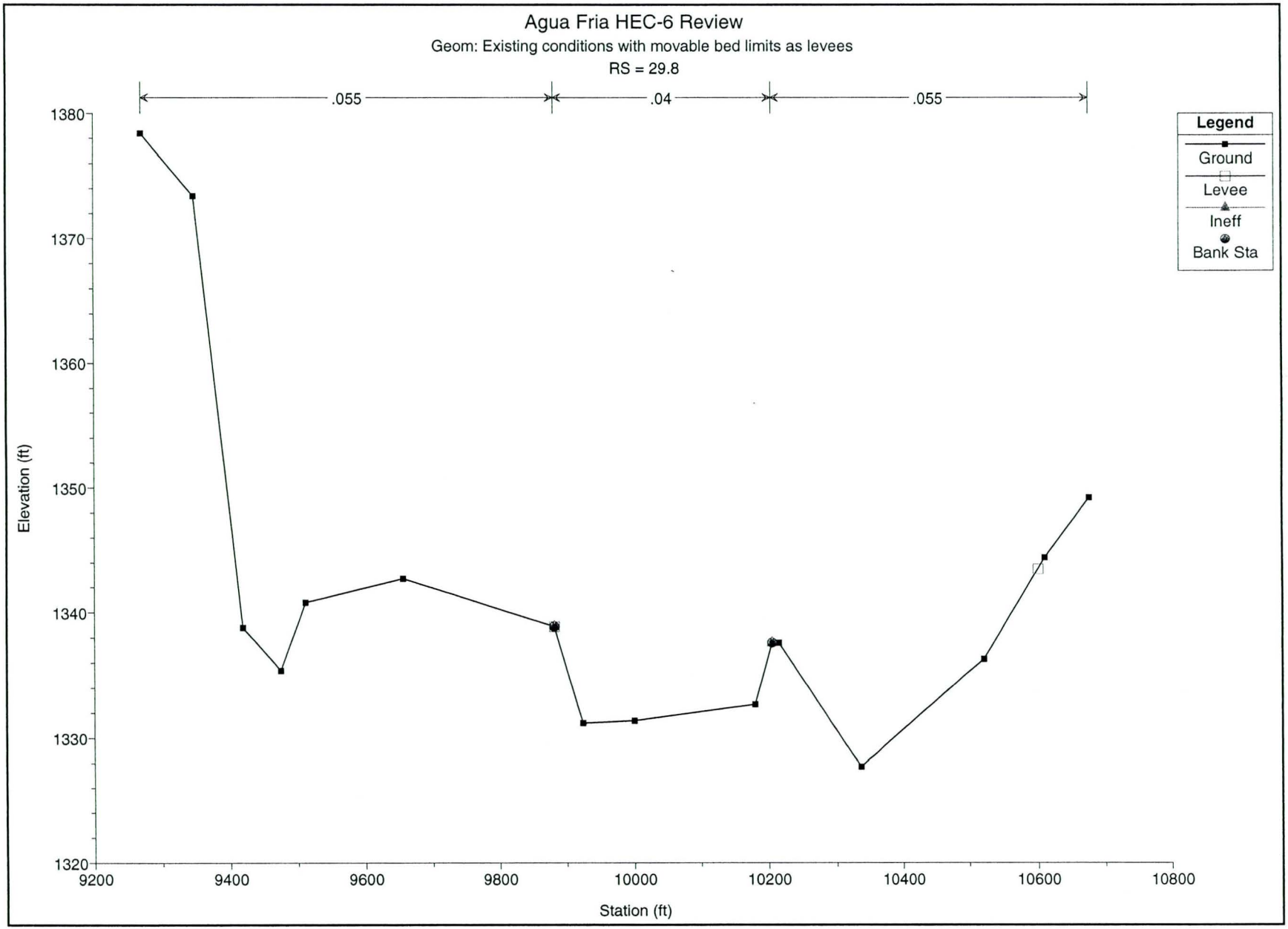

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 31.39
.055
.04
.055
Legend
Ground
Levee
Bank Sta
Elevation (ft)
1410
1400
1390
1380
1370
1360
1350
9200
9400
9600
9800
10000
10200
10400
10600
10800
Station (ft)

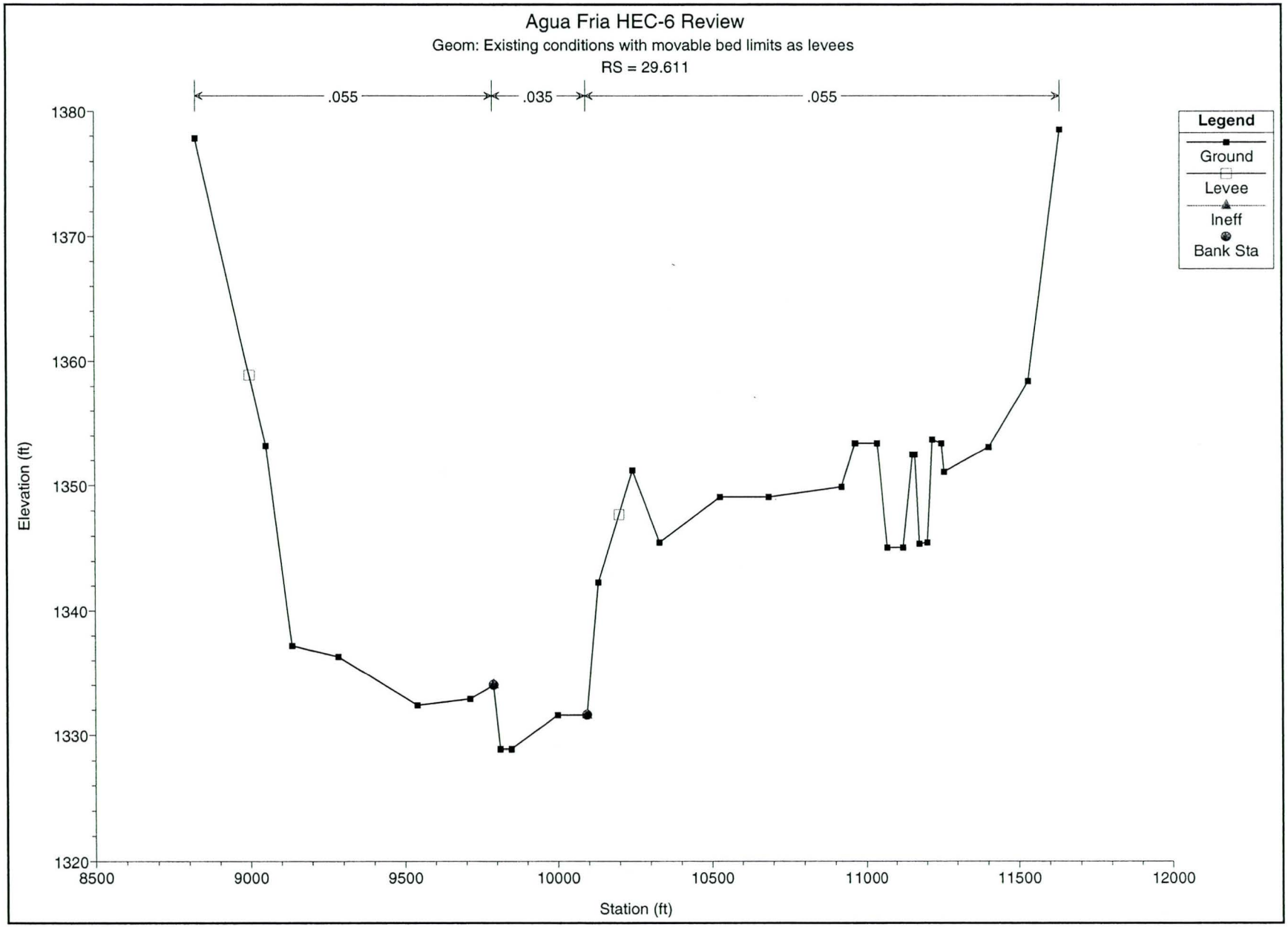

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 30.82
.055
.04
.055
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1400
1390
1380
1370
1360
1350
1340
9600
9800
10000
10200
10400
10600
10800
11000
11200
11400
Station (ft)

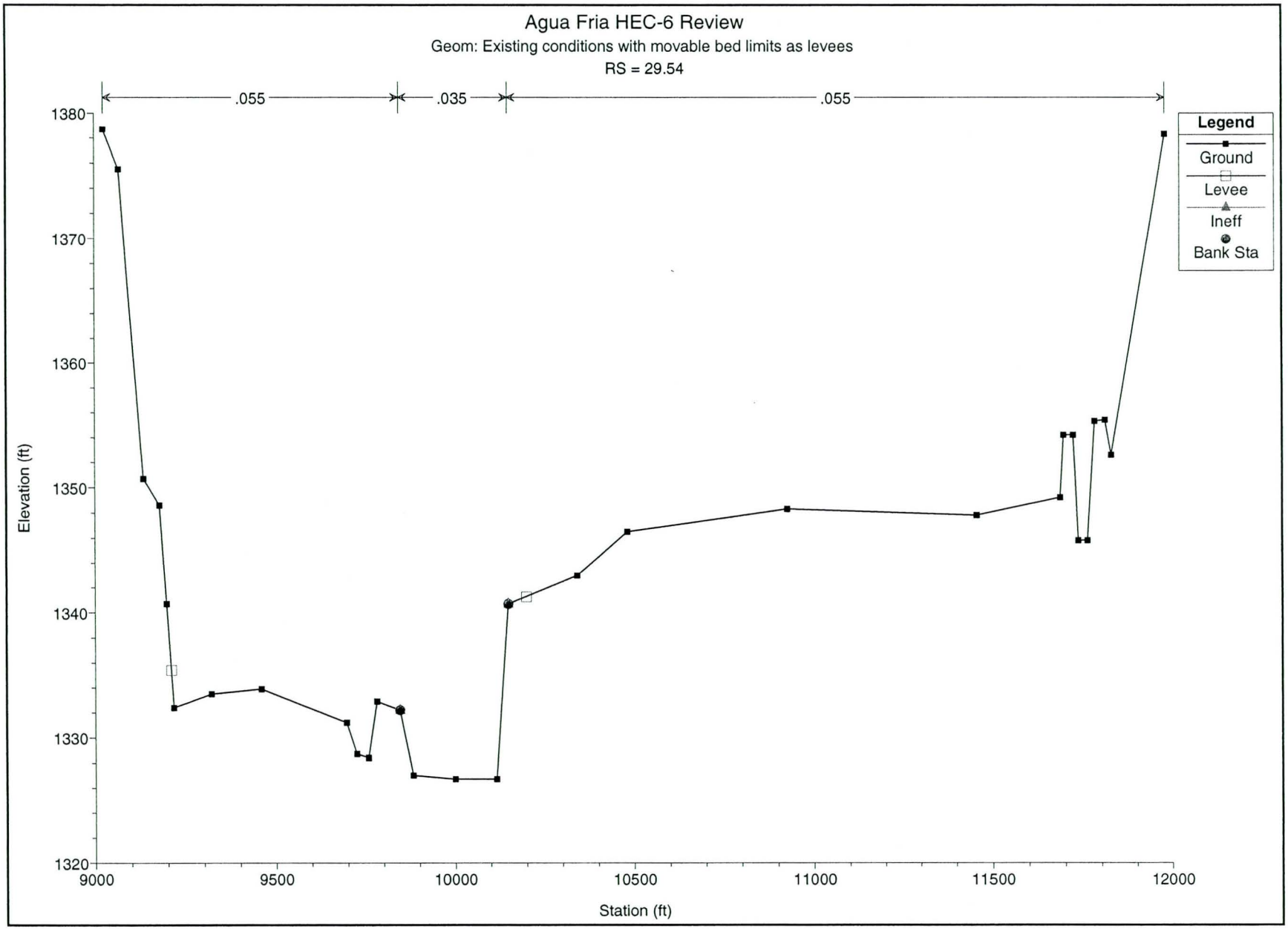

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 30.73
.055
.04
.055
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1400
1390
1380
1370
1360
1350
1340
9600
9800
10000
10200
10400
10600
10800
11000
11200
Station (ft)

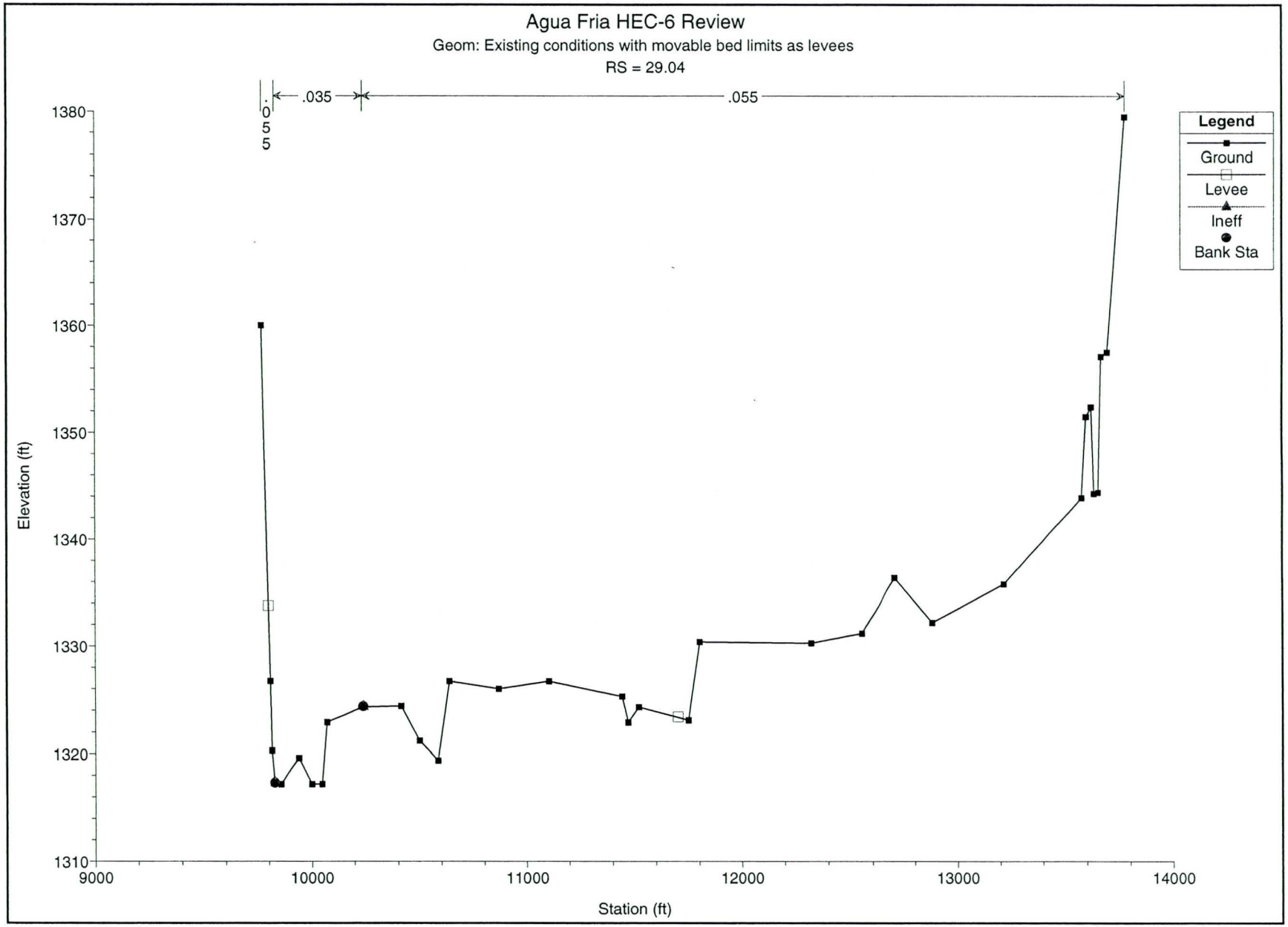

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 30.26
.055
.04
.055
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1390
1380
1370
1360
1350
1340
1330
9600
9800
10000
10200
10400
10600
10800
Station (ft)

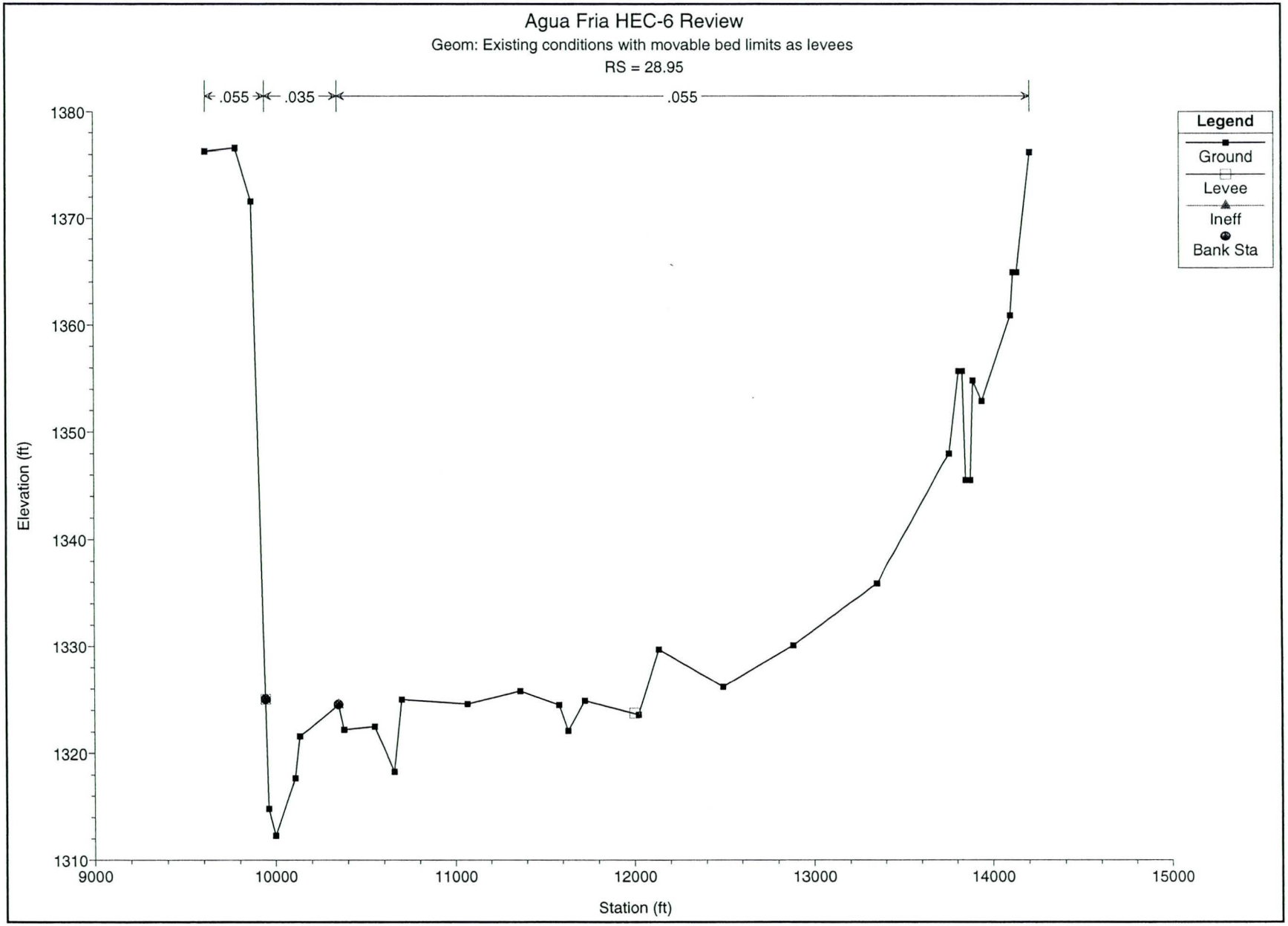

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 30.07
.055
.04
.055
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1370
1365
1360
1355
1350
1345
1340
1335
1330
9200
9400
9600
9800
10000
10200
10400
Station (ft)

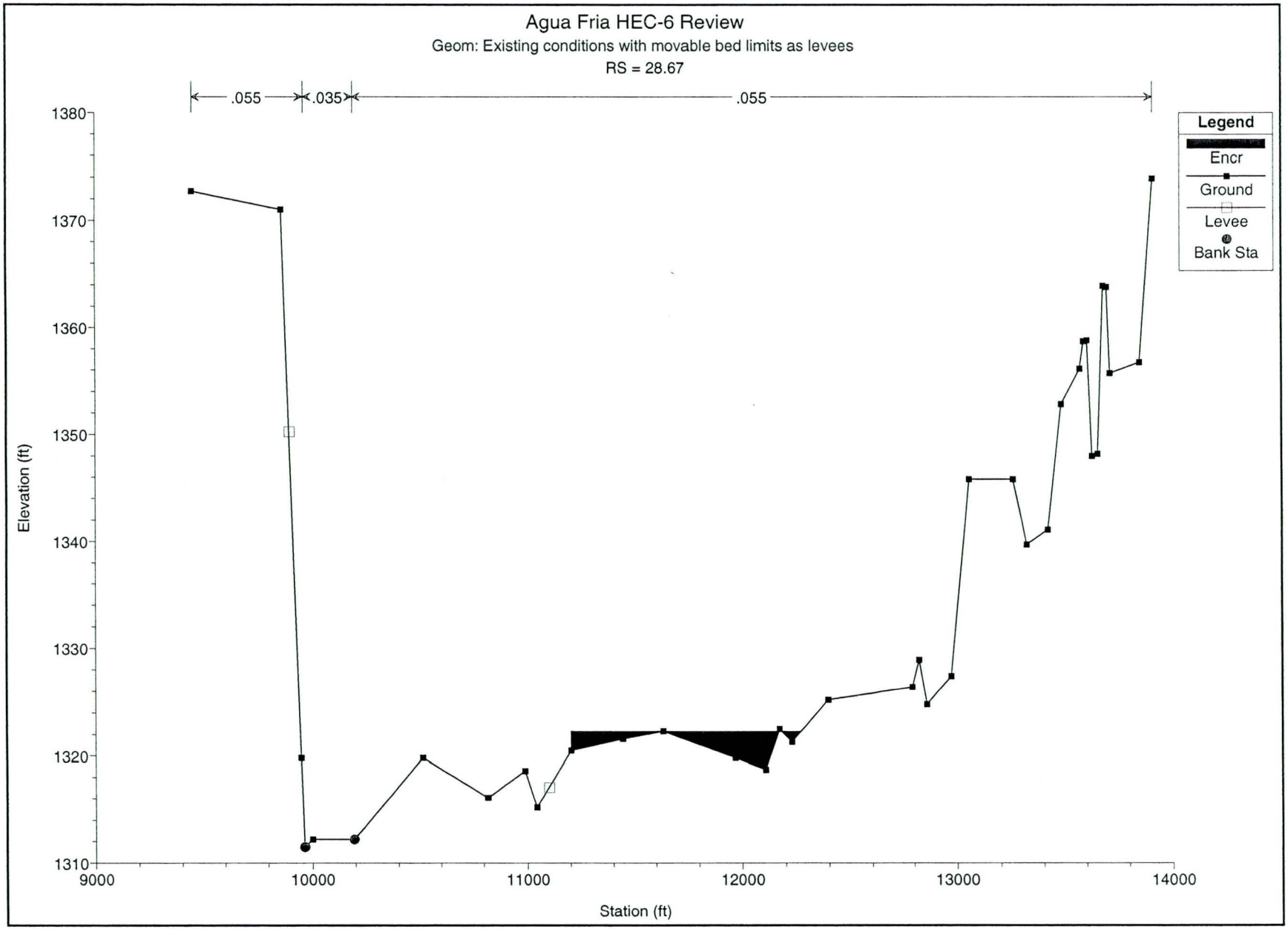

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 29.8
.055
.04
.055
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1380
1370
1360
1350
1340
1330
1320
9200
9400
9600
9800
10000
10200
10400
10600
10800
Station (ft)


Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 29.611
.055
.035
.055
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1380
1370
1360
1350
1340
1330
1320
8500
9000
9500
10000
10500
11000
11500
12000
Station (ft)


Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 29.54
.055
.035
.055
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1380
1370
1360
1350
1340
1330
1320
9000
9500
10000
10500
11000
11500
12000
Station (ft)


Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 29.04
.055
.035
.055
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1380
1370
1360
1350
1340
1330
1320
1310
9000
10000
11000
12000
13000
14000
Station (ft)


Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 28.95
.055
.035
.055
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1380
1370
1360
1350
1340
1330
1320
1310
9000
10000
11000
12000
13000
14000
15000
Station (ft)


Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 28.67
.055
.035
.055
Legend
Encr
Ground
Levee
Bank Sta
Elevation (ft)
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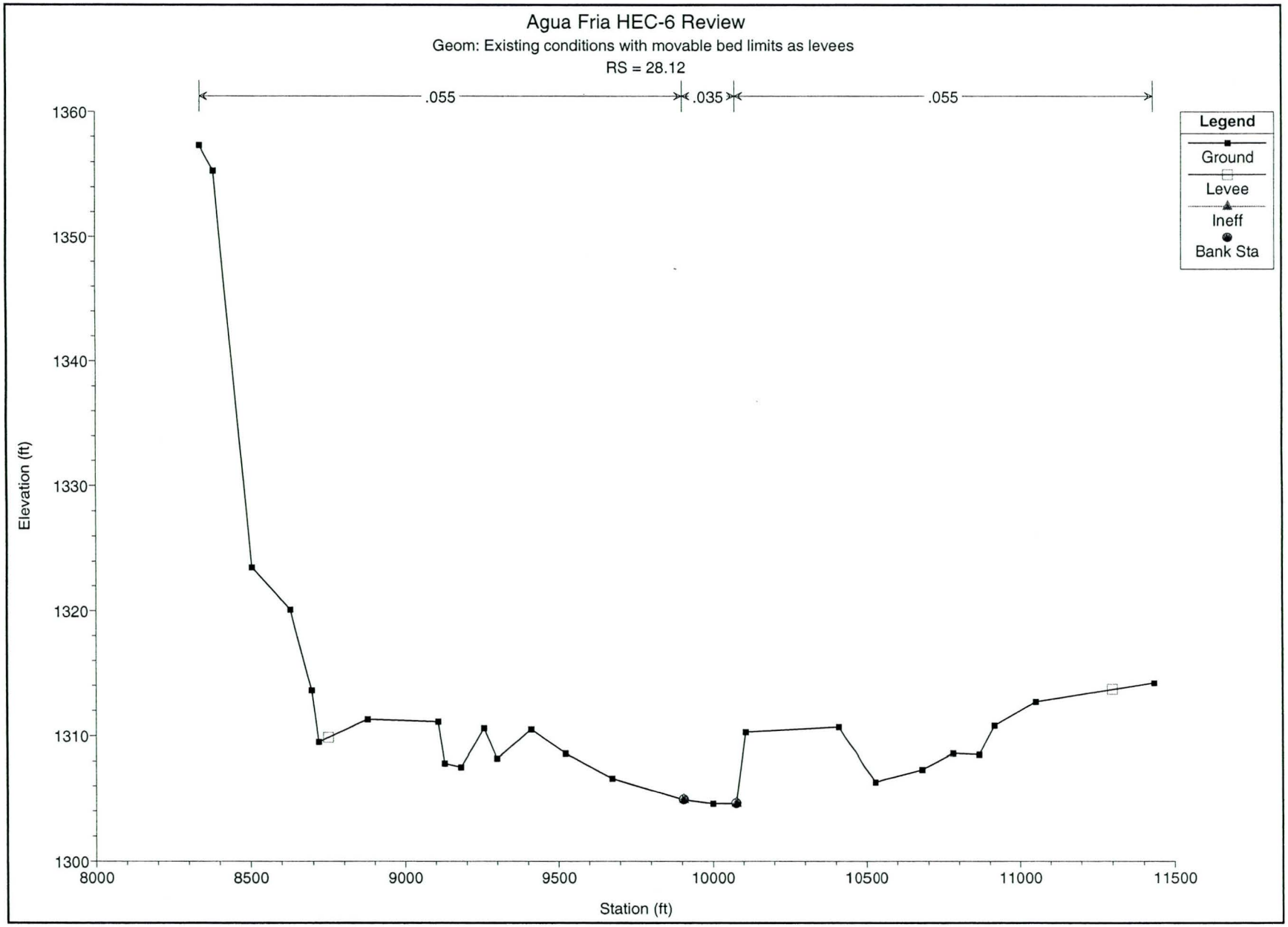
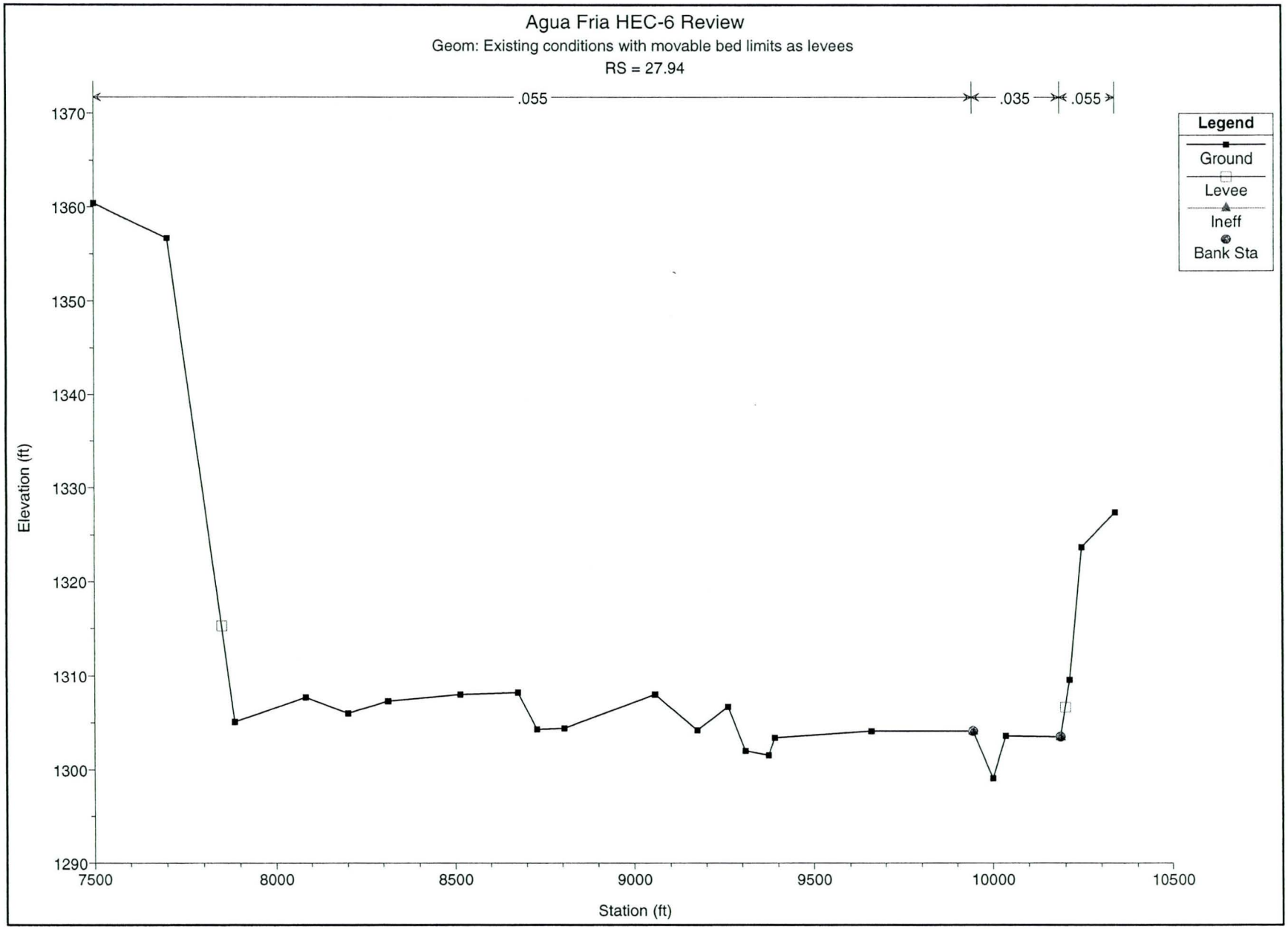
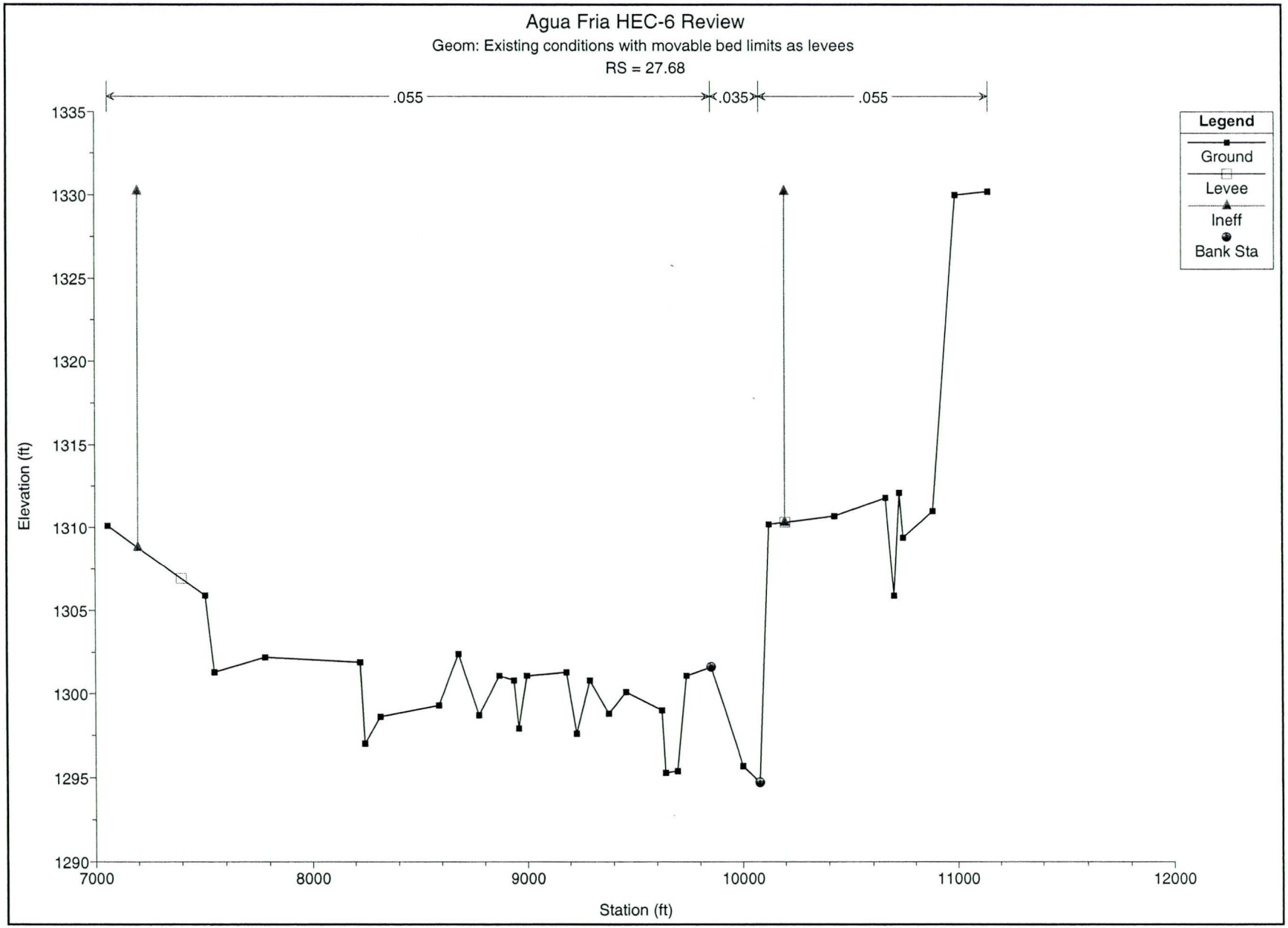
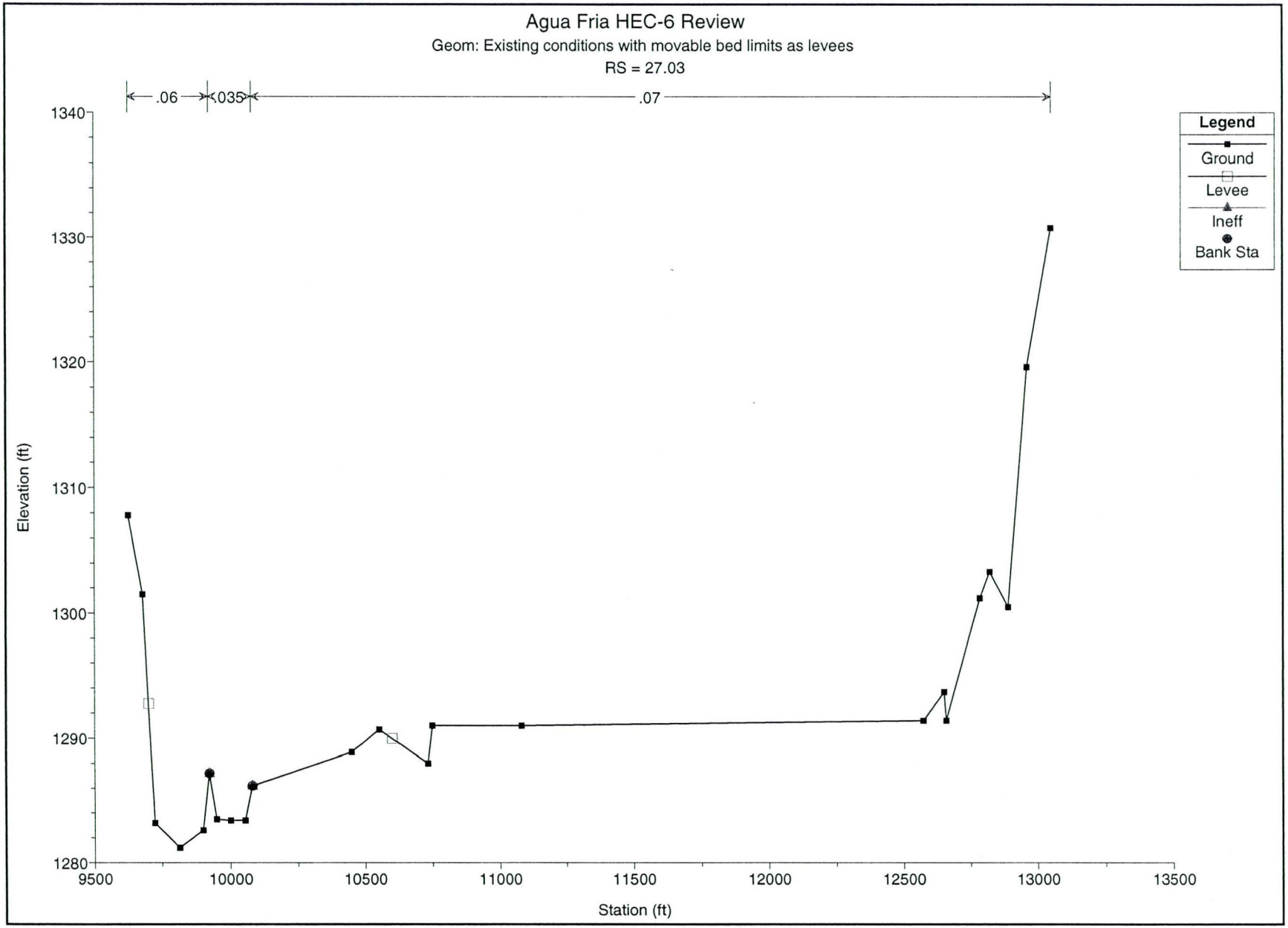
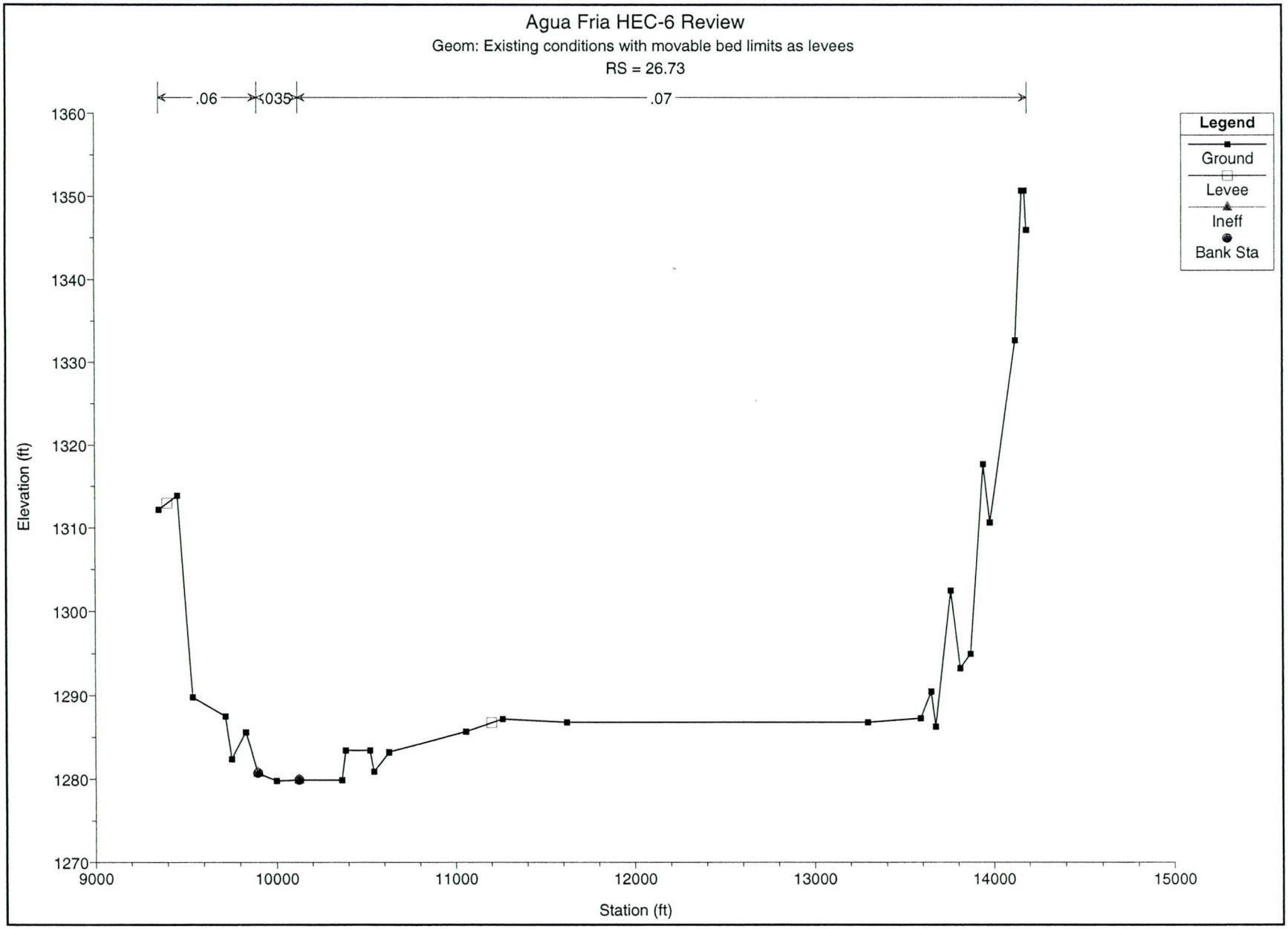
9000
10000
11000
12000
13000
14000
Station (ft)

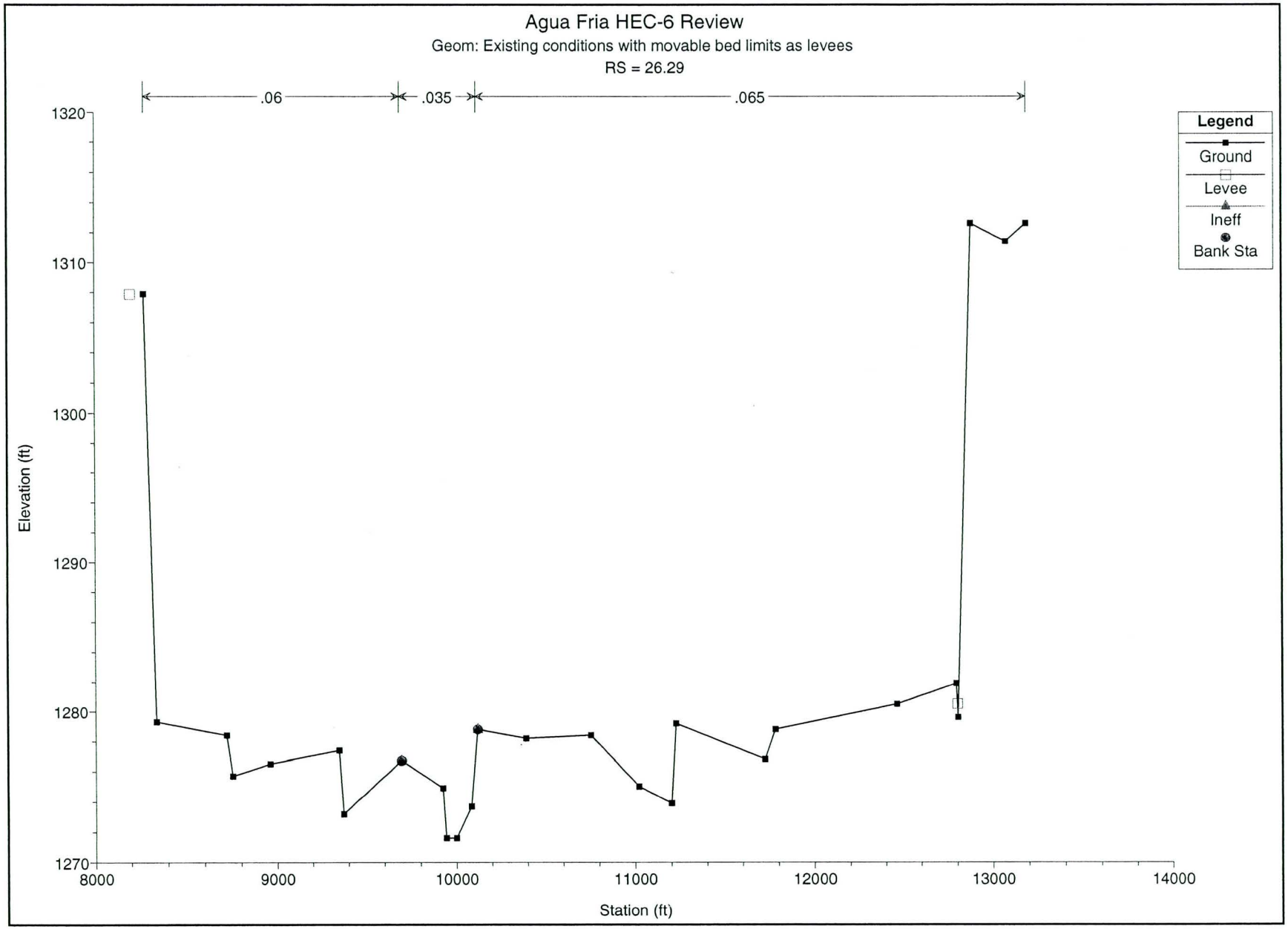

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 28.12
.055
.035
.055
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1360
1350
1340
1330
1320
1310
1300
8000
8500
9000
9500
10000
10500
11000
11500
Station (ft)

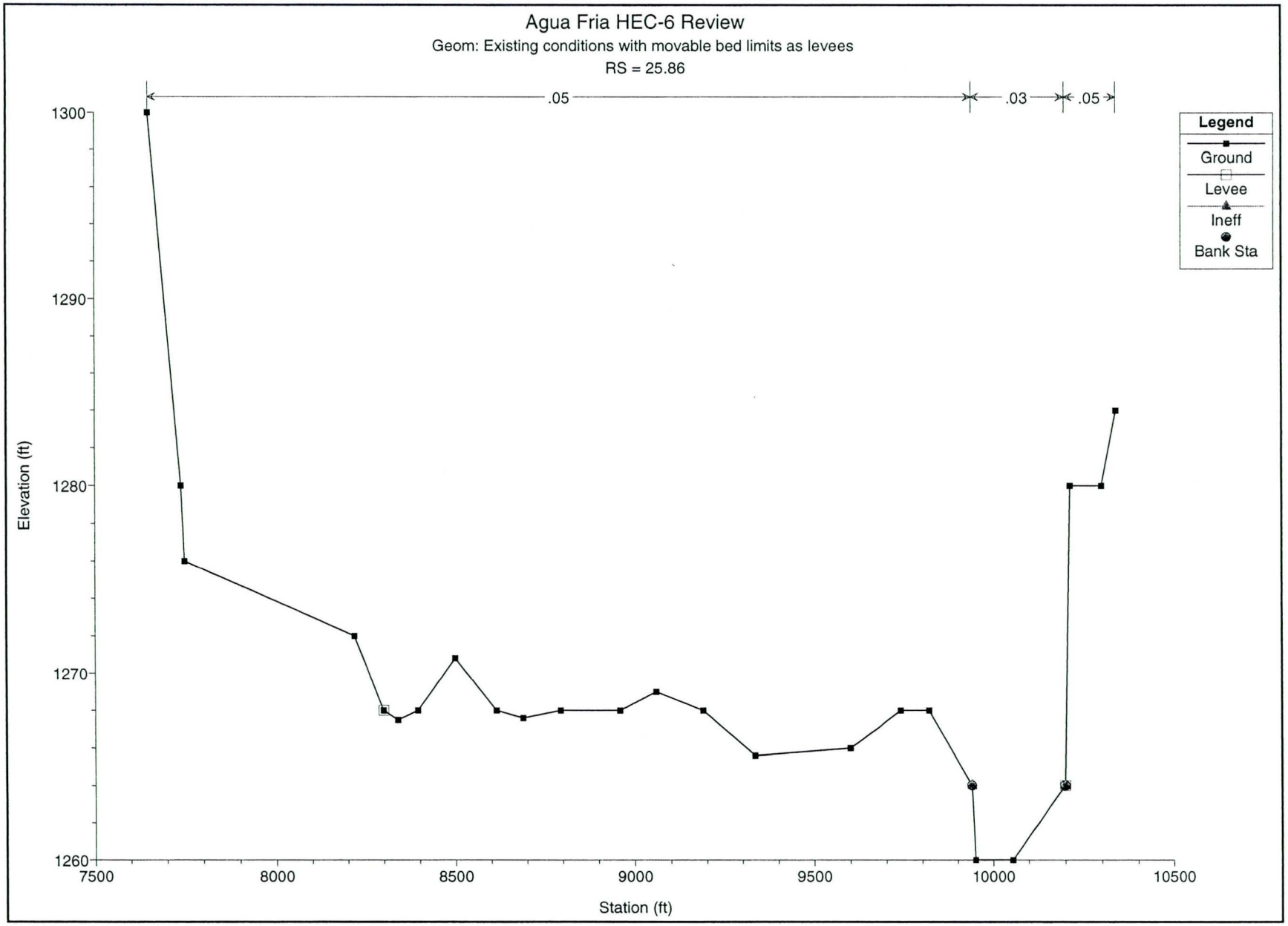

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 27.94
.055
.035
.055
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1370
1360
1350
1340
1330
1320
1310
1300
1290
7500
8000
8500
9000
9500
10000
10500
Station (ft)

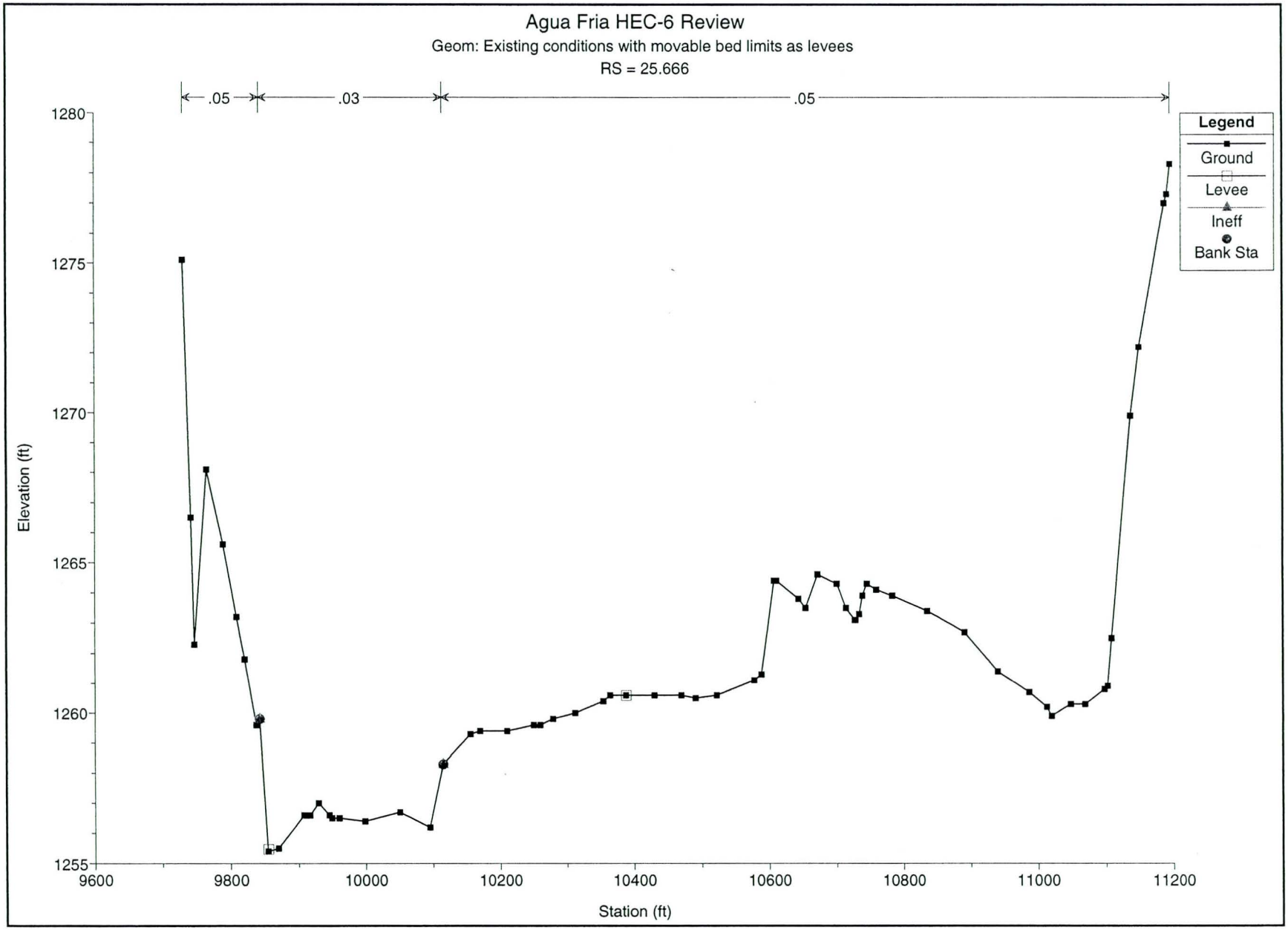

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 27.68
.055
.035
.055
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1335
1330
1325
1320
1315
1310
1305
1300
1295
1290
7000
8000
9000
10000
11000
12000
Station (ft)

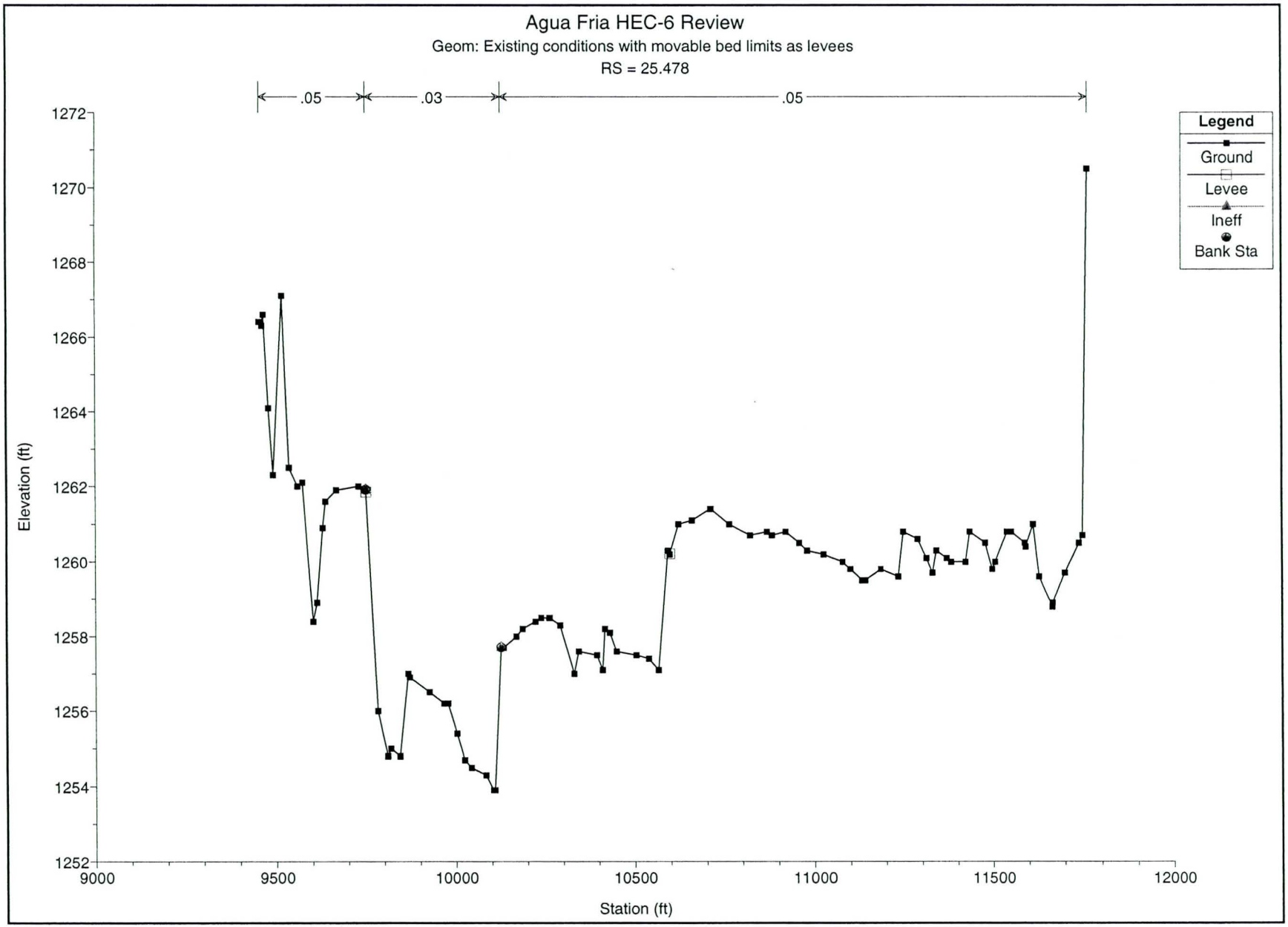

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 27.03
.06
.035
.07
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1340
1330
1320
1310
1300
1290
1280
9500
10000
10500
11000
11500
12000
12500
13000
13500
Station (ft)

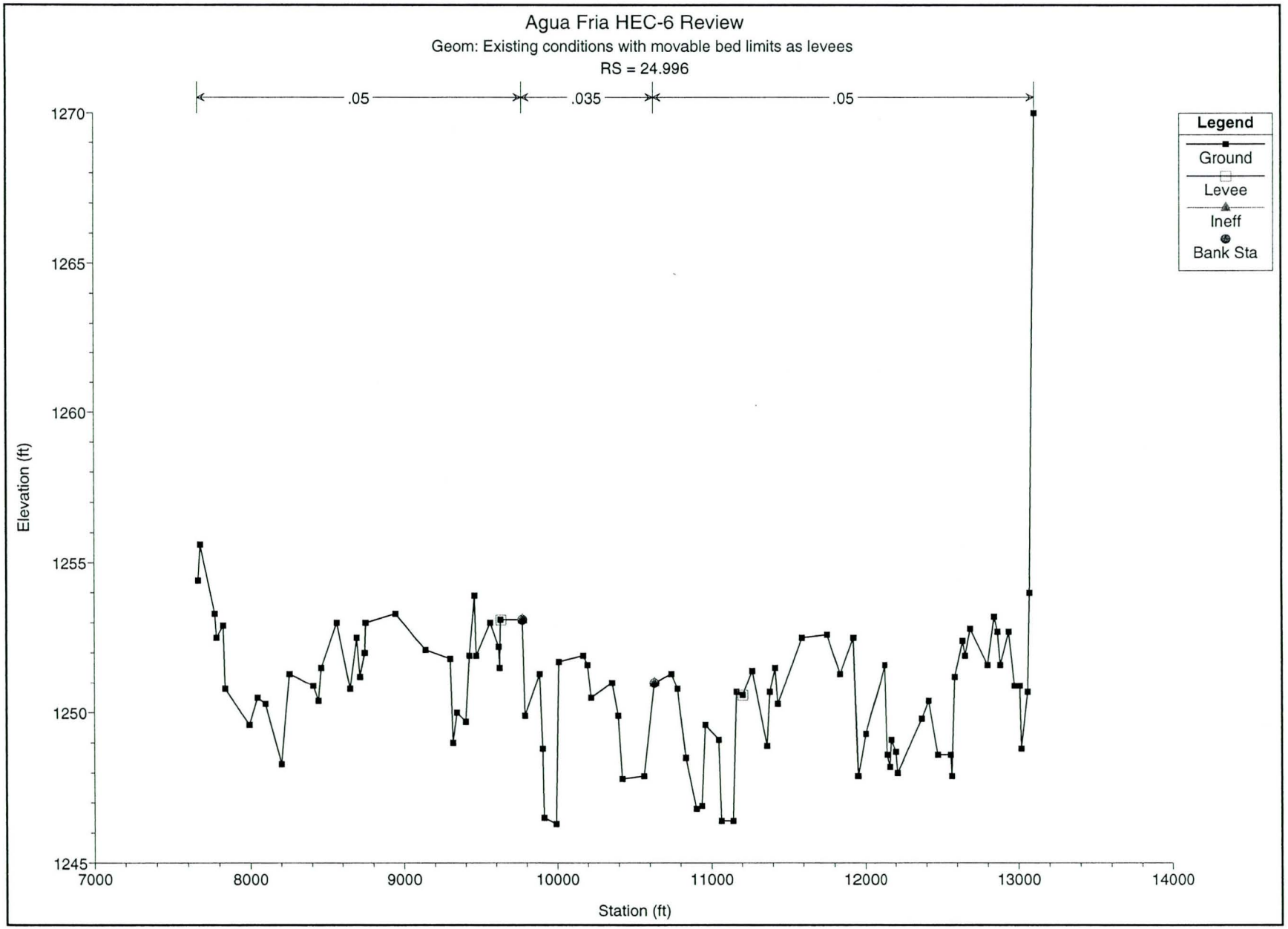

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 26.73
.06
.035
.07
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1360
1350
1340
1330
1320
1310
1300
1290
1280
1270
9000
10000
11000
12000
13000
14000
15000
Station (ft)

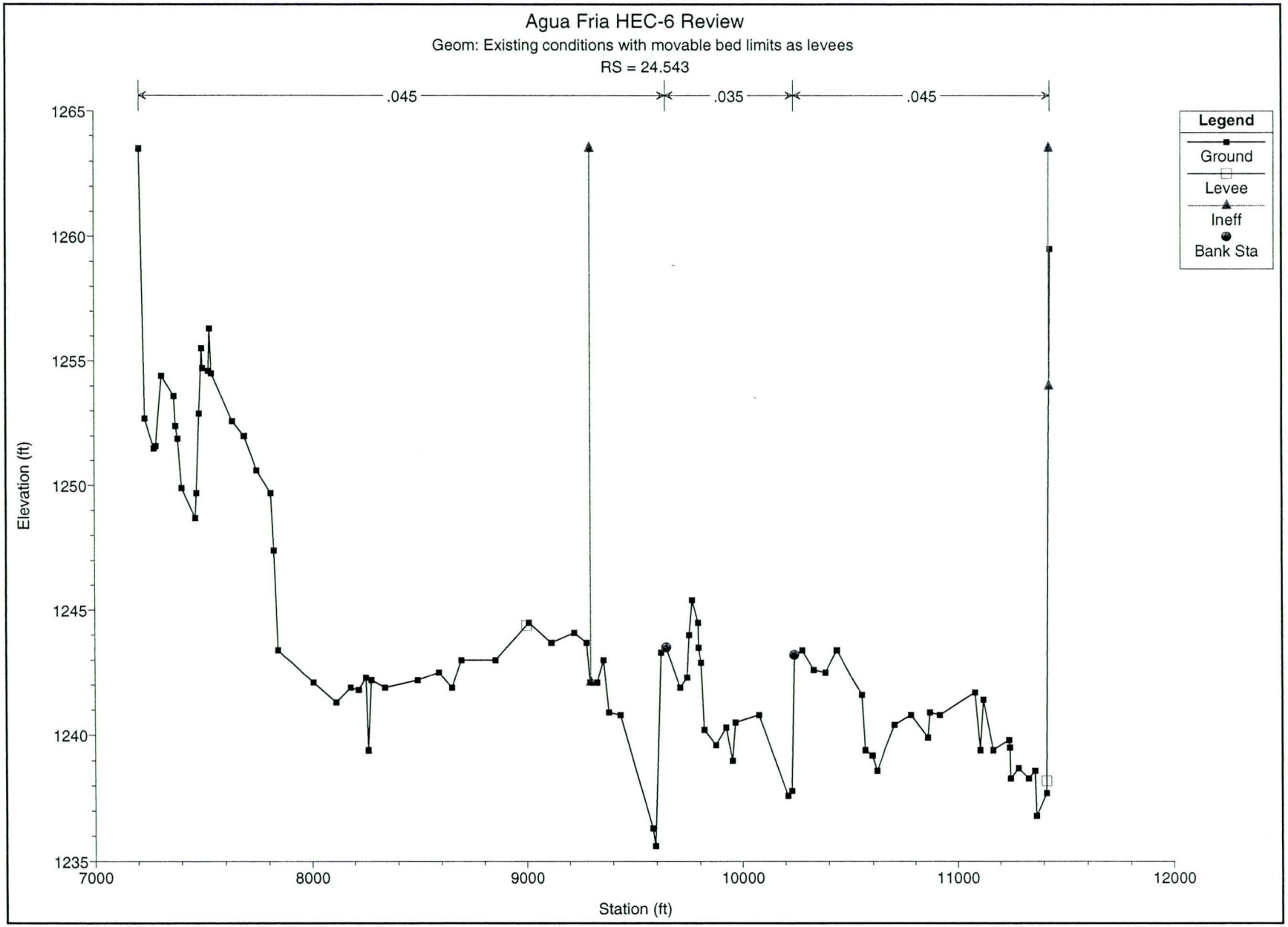

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 26.29
.06
.035
.065
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1320
1310
1300
1290
1280
1270
8000
9000
10000
11000
12000
13000
14000
Station (ft)

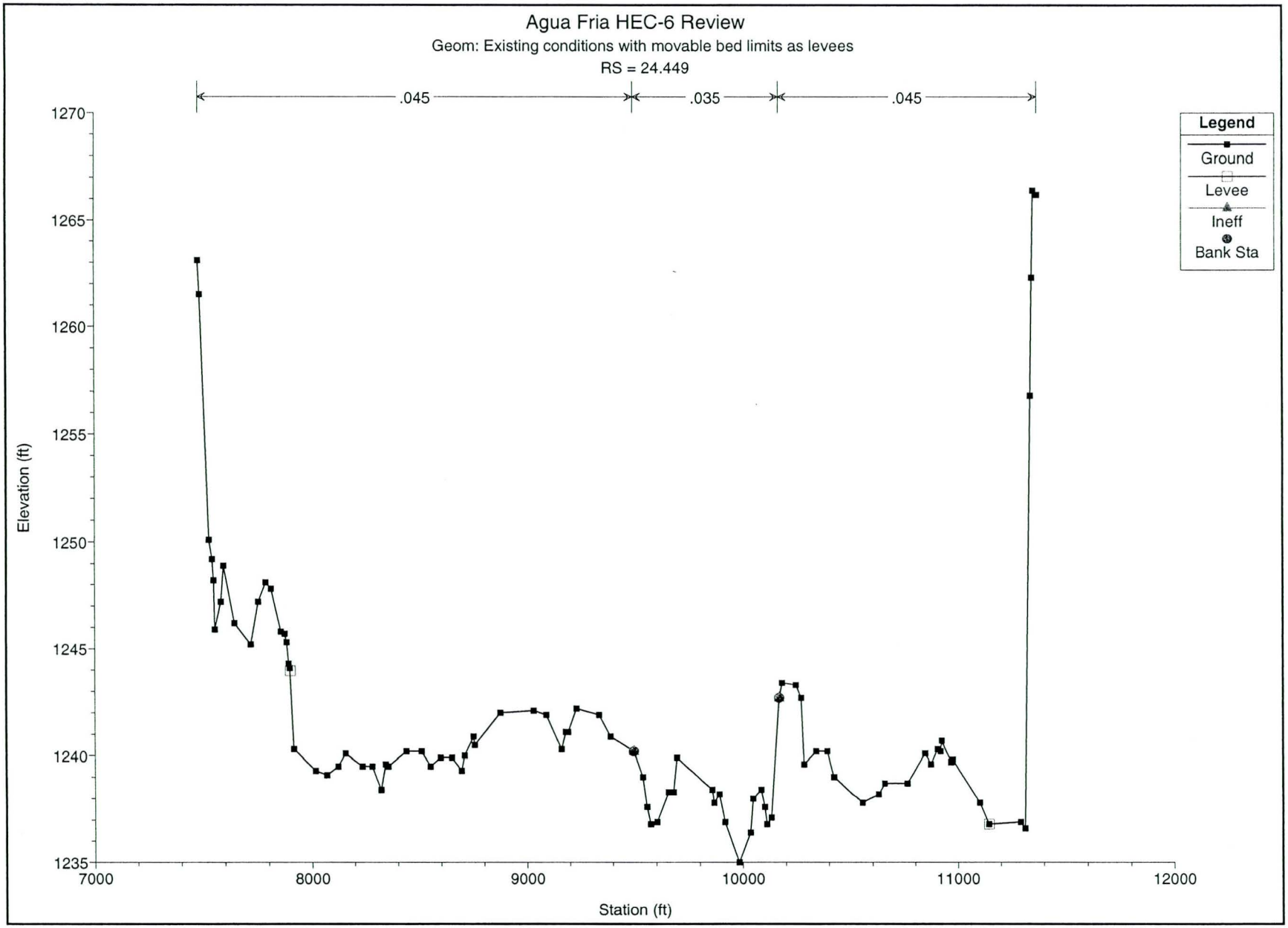

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 25.86
.05
.03
.05
Legend
Ground
Levee
Ineff
Bank Sta
1300
1290
1280
1270
1260
Elevation (ft)
7500
8000
8500
9000
9500
10000
10500
Station (ft)

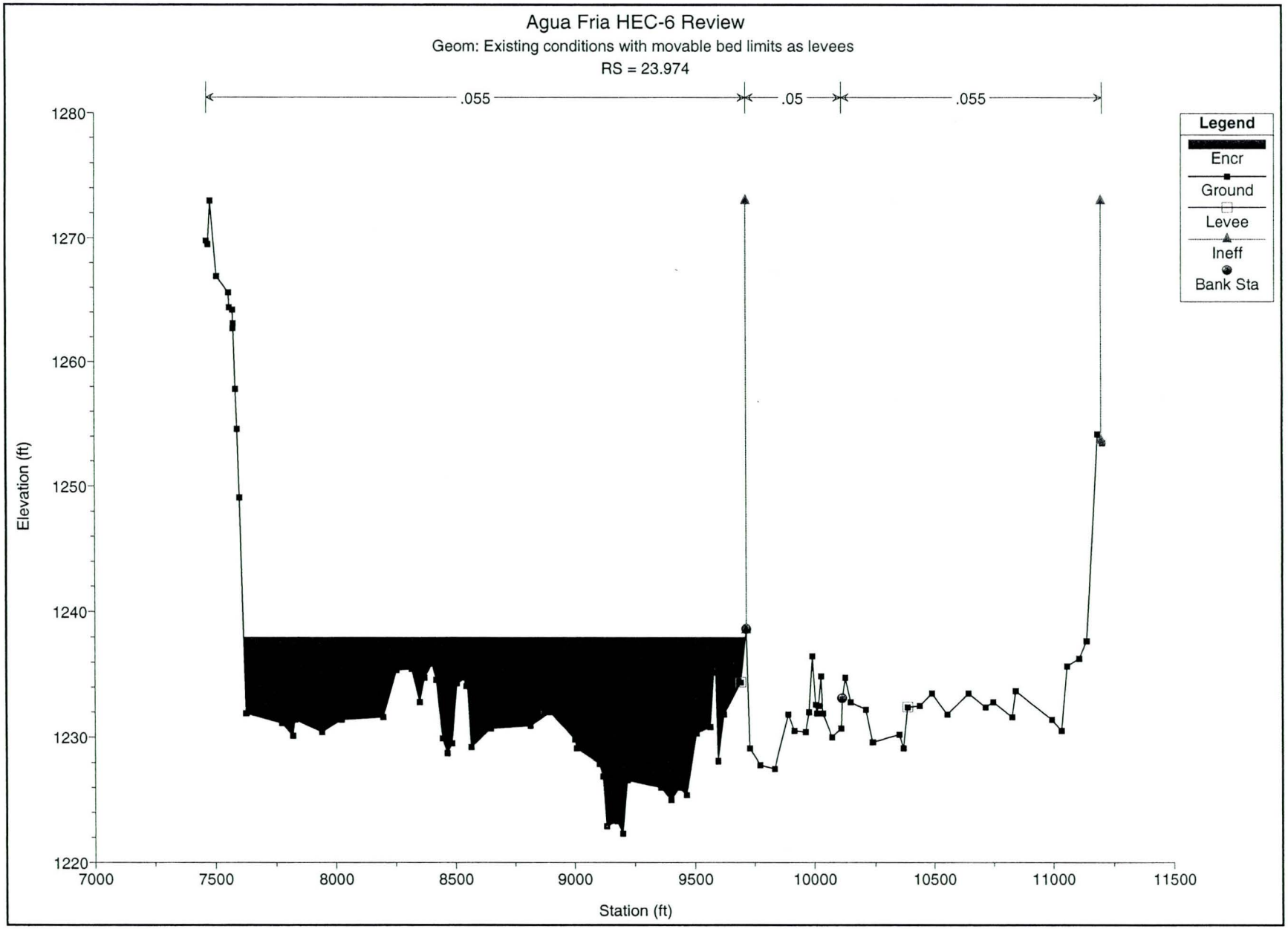

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 25.666
.05
.03
.05
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1280
1275
1270
1265
1260
1255
9600
9800
10000
10200
10400
10600
10800
11000
11200
Station (ft)

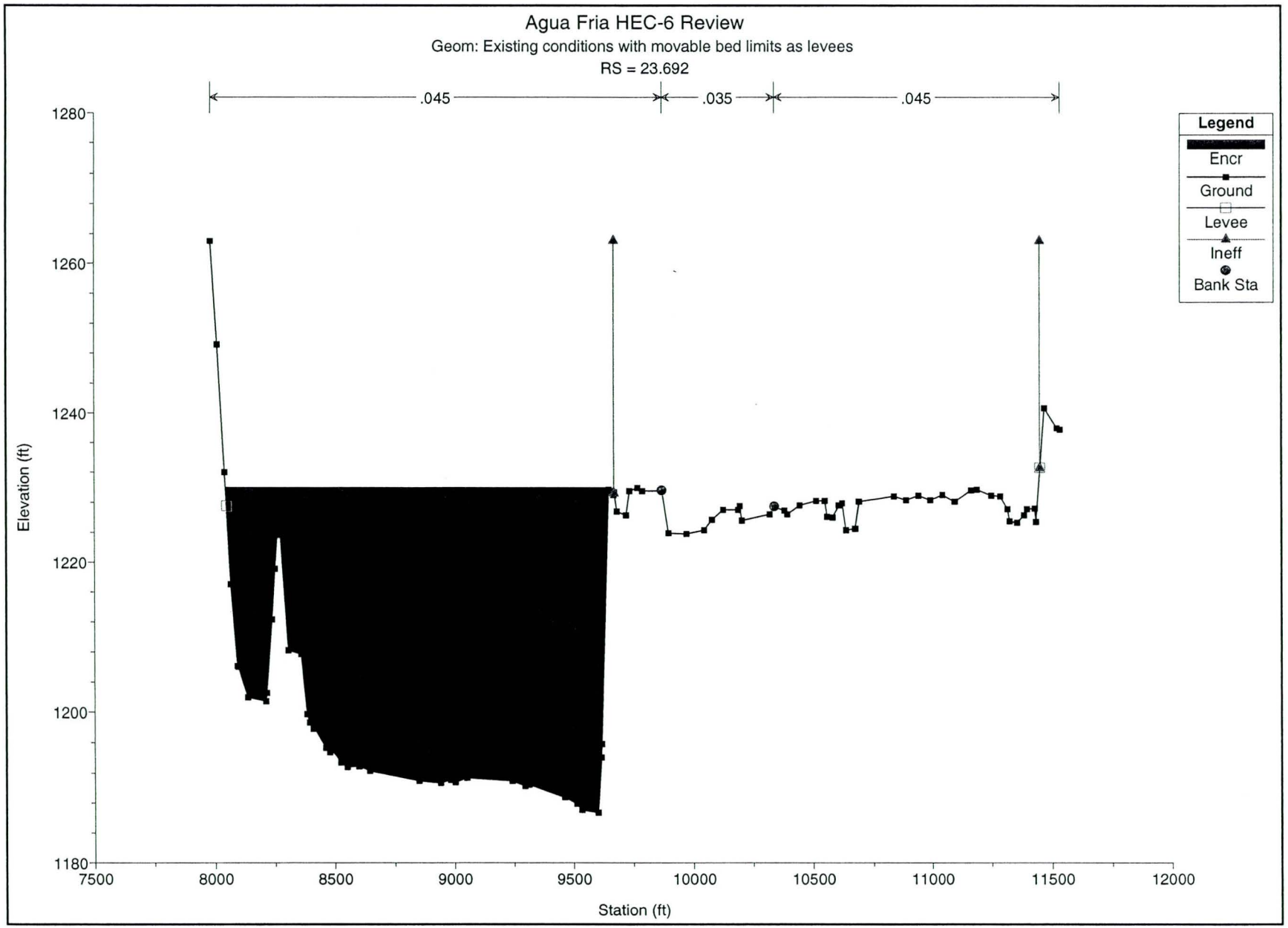

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 25.478
.05
.03
.05
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1272
1270
1268
1266
1264
1262
1260
1258
1256
1254
1252
9000
9500
10000
10500
11000
11500
12000
Station (ft)

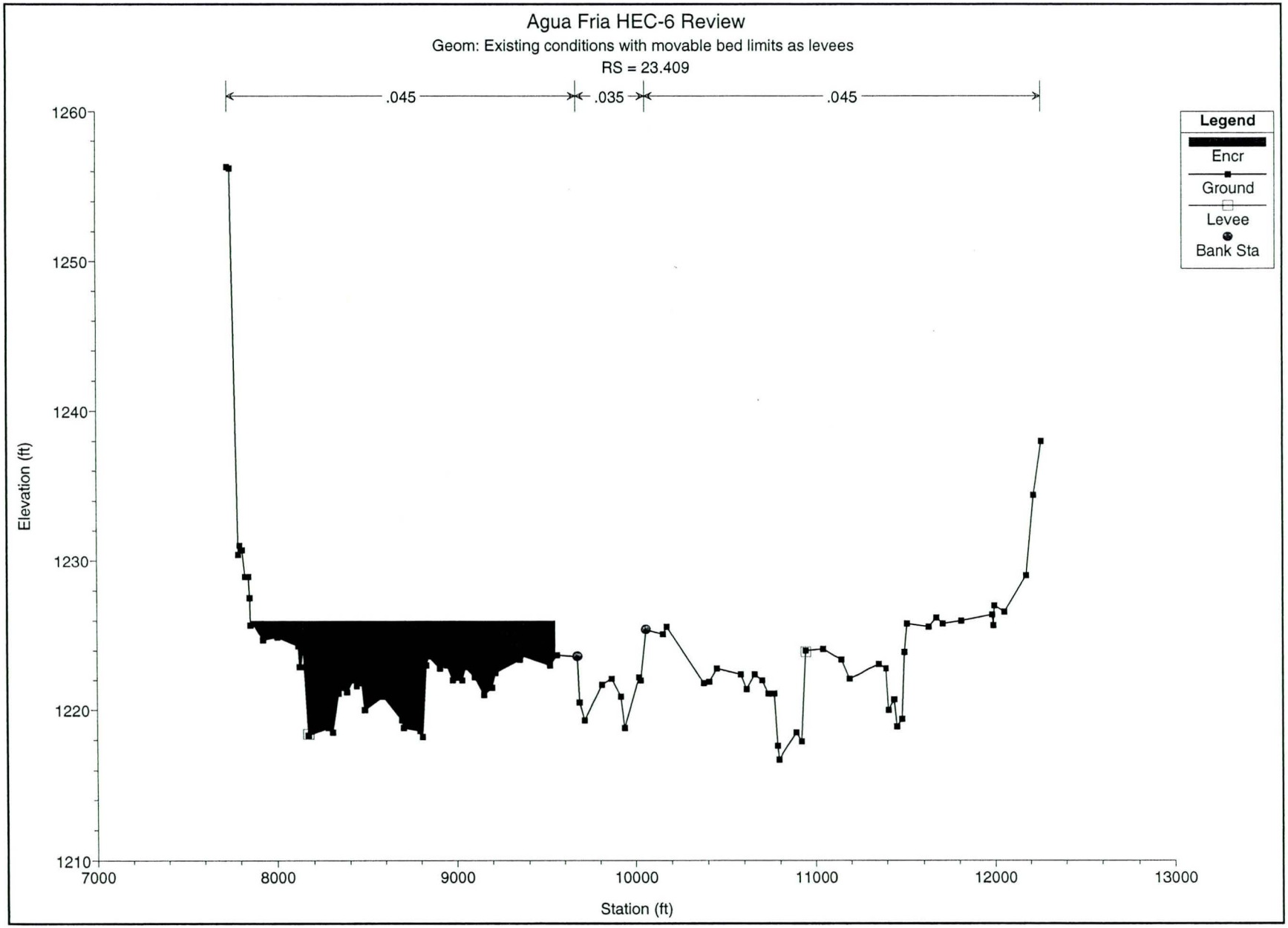

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 24.996
.05
.035
.05
Legend
Ground
Levee
Ineff
Bank Sta
1270
1265
1260
1255
1250
1245
Elevation (ft)
7000
8000
9000
10000
11000
12000
13000
14000
Station (ft)

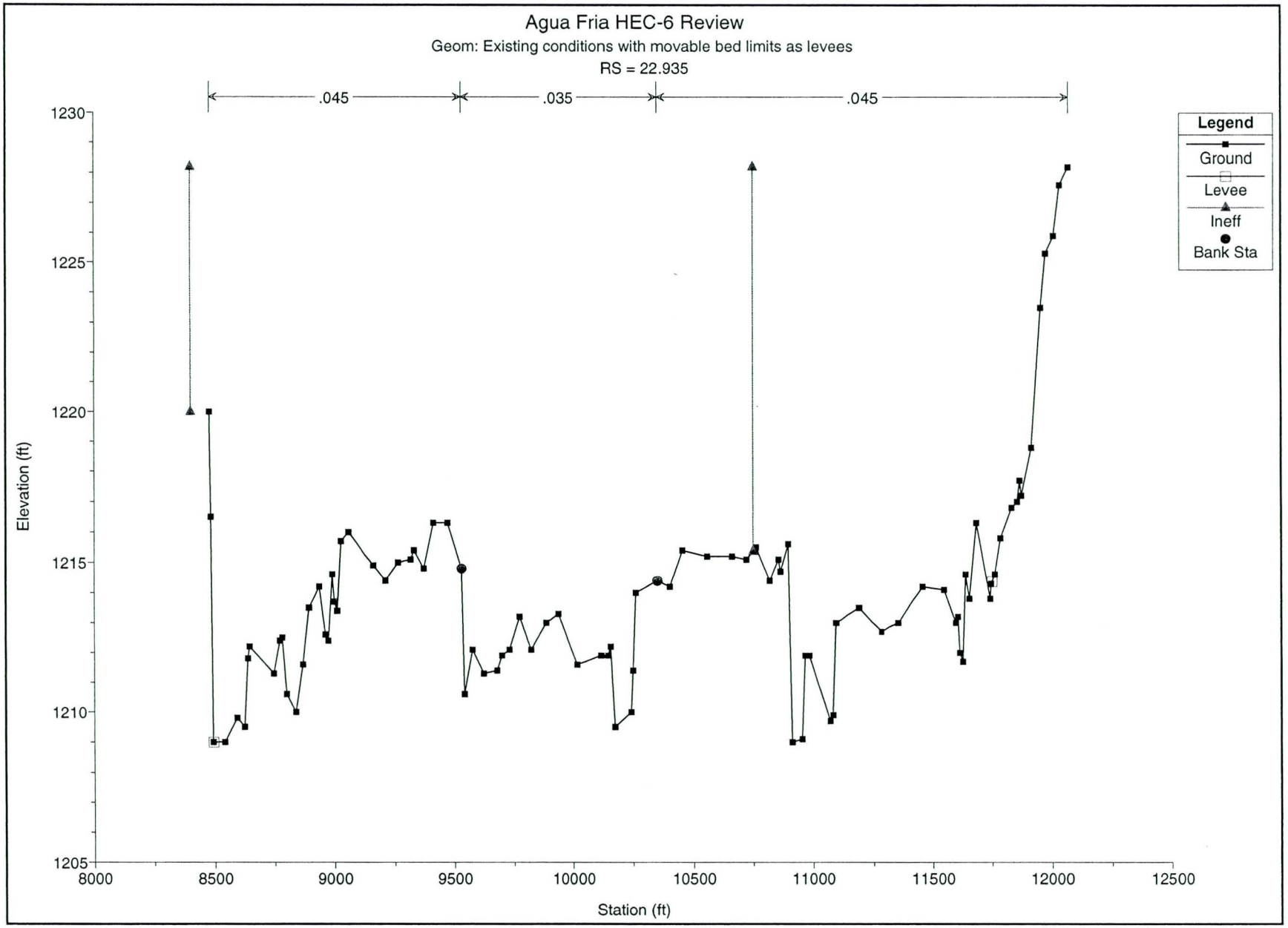

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 24.543
.045
.035
.045
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1265
1260
1255
1250
1245
1240
1235
7000
8000
9000
10000
11000
12000
Station (ft)

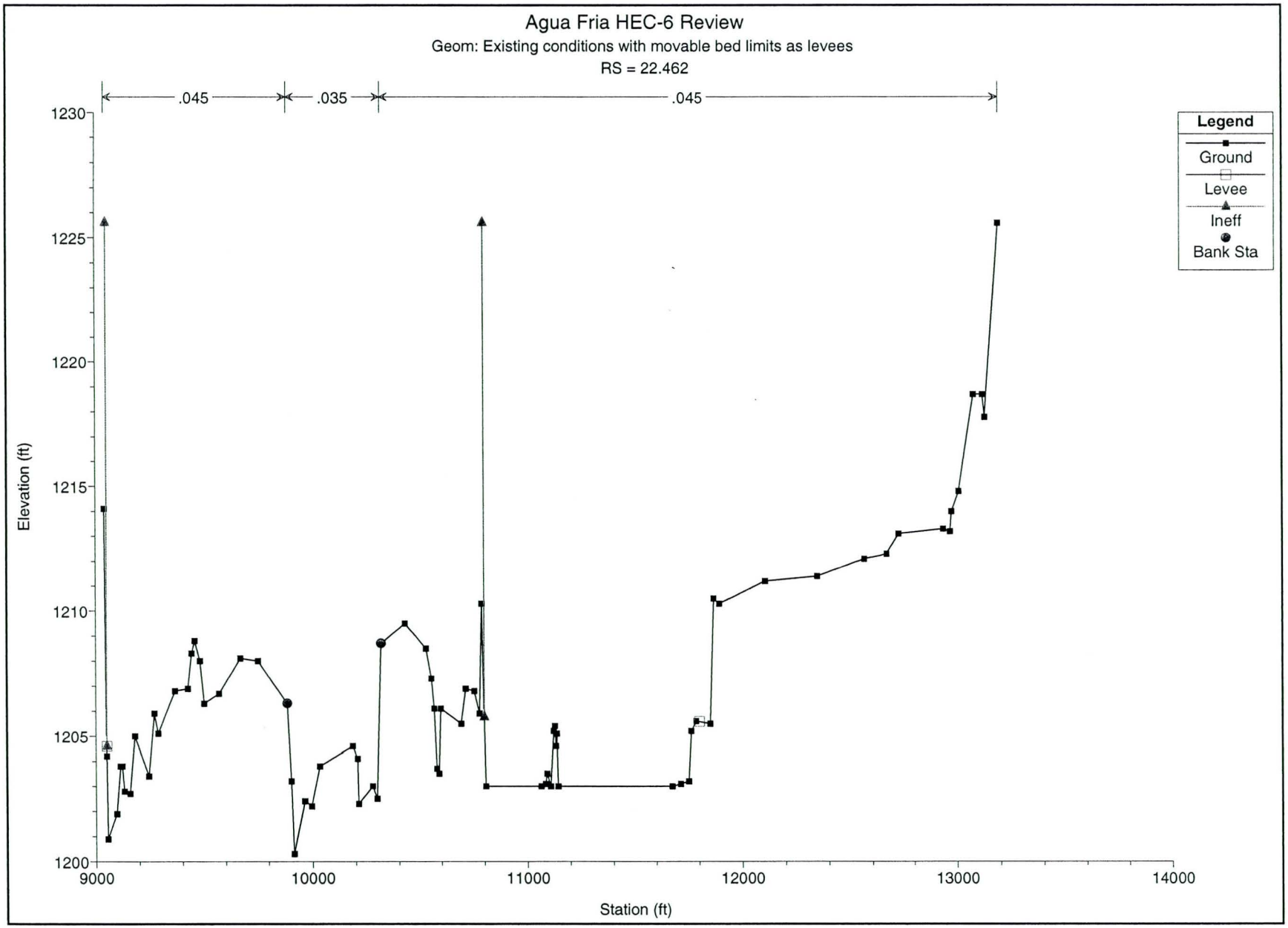

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 24.449
.045
.035
.045
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1270
1265
1260
1255
1250
1245
1240
1235
7000
8000
9000
10000
11000
12000
Station (ft)

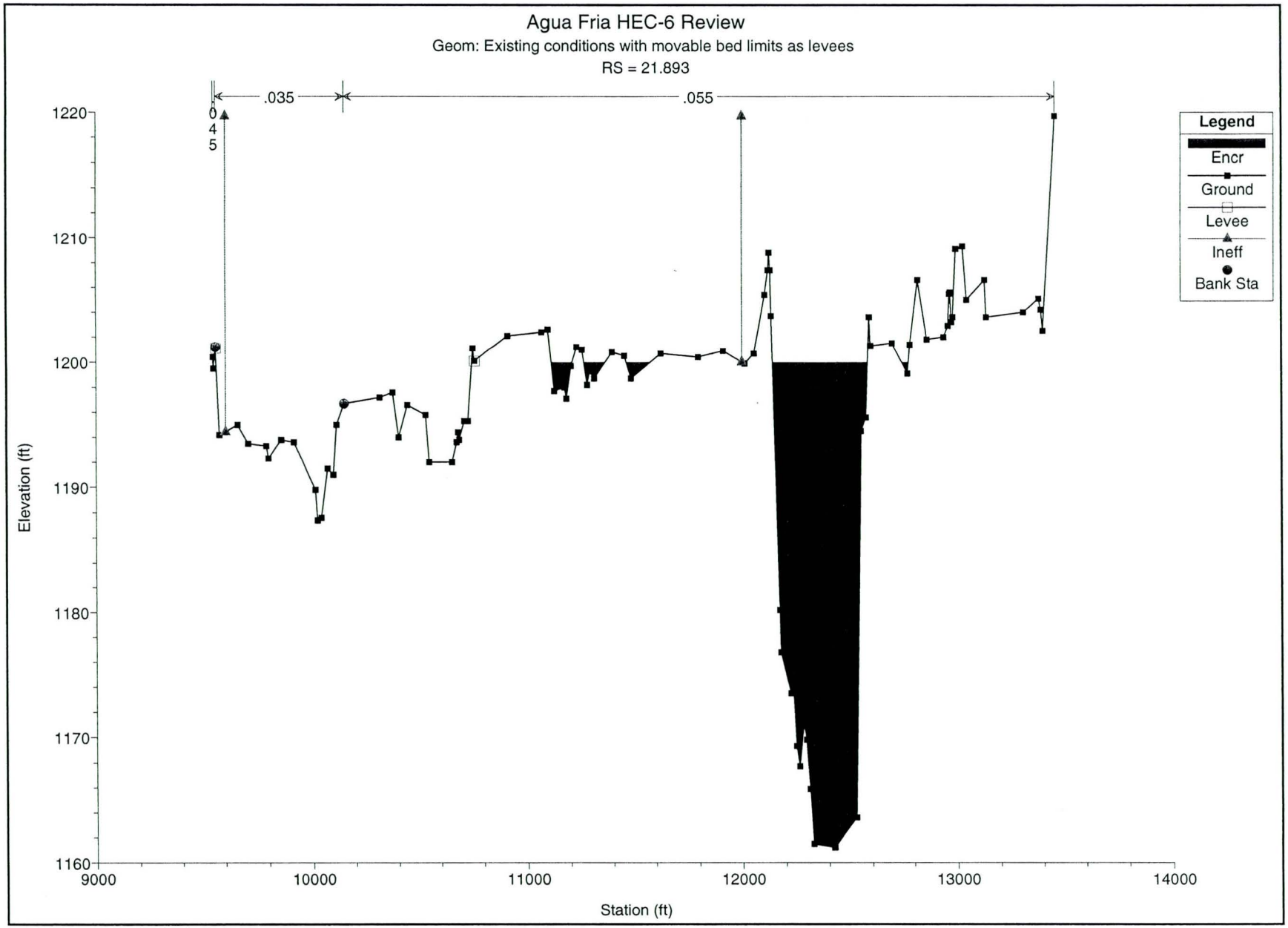

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 23.974
.055
.05
.055
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1280
1270
1260
1250
1240
1230
1220
7000
7500
8000
8500
9000
9500
10000
10500
11000
11500
Station (ft)

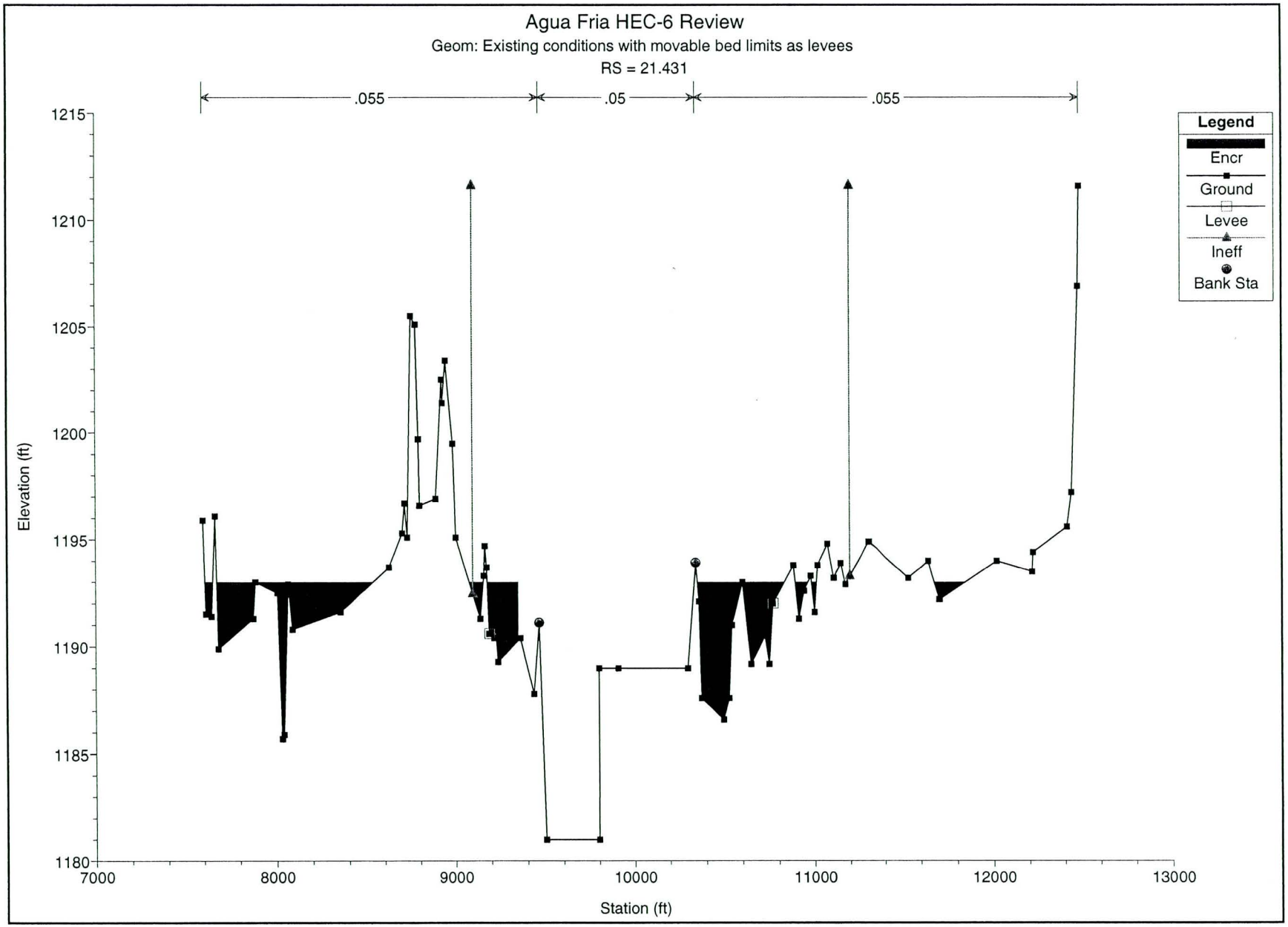

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 23.692
.045
.035
.045
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1280
1260
1240
1220
1200
1180
7500
8000
8500
9000
9500
10000
10500
11000
11500
12000
Station (ft)

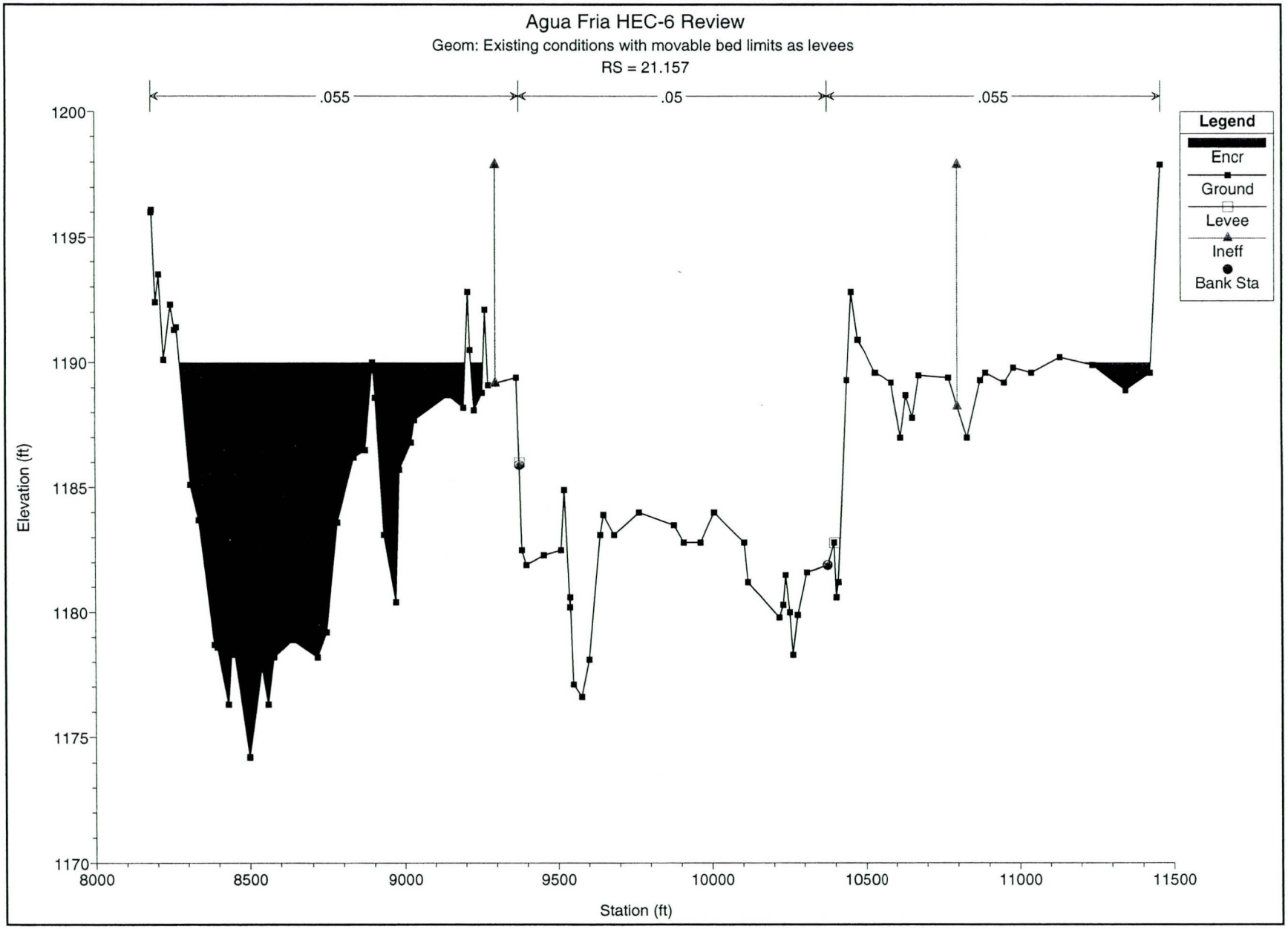

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 23.409
.045
.035
.045
Legend
Encr
Ground
Levee
Bank Sta
Elevation (ft)
1260
1250
1240
1230
1220
1210
7000
8000
9000
10000
11000
12000
13000
Station (ft)

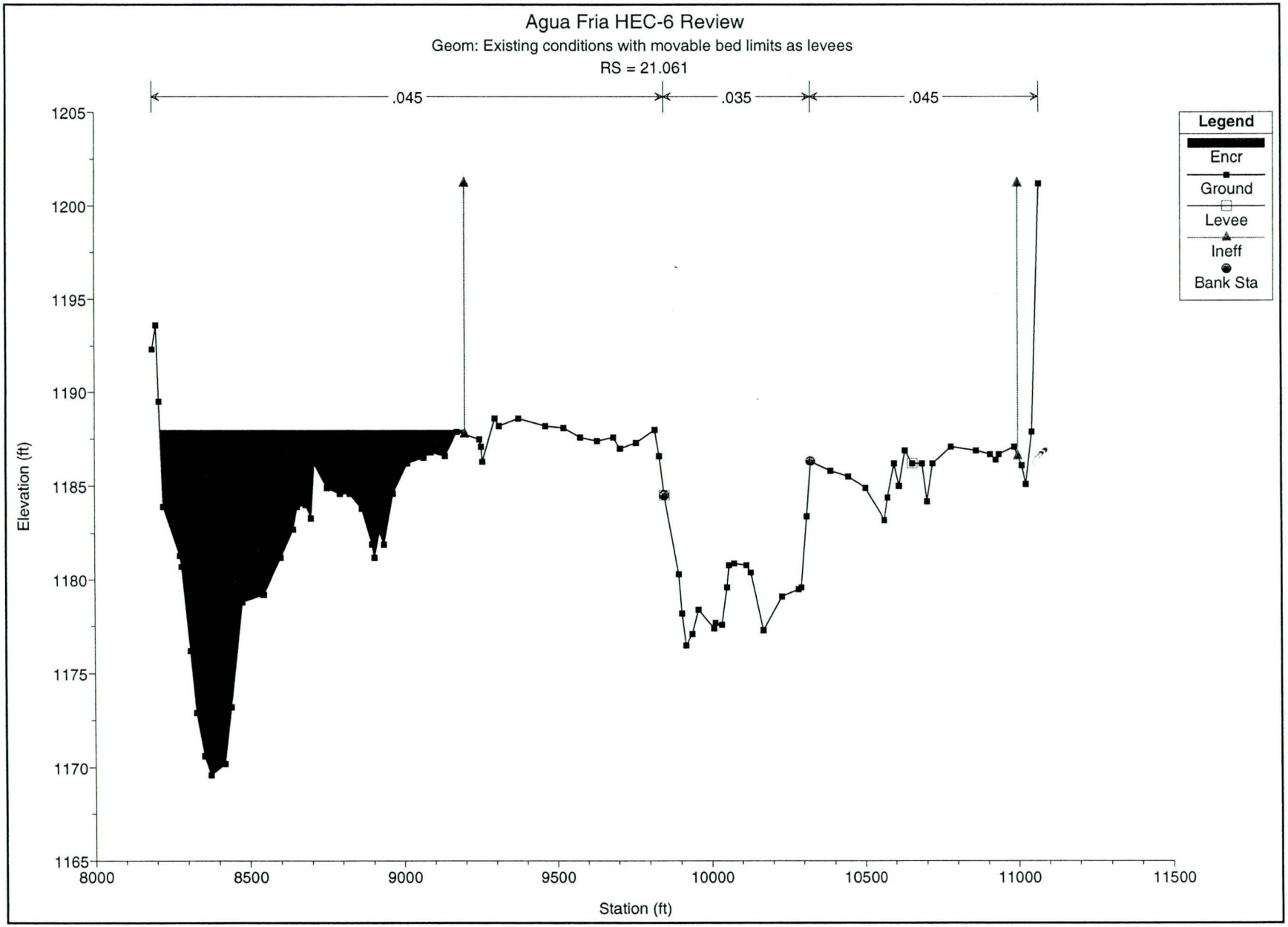

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 22.935
.045
.035
.045
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1230
1225
1220
1215
1210
1205
8000
8500
9000
9500
10000
10500
11000
11500
12000
12500
Station (ft)

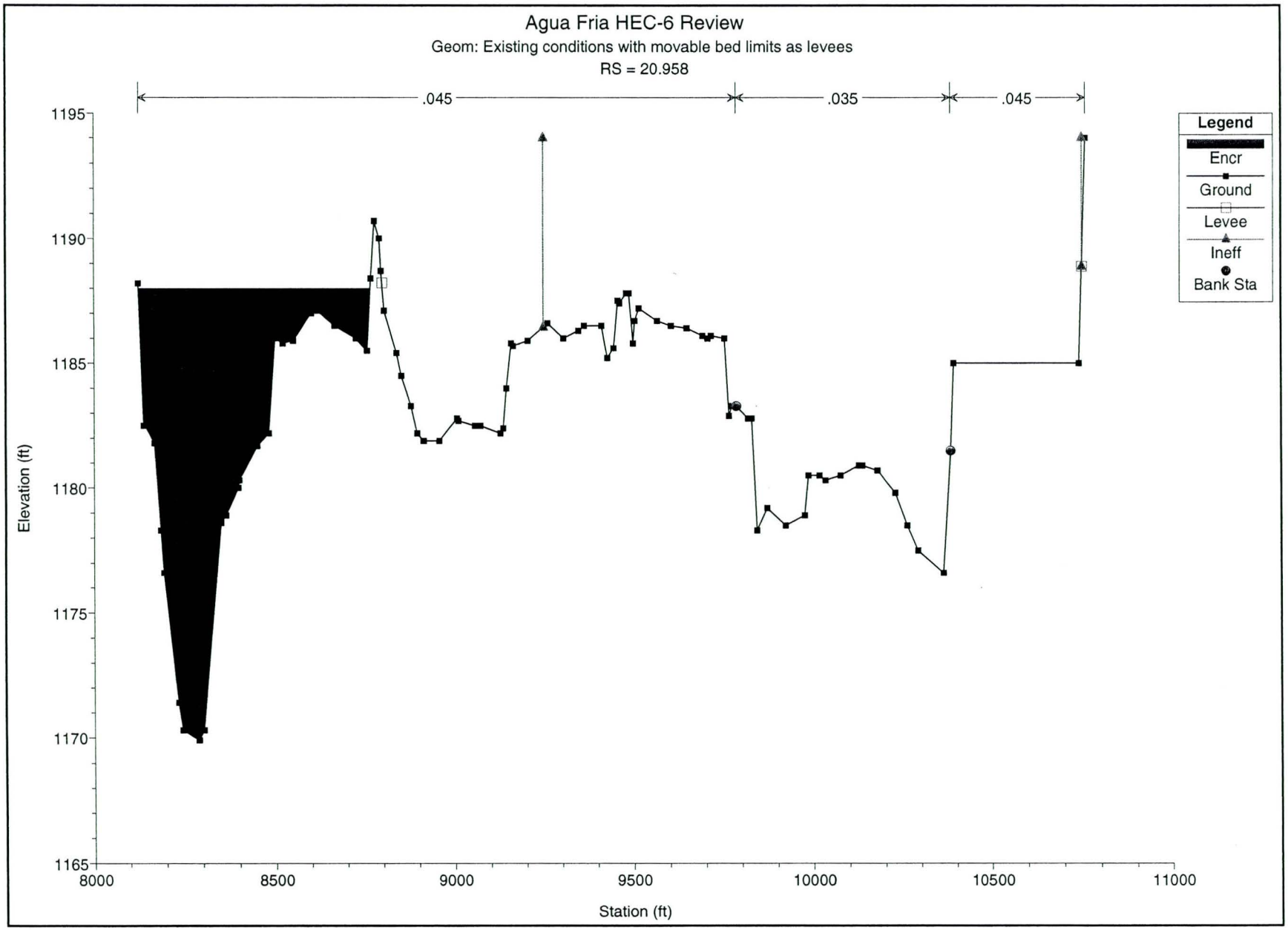

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 22.462
.045
.035
.045
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1230
1225
1220
1215
1210
1205
1200
9000
10000
11000
12000
13000
14000
Station (ft)

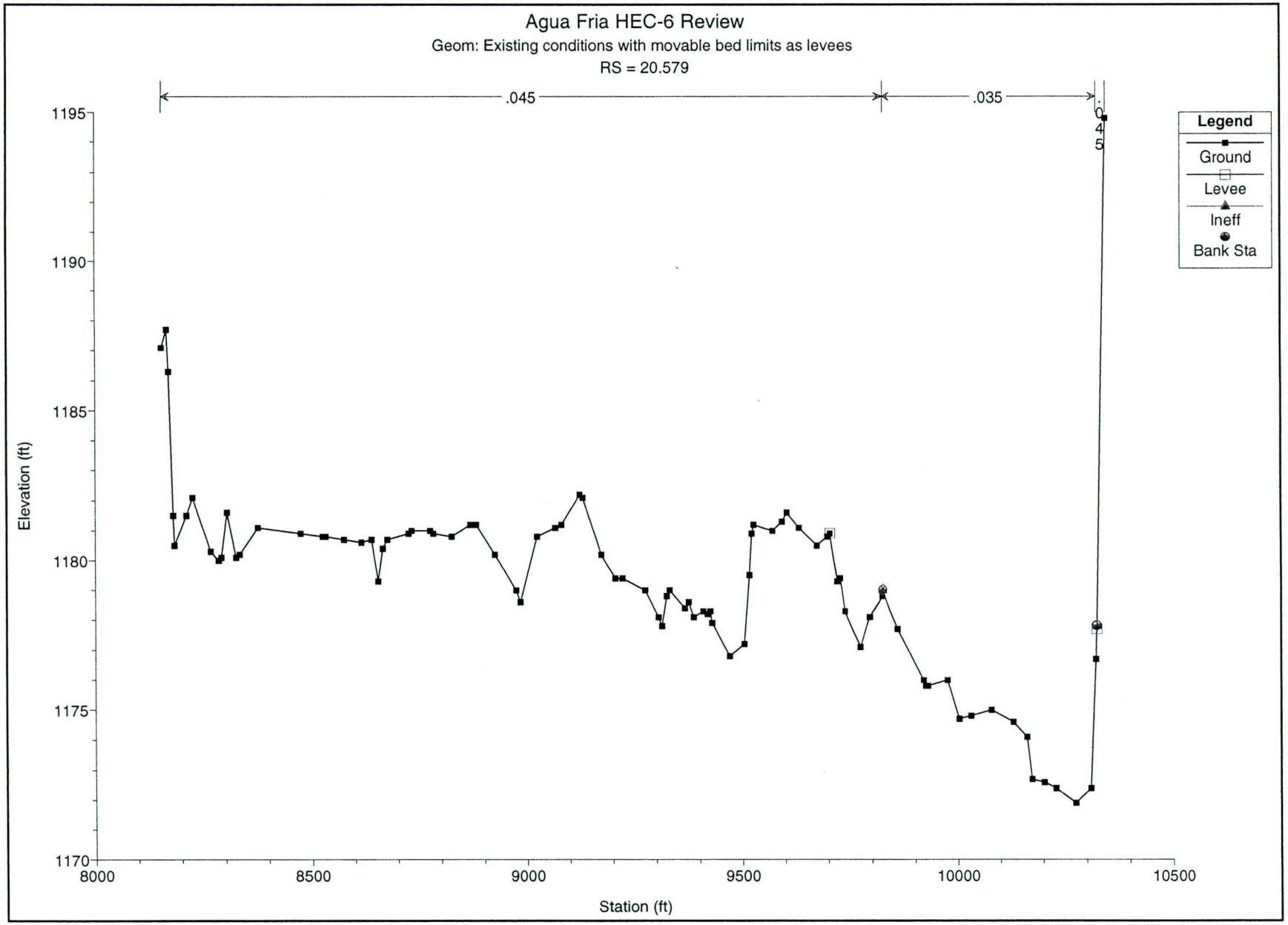

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 21.893
.035
.055
0
4
5
Legend
Encr
Ground
Levee
Ineff
Bank Sta
1220
1210
1200
1190
1180
1170
1160
Elevation (ft)
9000
10000
11000
12000
13000
14000
Station (ft)

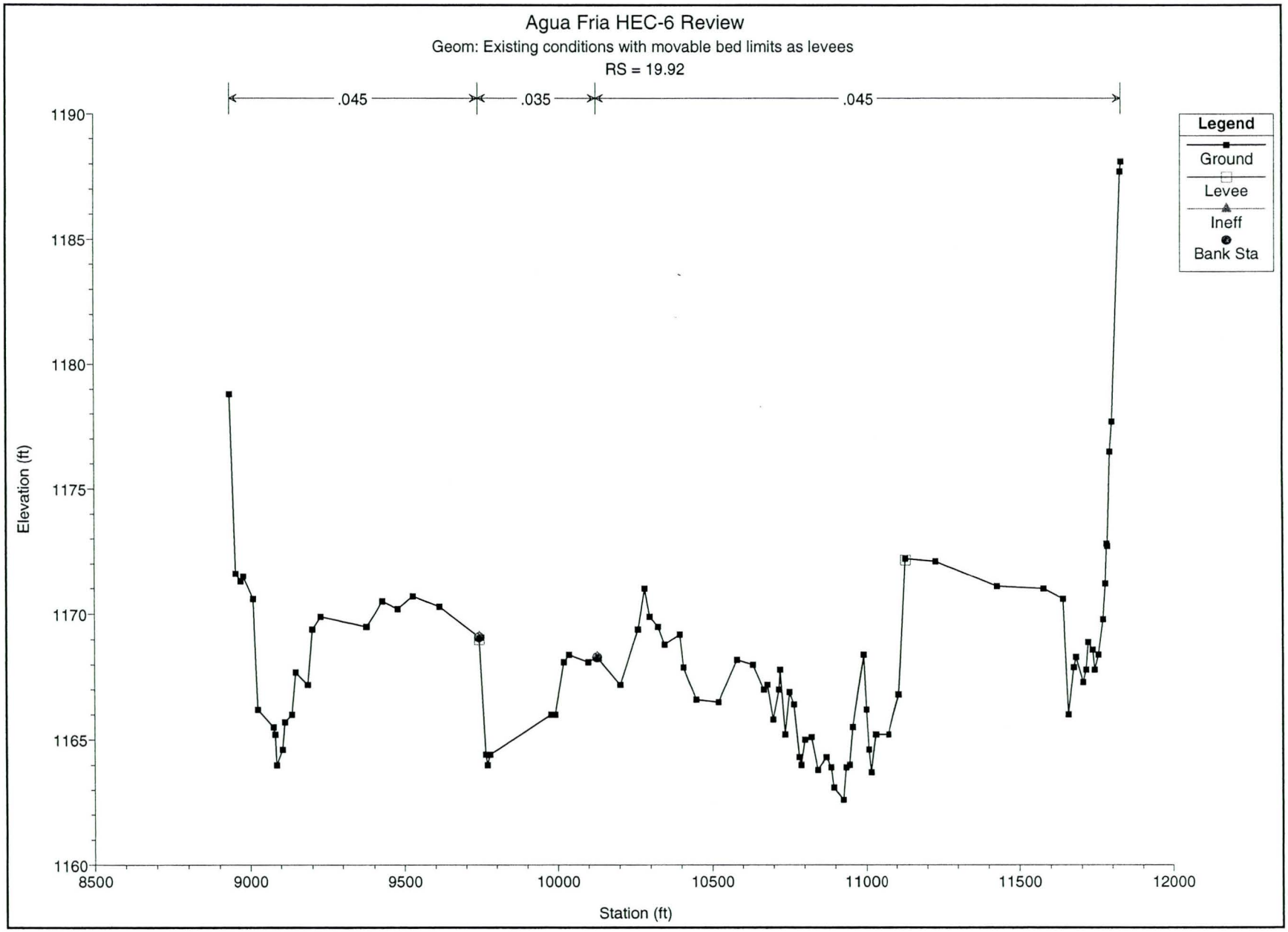

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 21.431
.055
.05
.055
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1215
1210
1205
1200
1195
1190
1185
1180
7000
8000
9000
10000
11000
12000
13000
Station (ft)

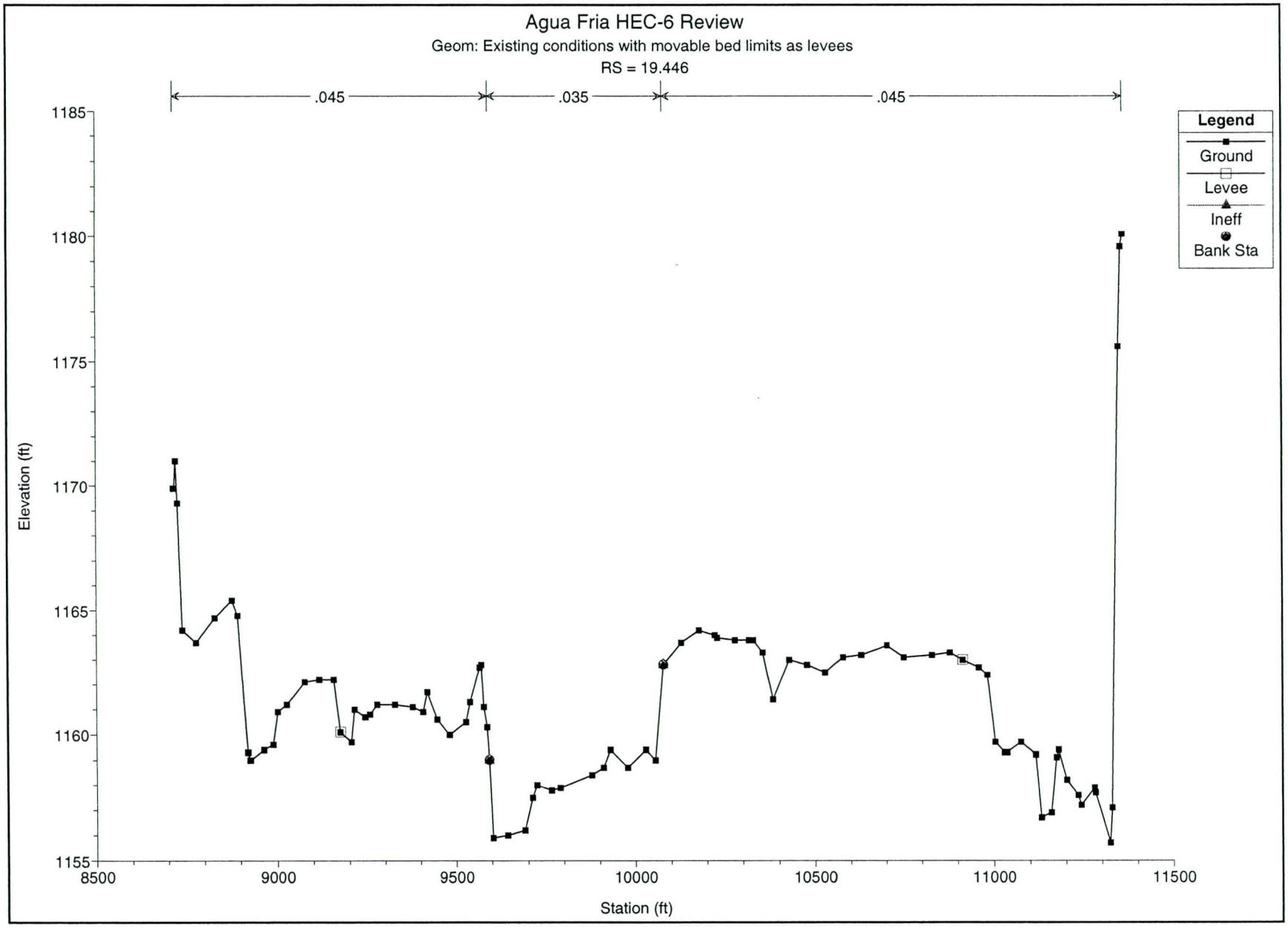

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 21.157
.055
.05
.055
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1200
1195
1190
1185
1180
1175
1170
8000
8500
9000
9500
10000
10500
11000
11500
Station (ft)

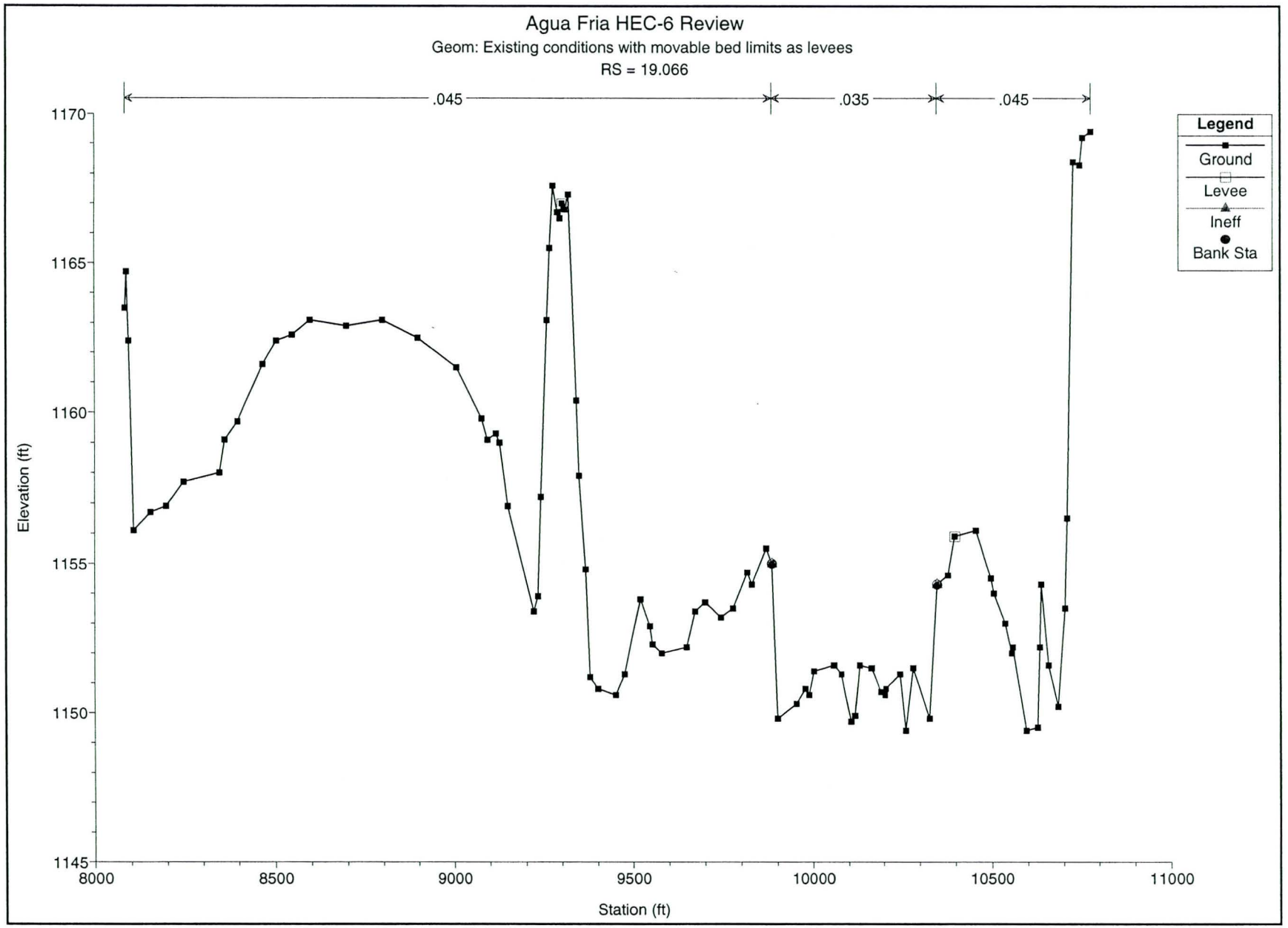

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 21.061
.045
.035
.045
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1205
1200
1195
1190
1185
1180
1175
1170
1165
8000
8500
9000
9500
10000
10500
11000
11500
Station (ft)

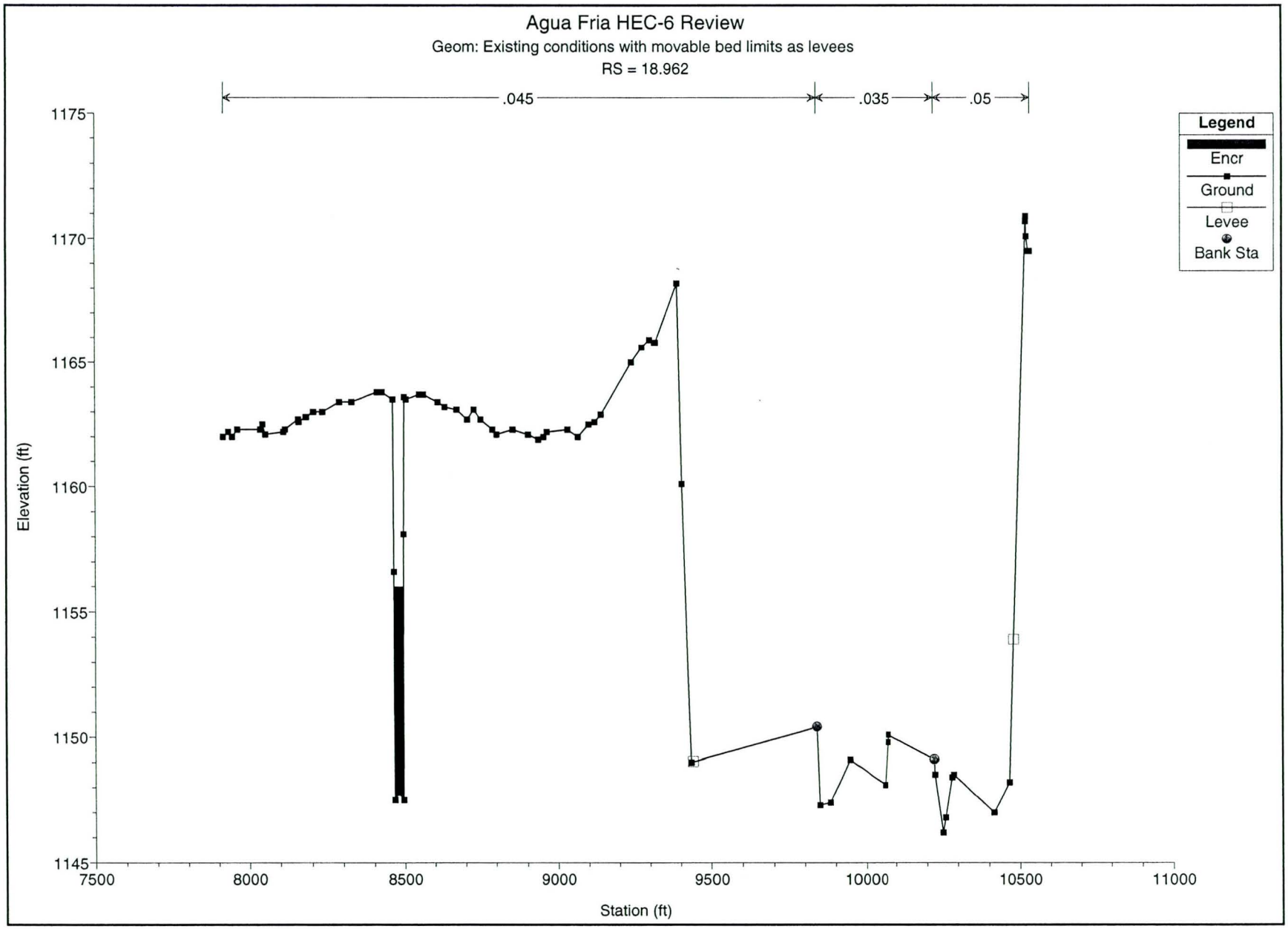

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 20.958
.045
.035
.045
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1195
1190
1185
1180
1175
1170
1165
8000
8500
9000
9500
10000
10500
11000
Station (ft)

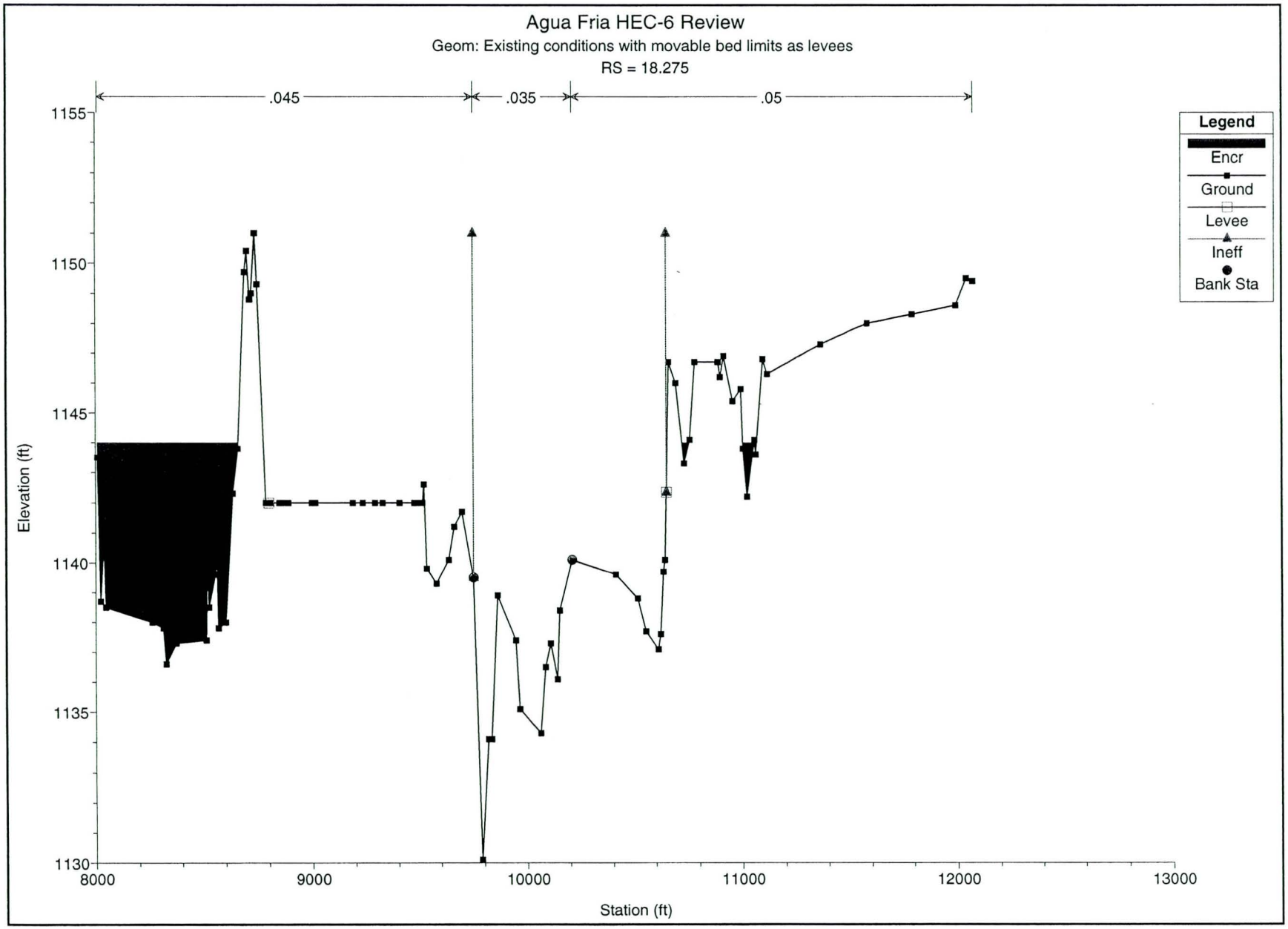

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 20.579
.045
.035
.045
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1195
1190
1185
1180
1175
1170
8000
8500
9000
9500
10000
10500
Station (ft)

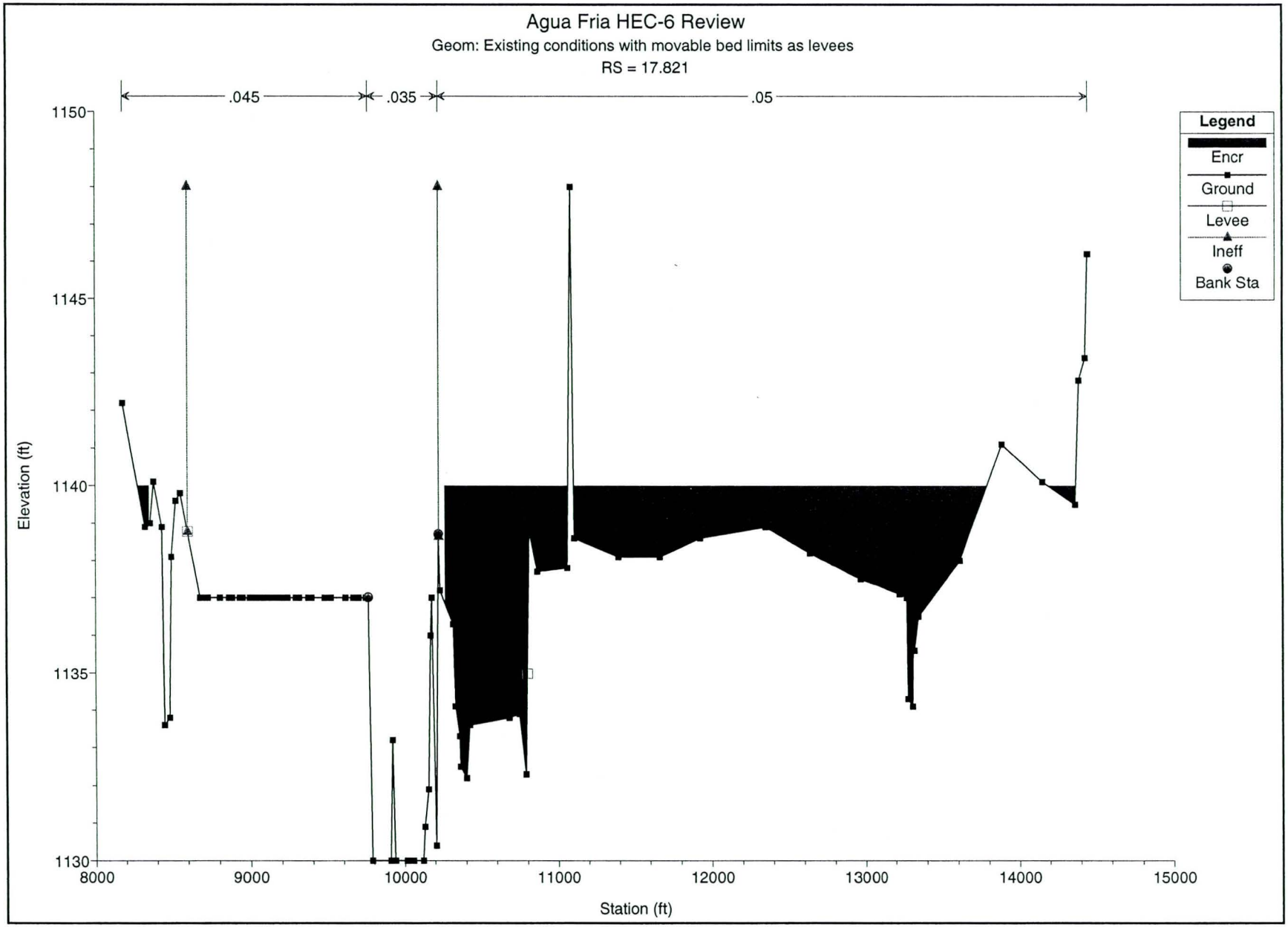

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 19.92
.045
.035
.045
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1190
1185
1180
1175
1170
1165
1160
8500
9000
9500
10000
10500
11000
11500
12000
Station (ft)

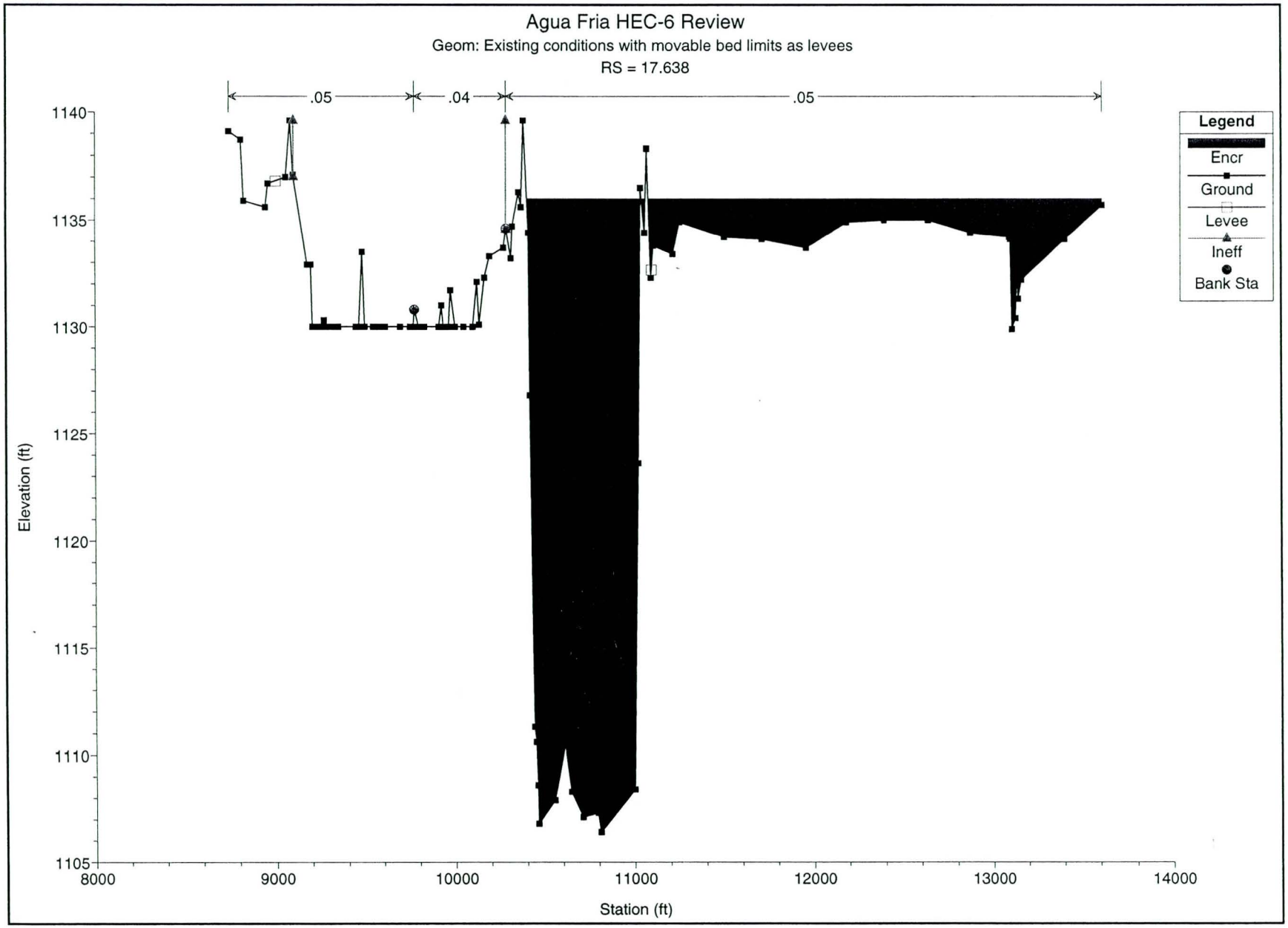

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 19.446
.045
.035
.045
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1185
1180
1175
1170
1165
1160
1155
8500
9000
9500
10000
10500
11000
11500
Station (ft)

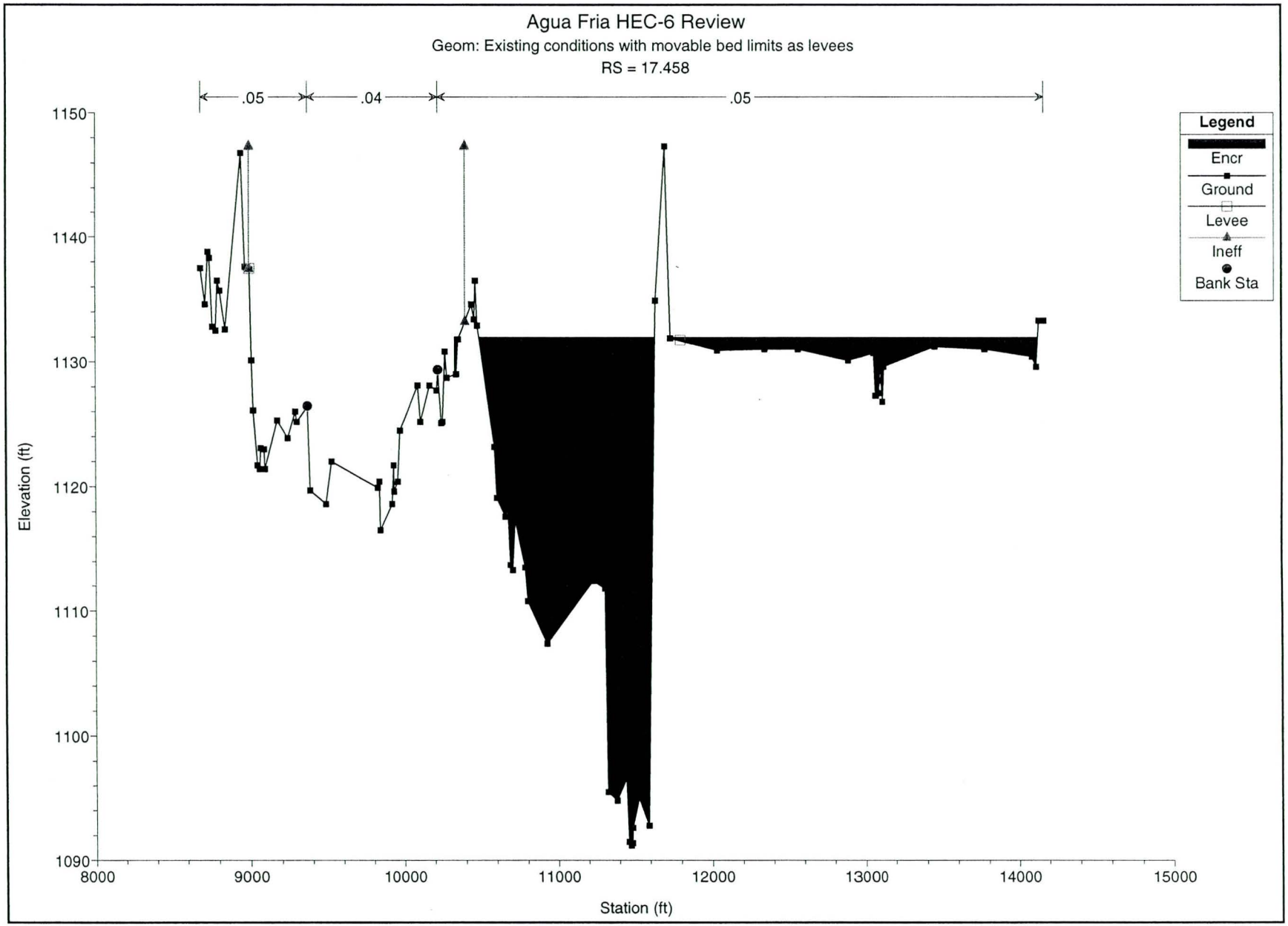

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 19.066
.045
.035
.045
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1170
1165
1160
1155
1150
1145
8000
8500
9000
9500
10000
10500
11000
Station (ft)

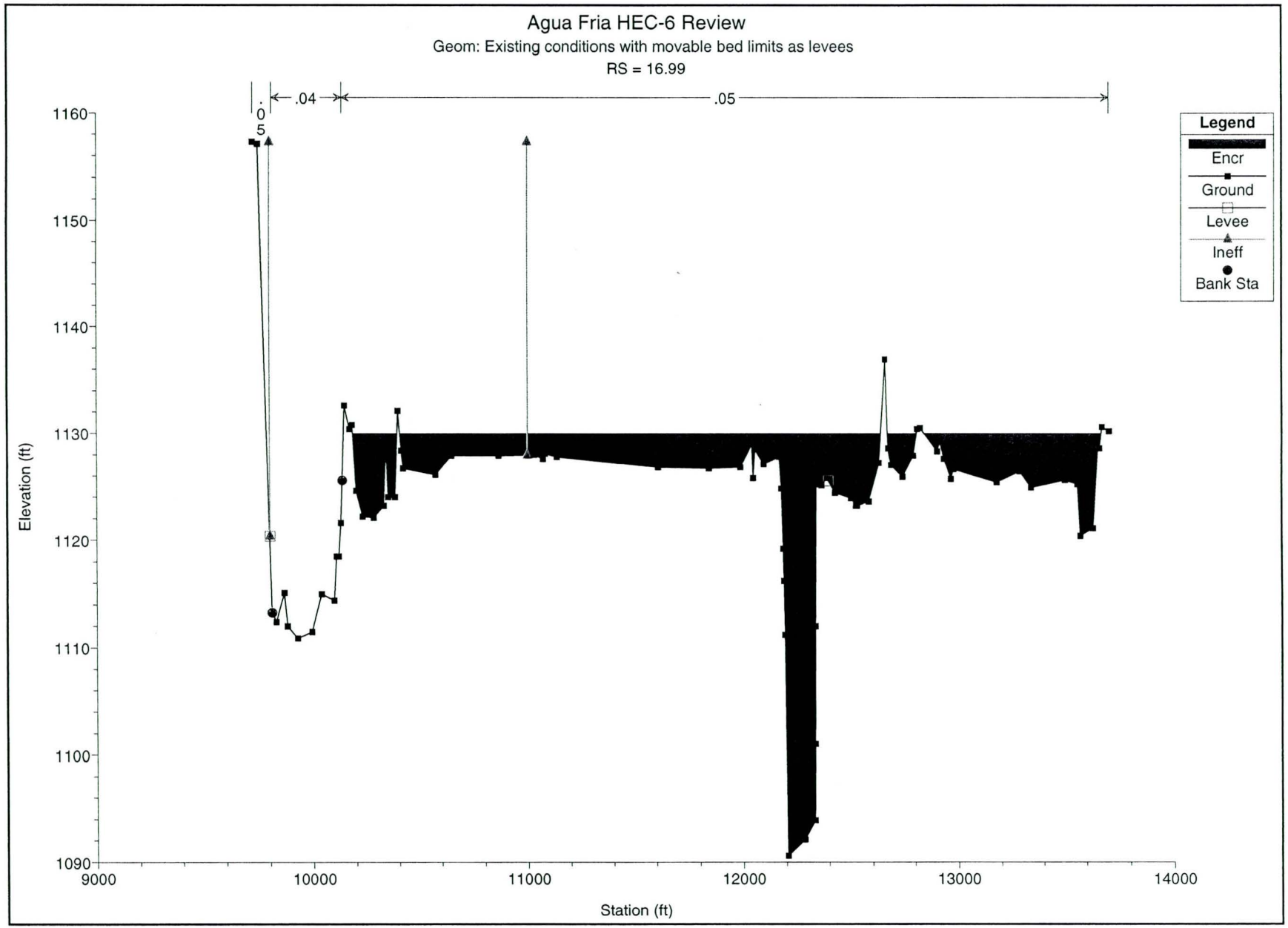

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 18.962
.045
.035
.05
Legend
Encr
Ground
Levee
Bank Sta
Elevation (ft)
1175
1170
1165
1160
1155
1150
1145
7500
8000
8500
9000
9500
10000
10500
11000
Station (ft)

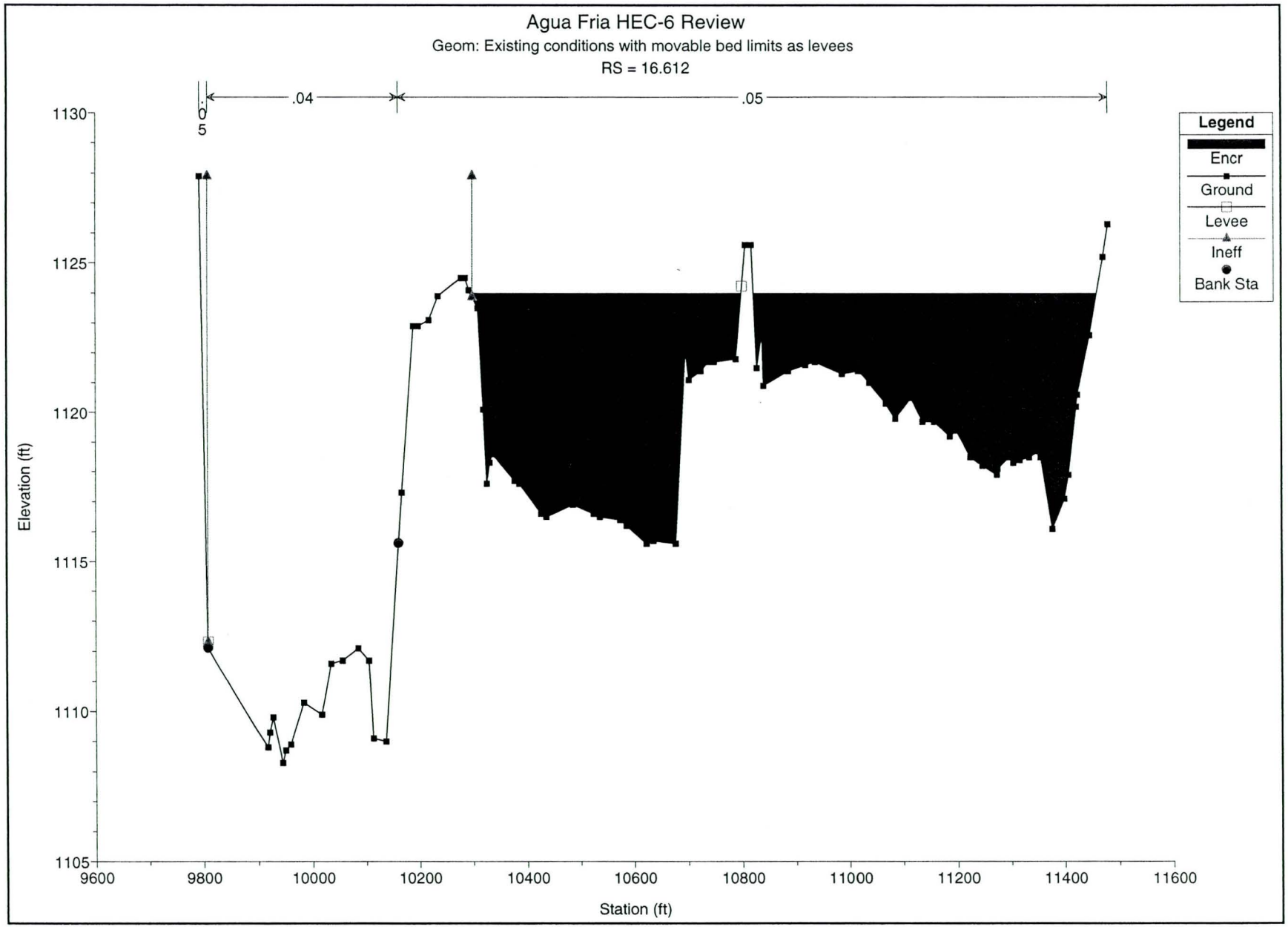

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 18.275
.045
.035
.05
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1155
1150
1145
1140
1135
1130
8000
9000
10000
11000
12000
13000
Station (ft)

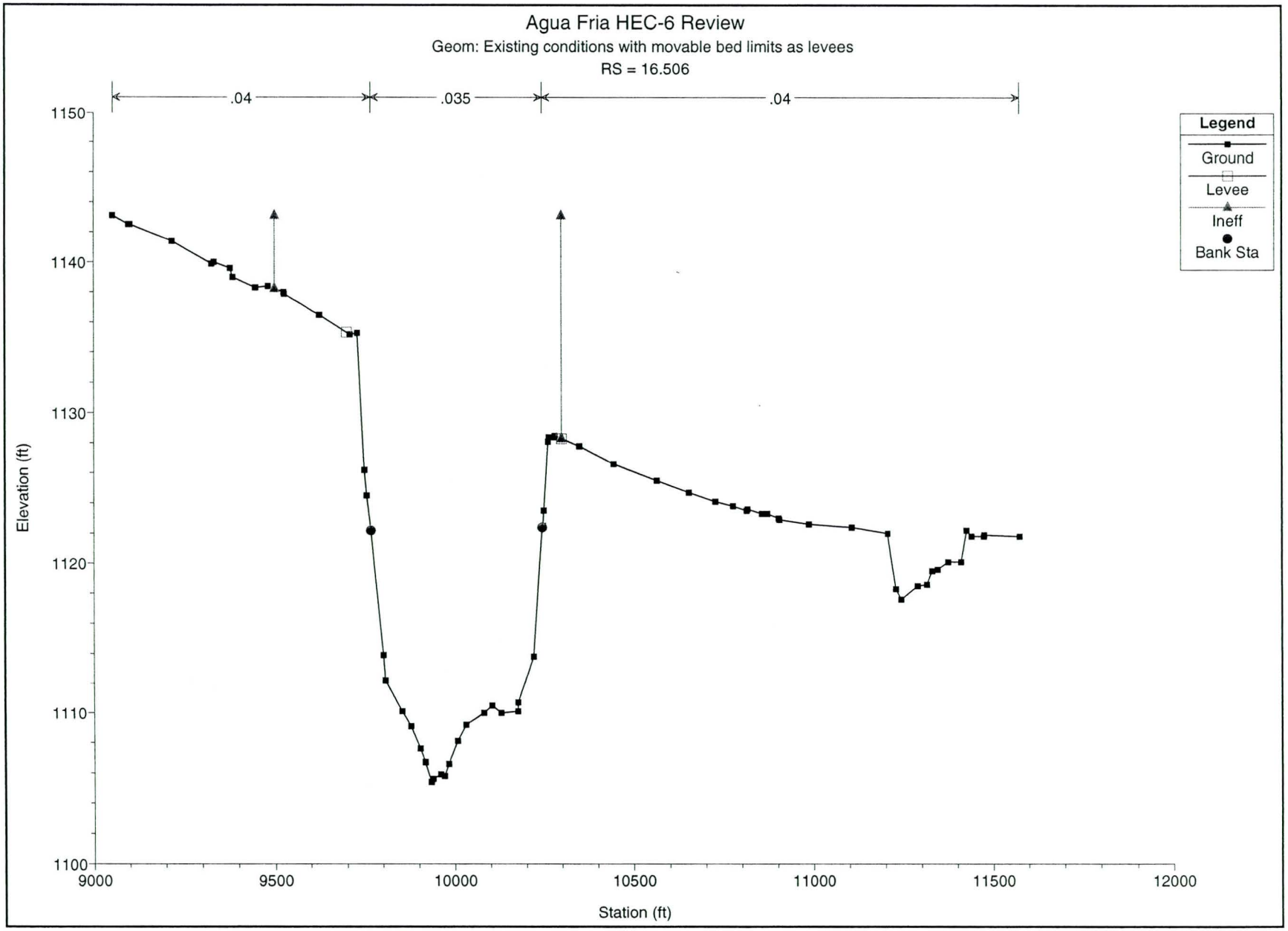

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 17.821
.045
.035
.05
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1150
1145
1140
1135
1130
8000
9000
10000
11000
12000
13000
14000
15000
Station (ft)

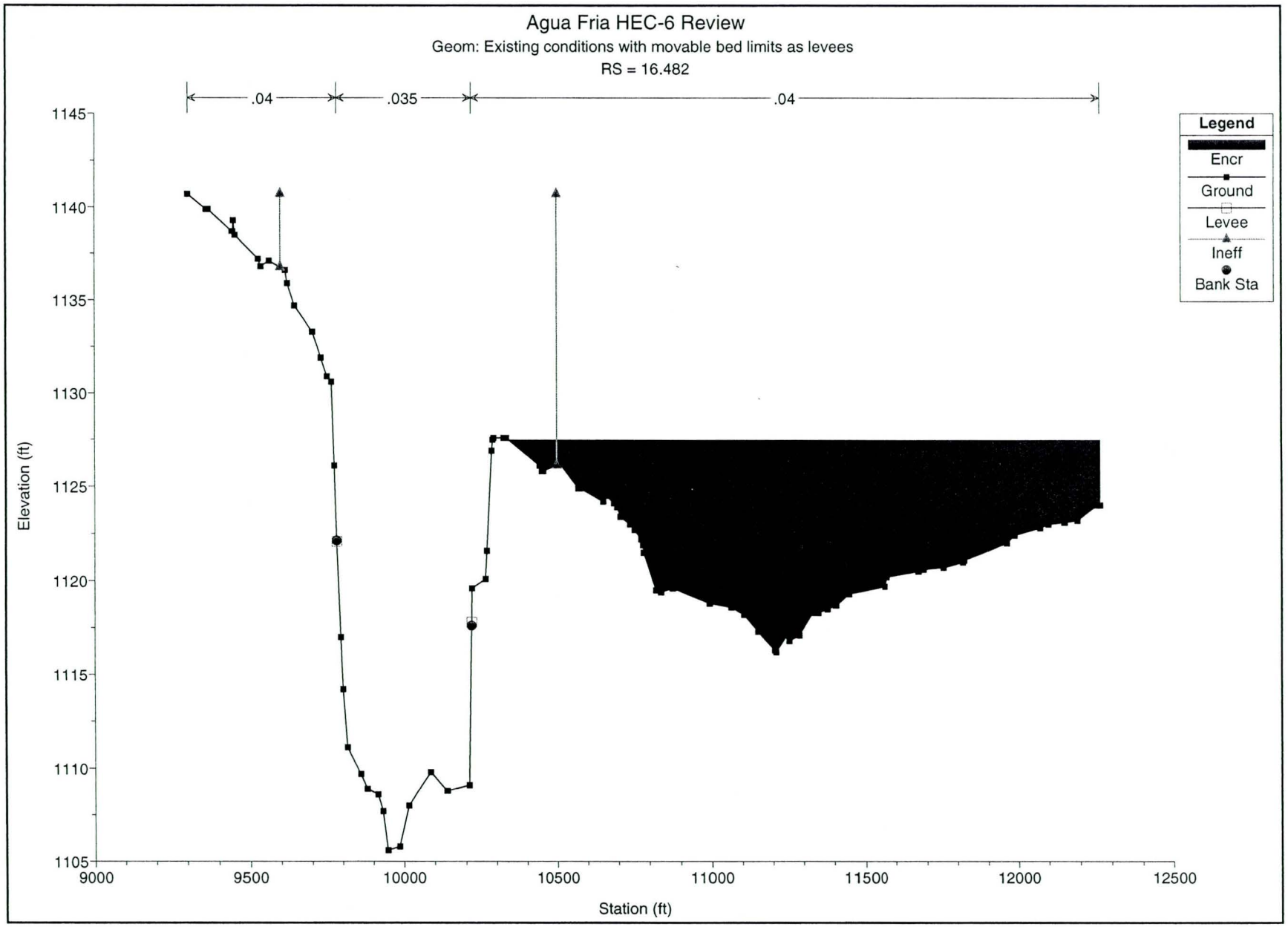

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 17.638
.05
.04
.05
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1140
1135
1130
1125
1120
1115
1110
1105
8000
9000
10000
11000
12000
13000
14000
Station (ft)

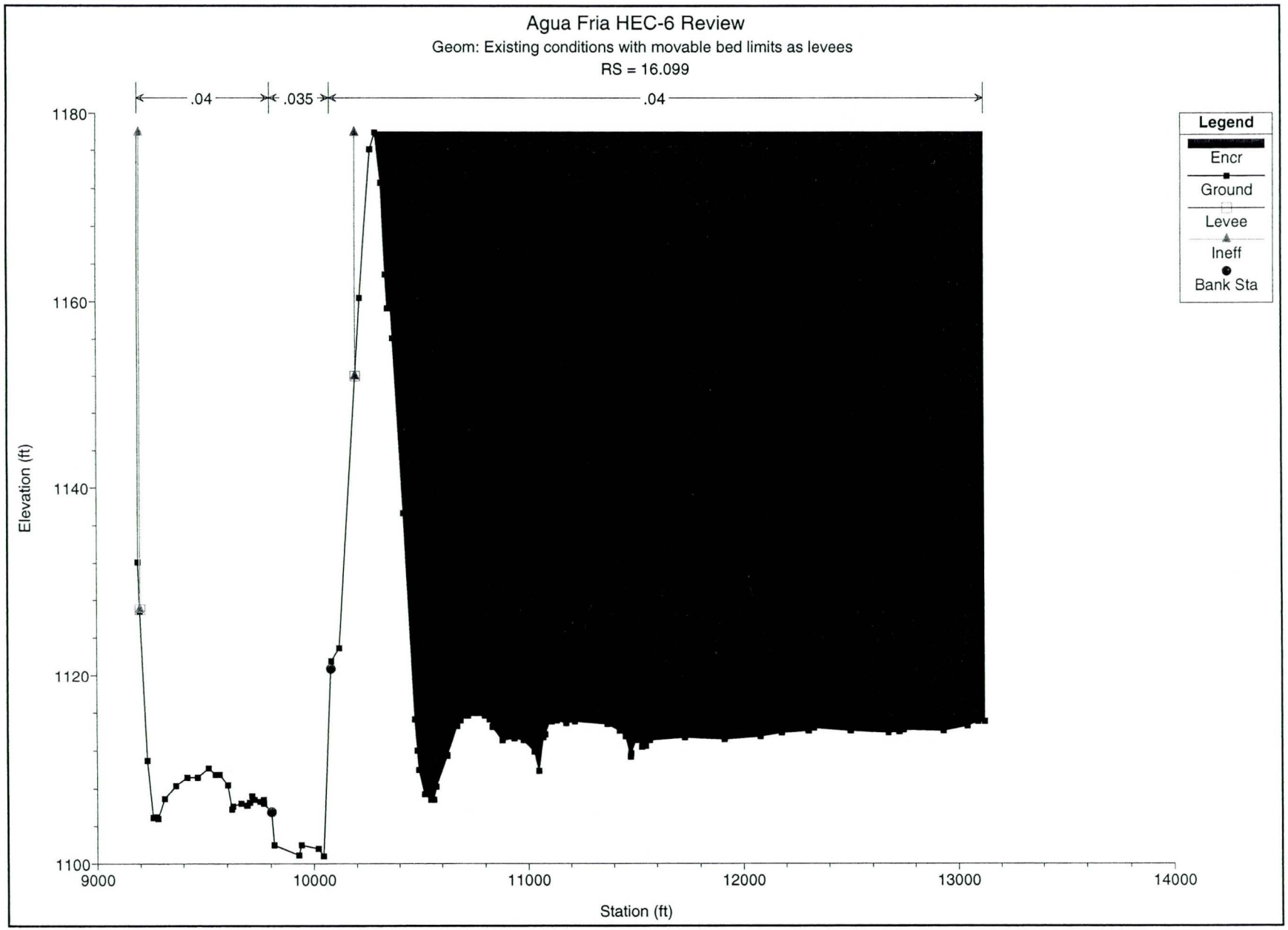

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 17.458
.05
.04
.05
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1150
1140
1130
1120
1110
1100
1090
8000
9000
10000
11000
12000
13000
14000
15000
Station (ft)

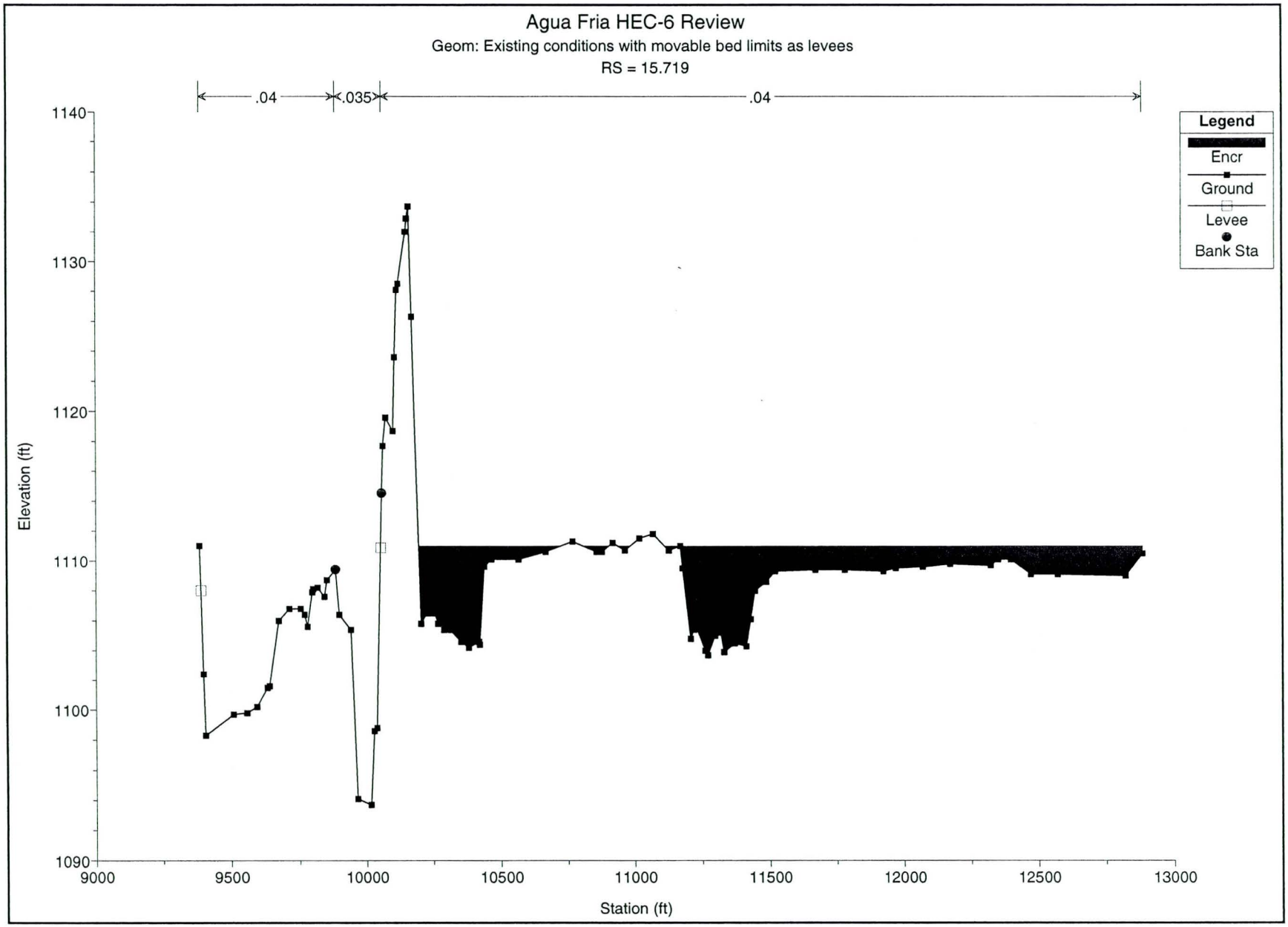

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 16.99
.05
.04
.05
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1160
1150
1140
1130
1120
1110
1100
1090
9000
10000
11000
12000
13000
14000
Station (ft)

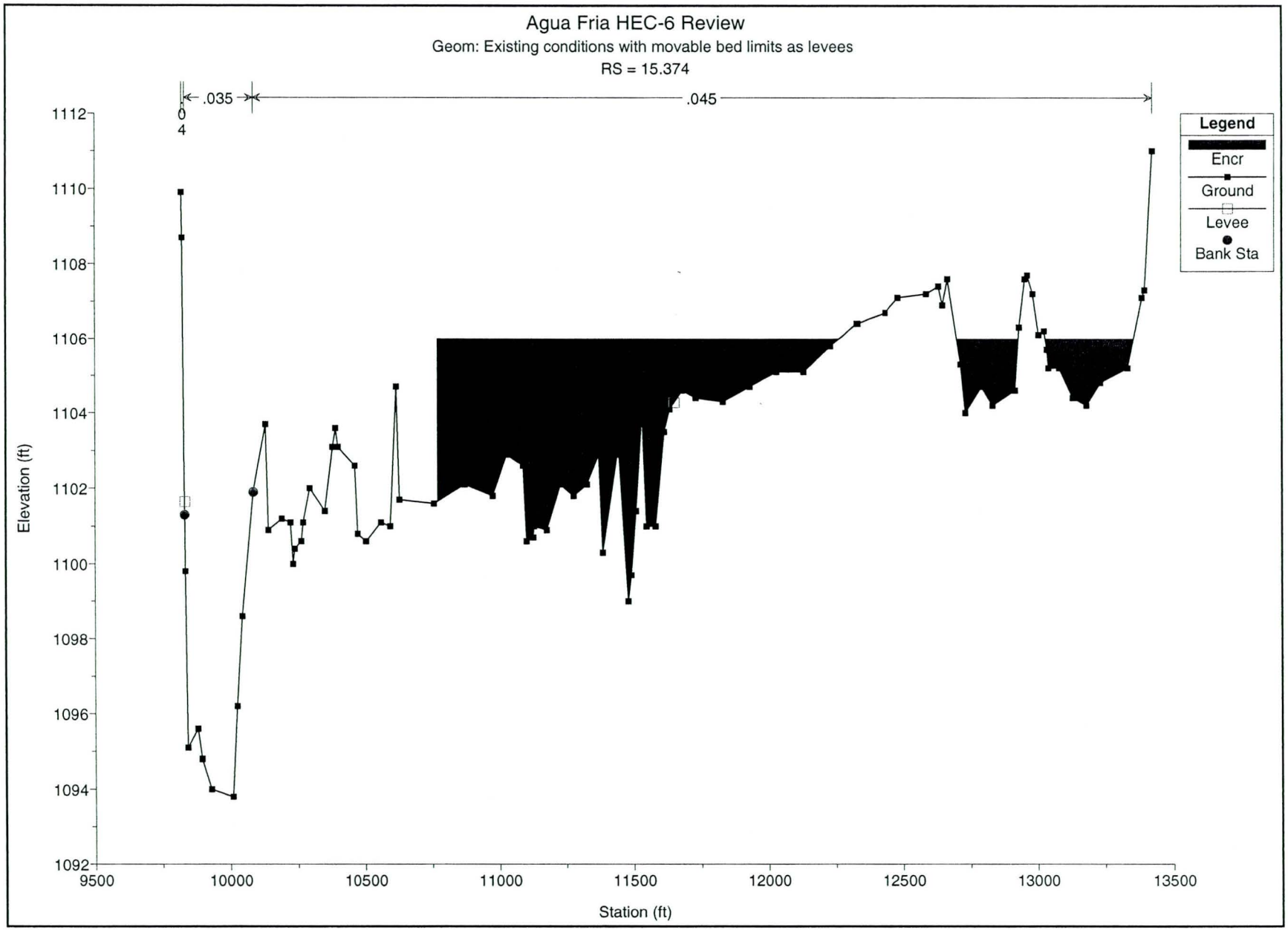

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 16.612
.05
.04
.05
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1130
1125
1120
1115
1110
1105
9600
9800
10000
10200
10400
10600
10800
11000
11200
11400
11600
Station (ft)

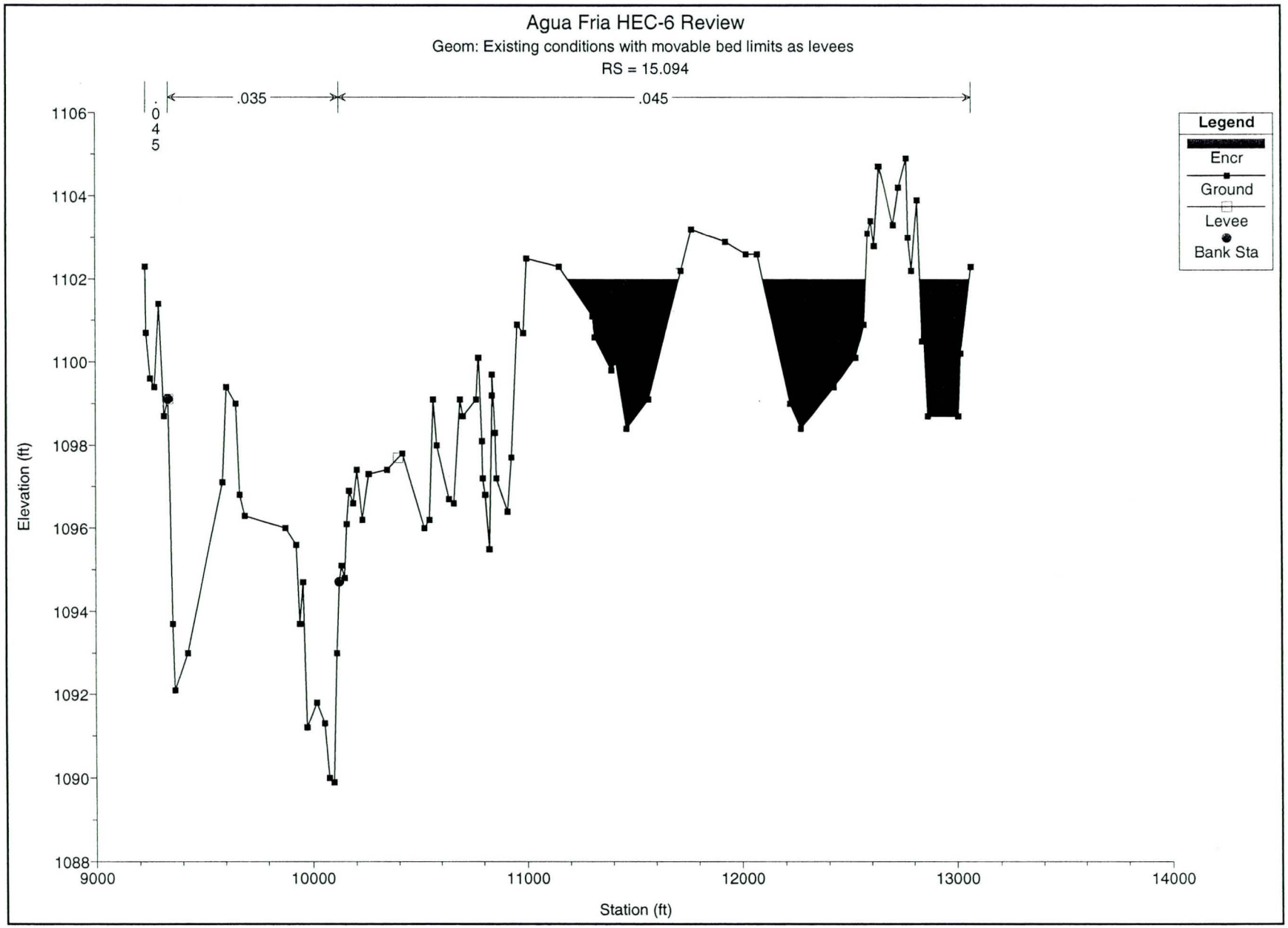

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 16.506
.04
.035
.04
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1150
1140
1130
1120
1110
1100
9000
9500
10000
10500
11000
11500
12000
Station (ft)

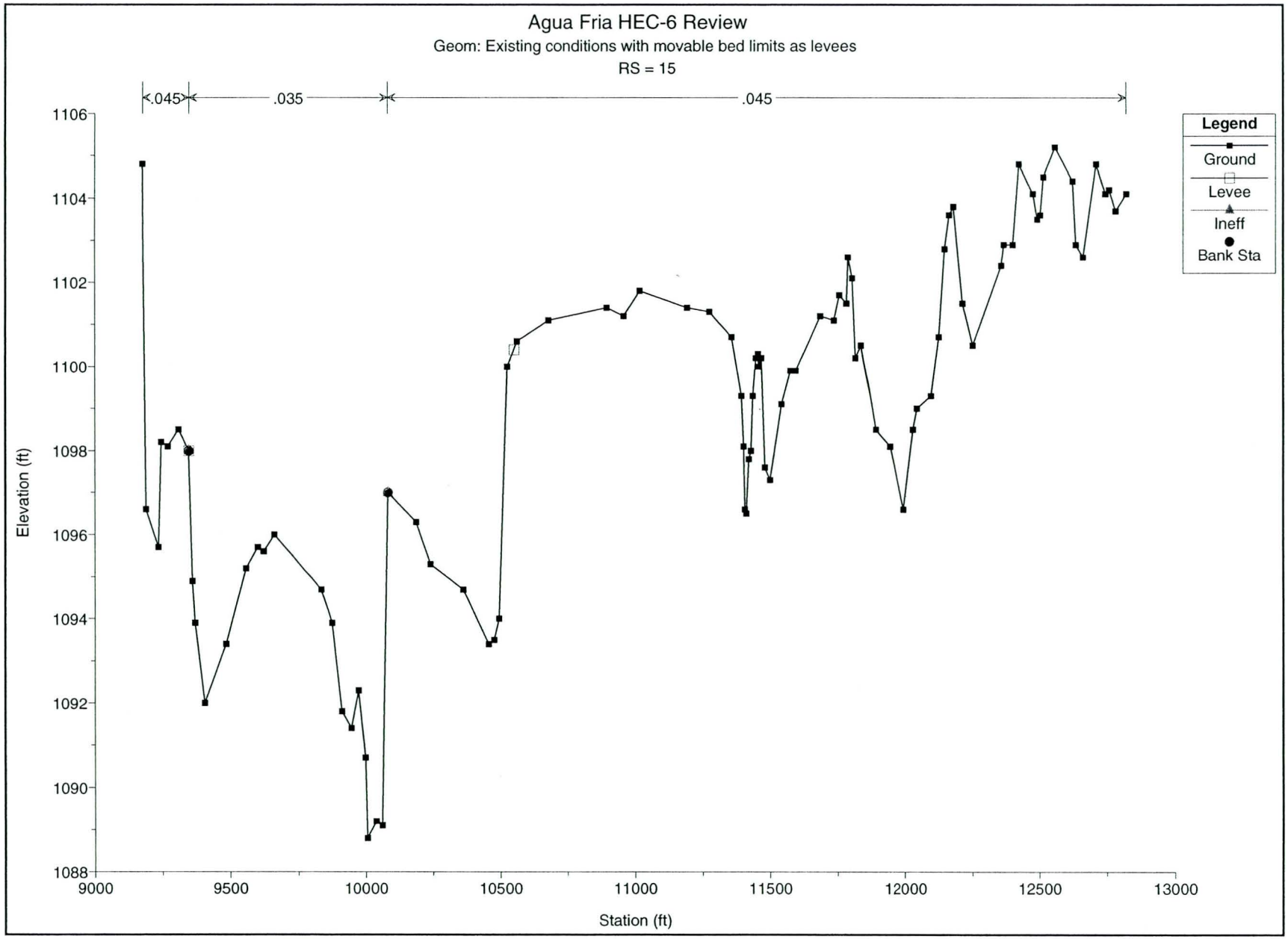

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 16.482
.04
.035
.04
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1145
1140
1135
1130
1125
1120
1115
1110
1105
9000
9500
10000
10500
11000
11500
12000
12500
Station (ft)

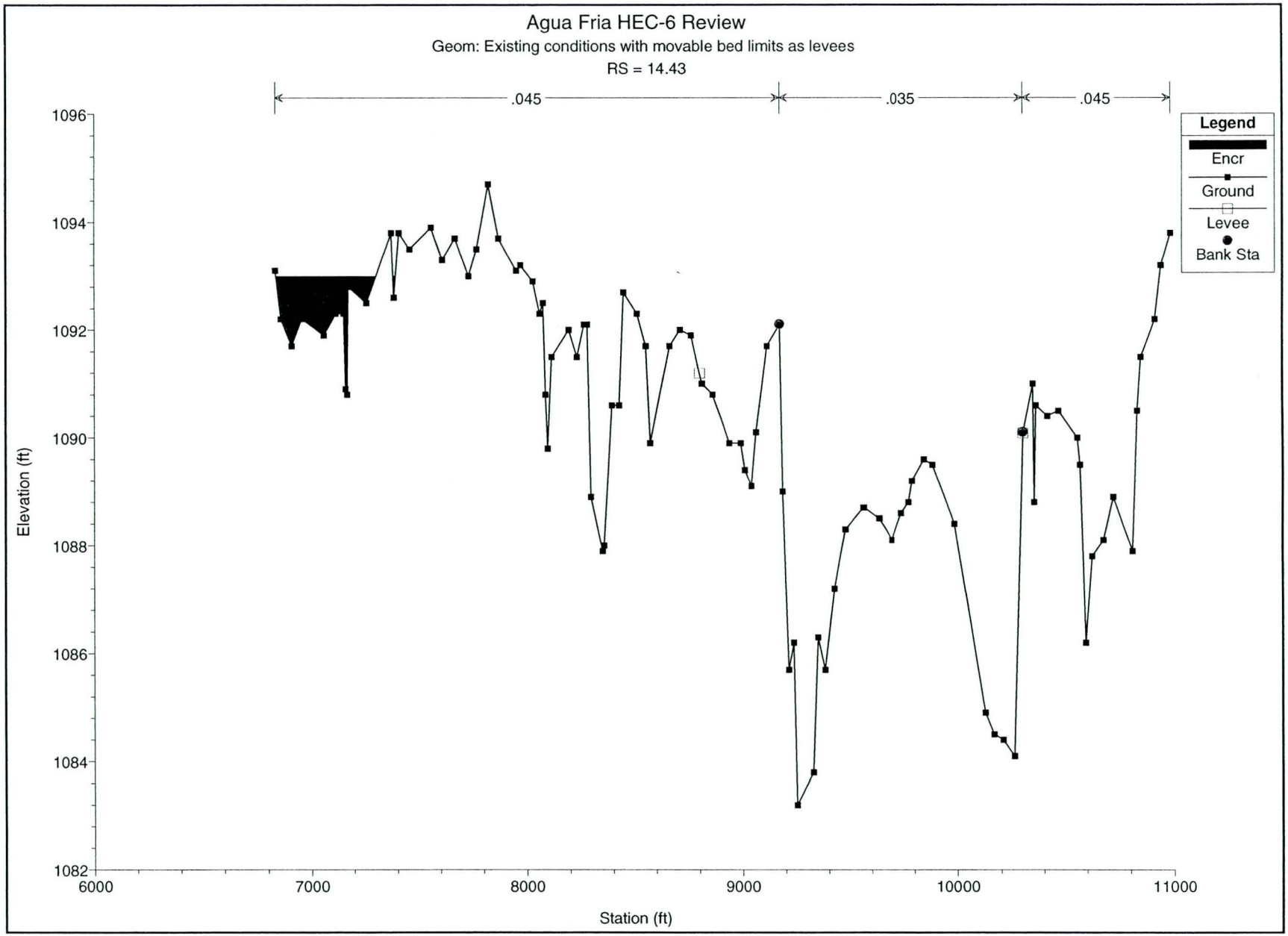

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 16.099
.04
.035
.04
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1180
1160
1140
1120
1100
9000
10000
11000
12000
13000
14000
Station (ft)

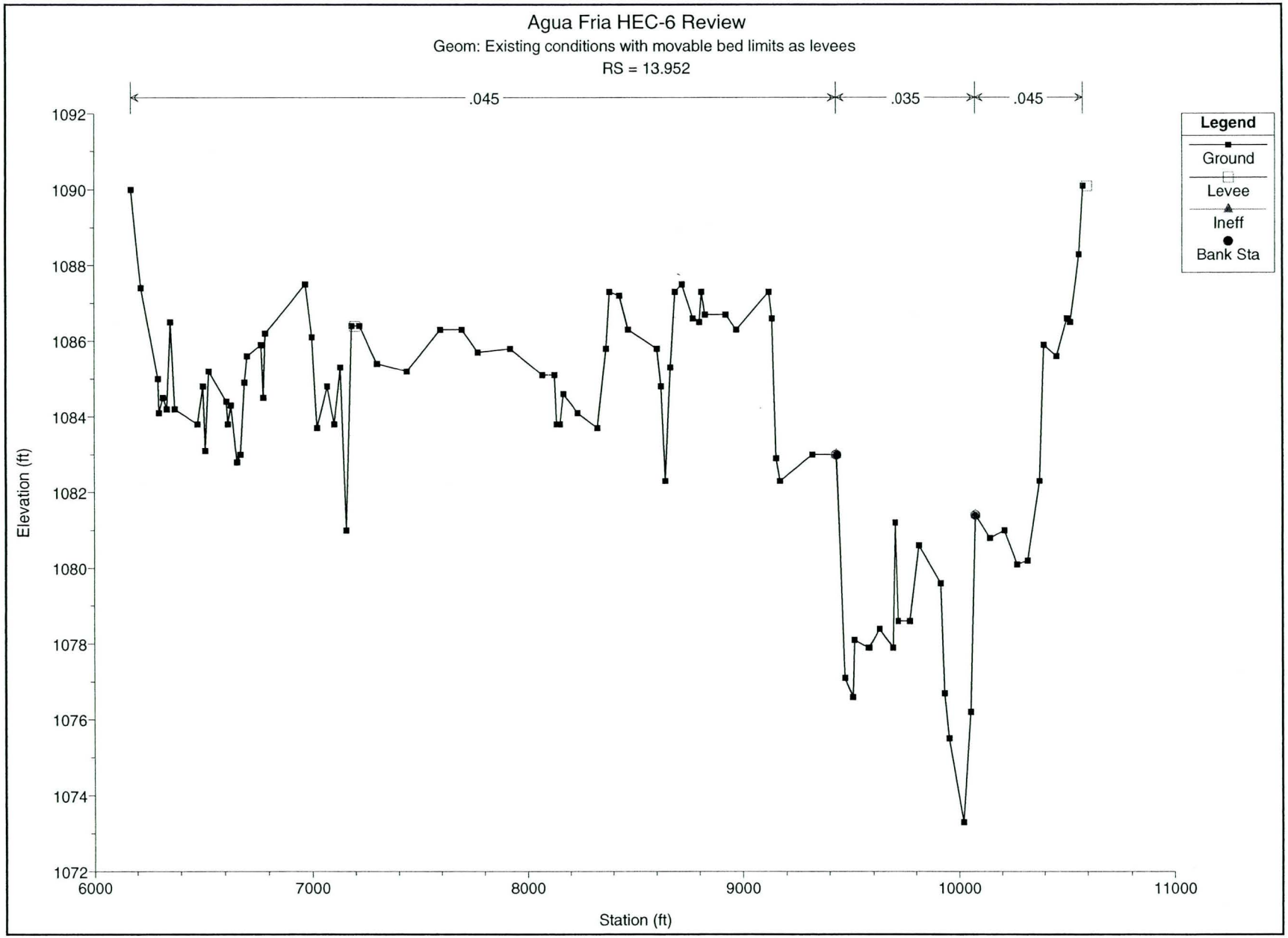

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 15.719
.04
.035
.04
Legend
Encr
Ground
Levee
Bank Sta
Elevation (ft)
1140
1130
1120
1110
1100
1090
9000
9500
10000
10500
11000
11500
12000
12500
13000
Station (ft)

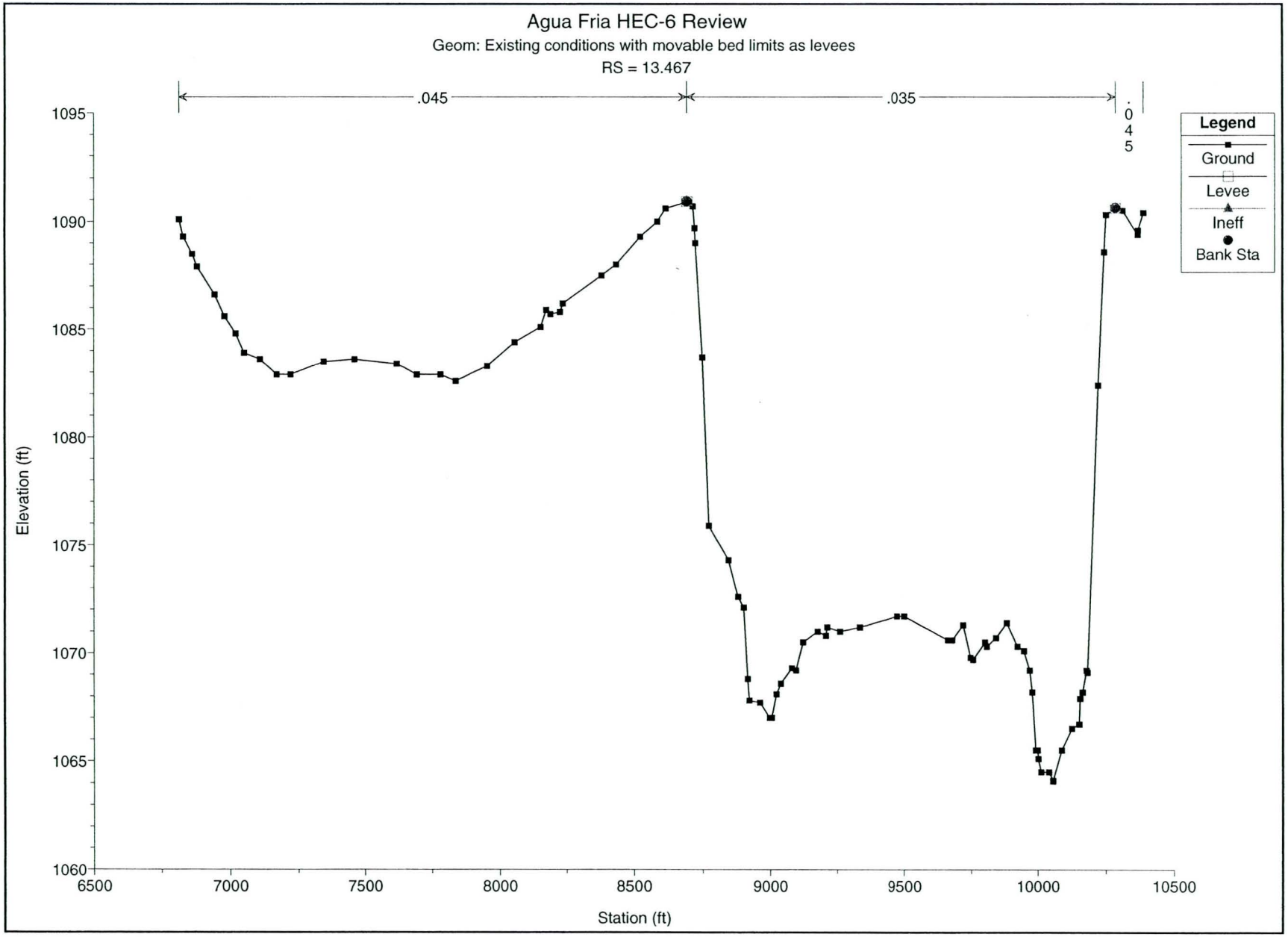

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 15.374
.035
.045
0
4
Legend
Encr
Ground
Levee
Bank Sta
Elevation (ft)
1112
1110
1108
1106
1104
1102
1100
1098
1096
1094
1092
9500
10000
10500
11000
11500
12000
12500
13000
13500
Station (ft)

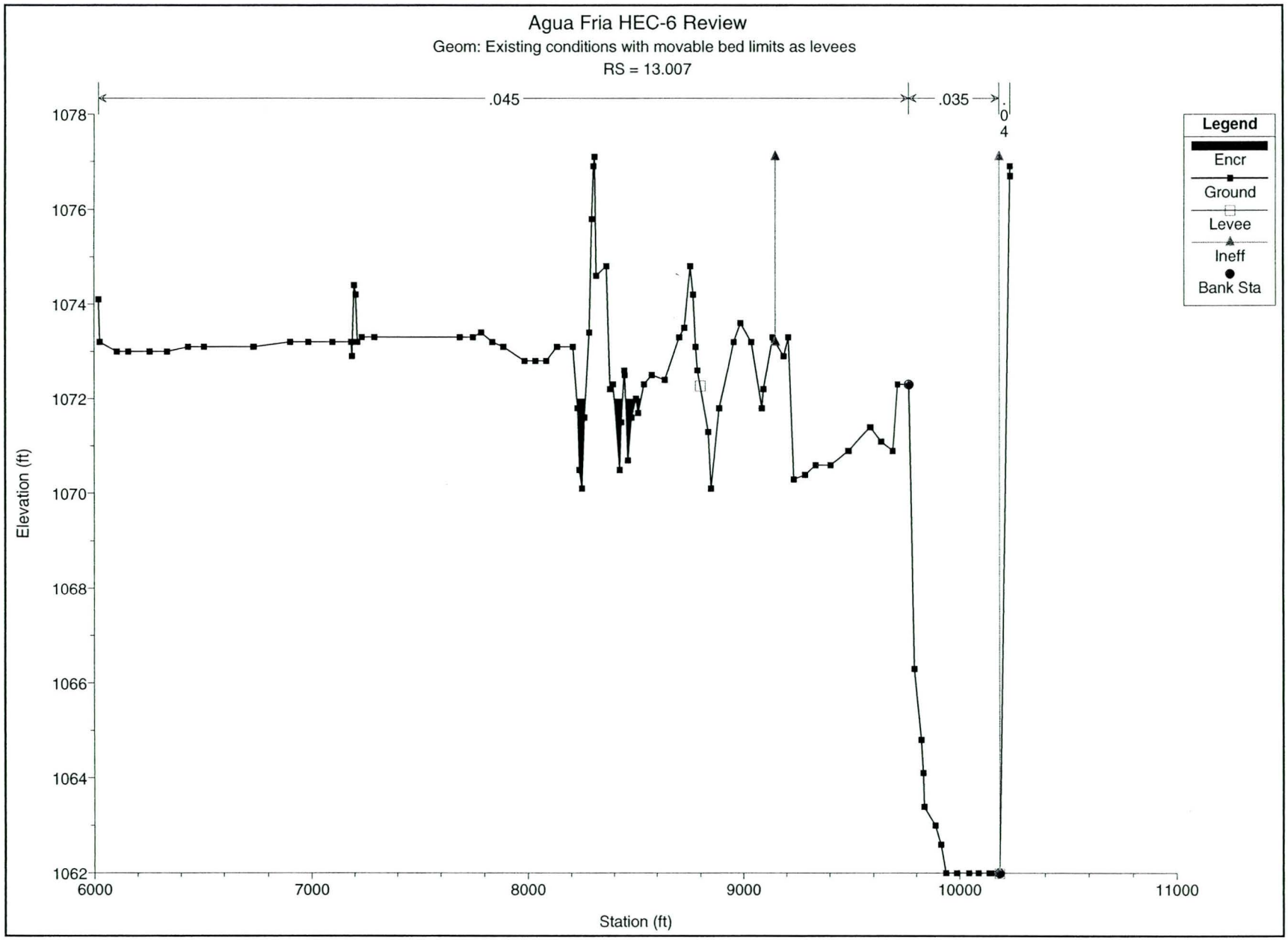

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 15.094
.045
.035
.045
Legend
Encr
Ground
Levee
Bank Sta
Elevation (ft)
1106
1104
1102
1100
1098
1096
1094
1092
1090
1088
9000
10000
11000
12000
13000
14000
Station (ft)

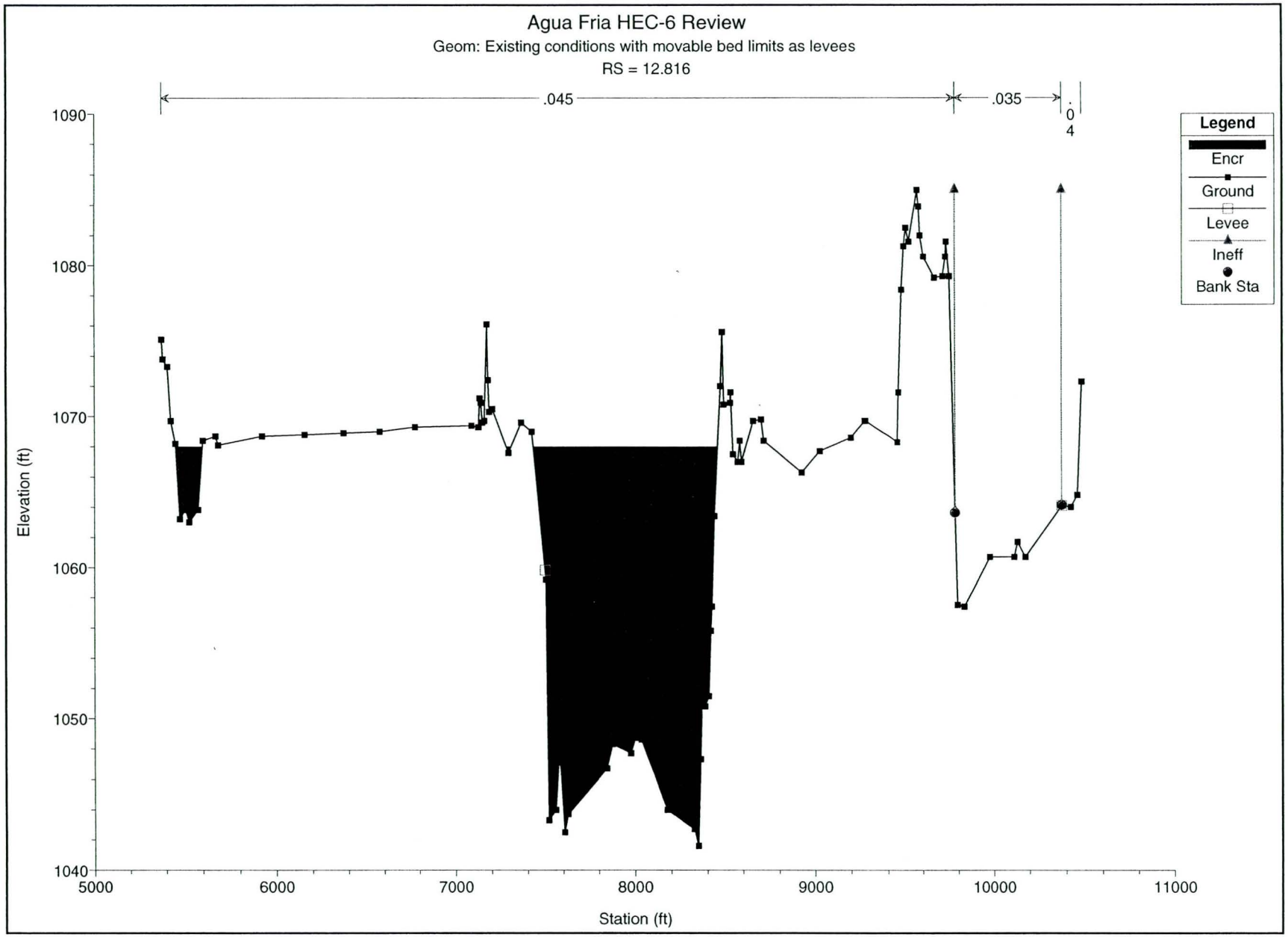

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 15
.045
.035
.045
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1106
1104
1102
1100
1098
1096
1094
1092
1090
1088
9000
9500
10000
10500
11000
11500
12000
12500
13000
Station (ft)

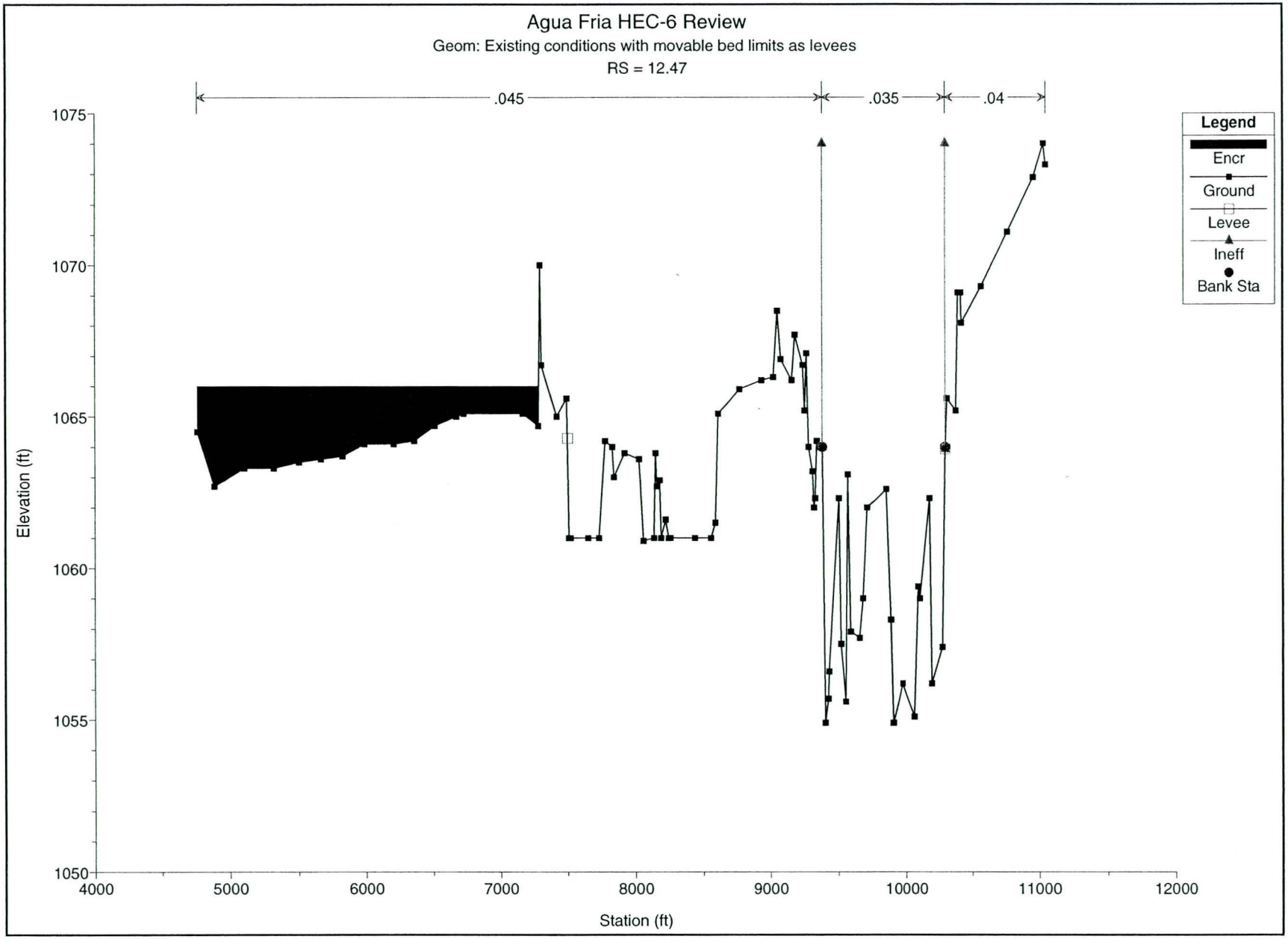

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 14.43
.045
.035
.045
Legend
Encr
Ground
Levee
Bank Sta
Elevation (ft)
1096
1094
1092
1090
1088
1086
1084
1082
6000
7000
8000
9000
10000
11000
Station (ft)

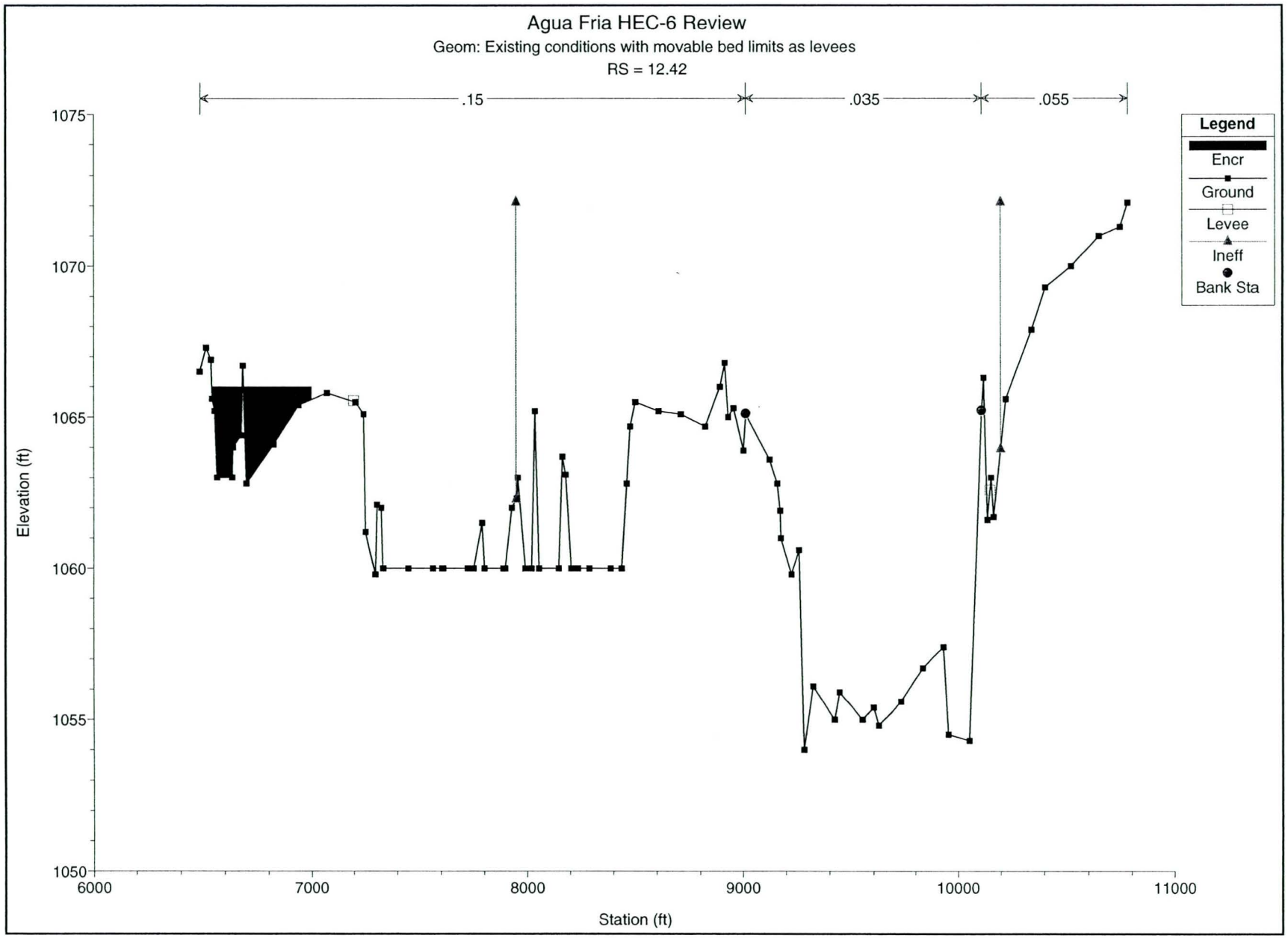

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 13.952
.045
.035
.045
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1092
1090
1088
1086
1084
1082
1080
1078
1076
1074
1072
6000
7000
8000
9000
10000
11000
Station (ft)

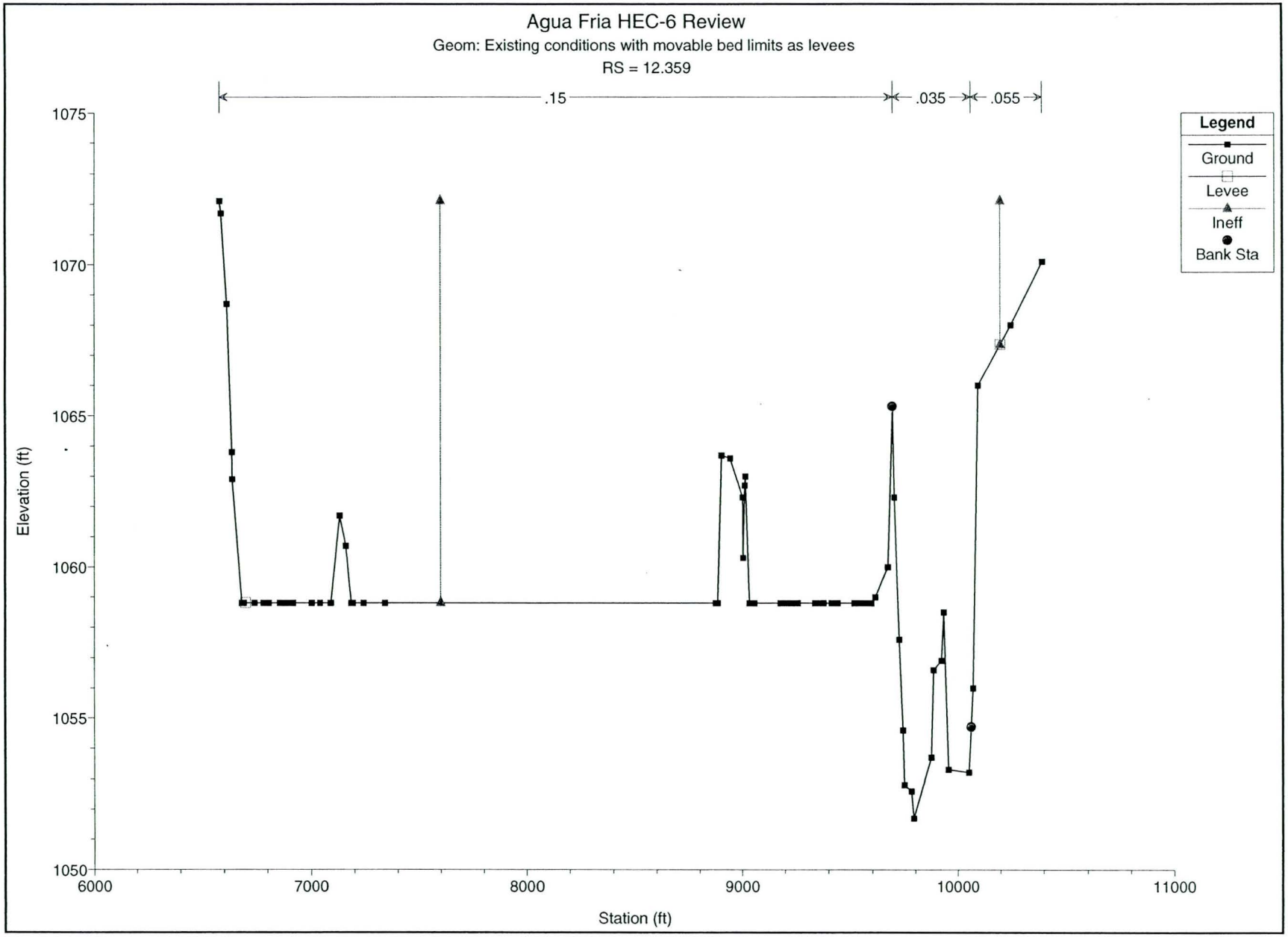

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 13.467
.045
.035
.045
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1095
1090
1085
1080
1075
1070
1065
1060
6500
7000
7500
8000
8500
9000
9500
10000
10500
Station (ft)

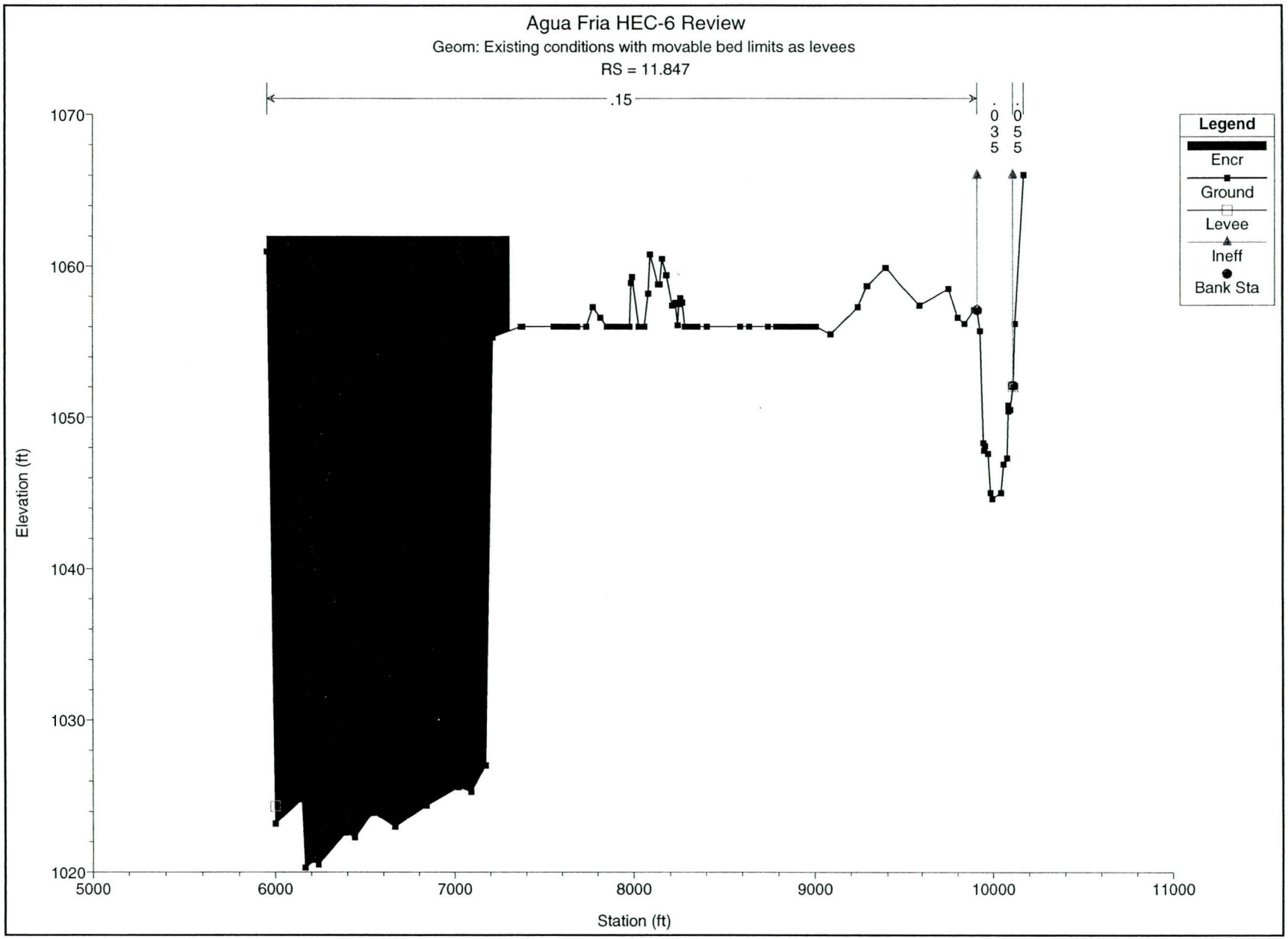

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 13.007
.045
.035
.04
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1078
1076
1074
1072
1070
1068
1066
1064
1062
6000
7000
8000
9000
10000
11000
Station (ft)

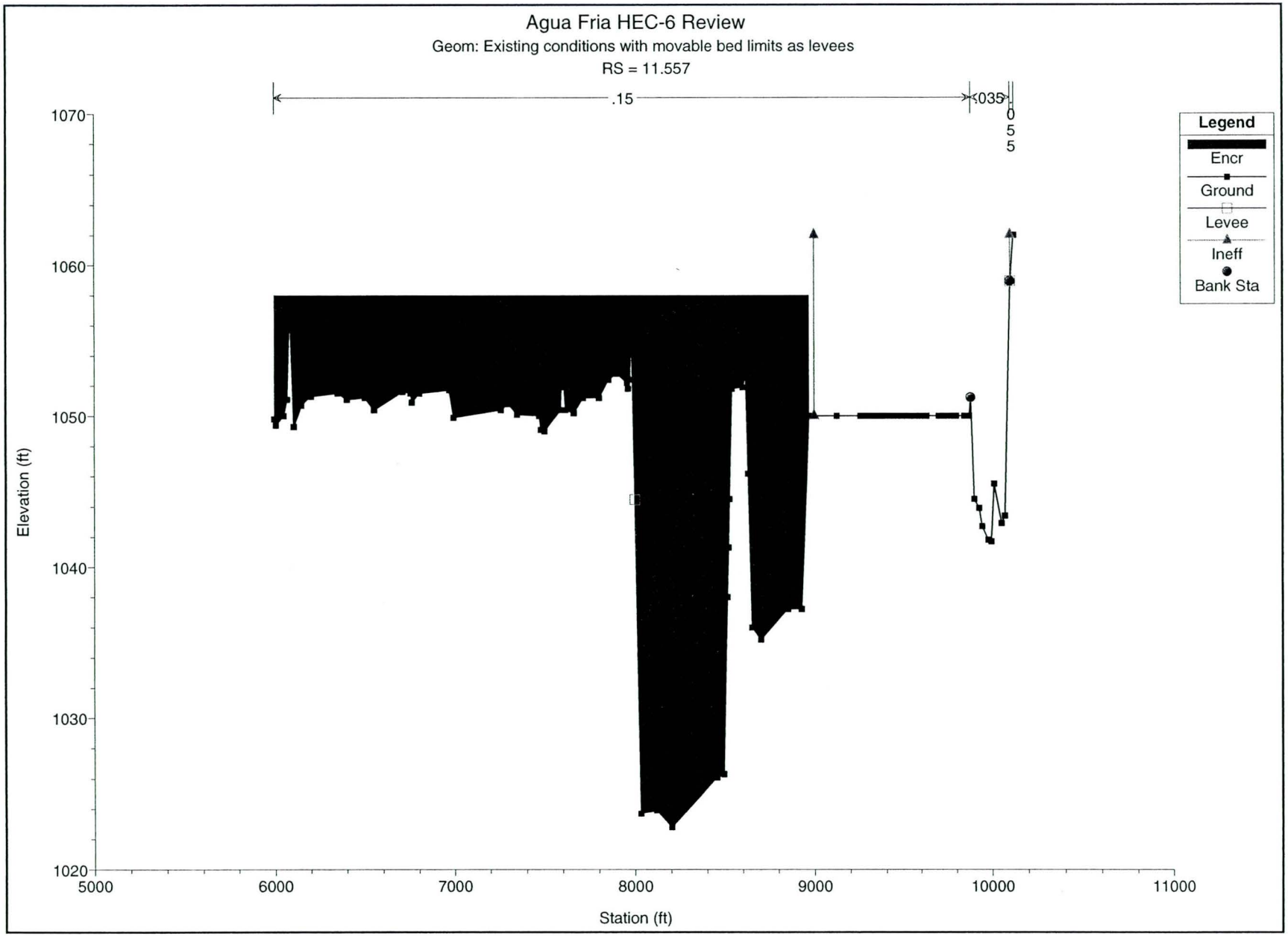

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 12.816
.045
.035
.04
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1090
1080
1070
1060
1050
1040
5000
6000
7000
8000
9000
10000
11000
Station (ft)

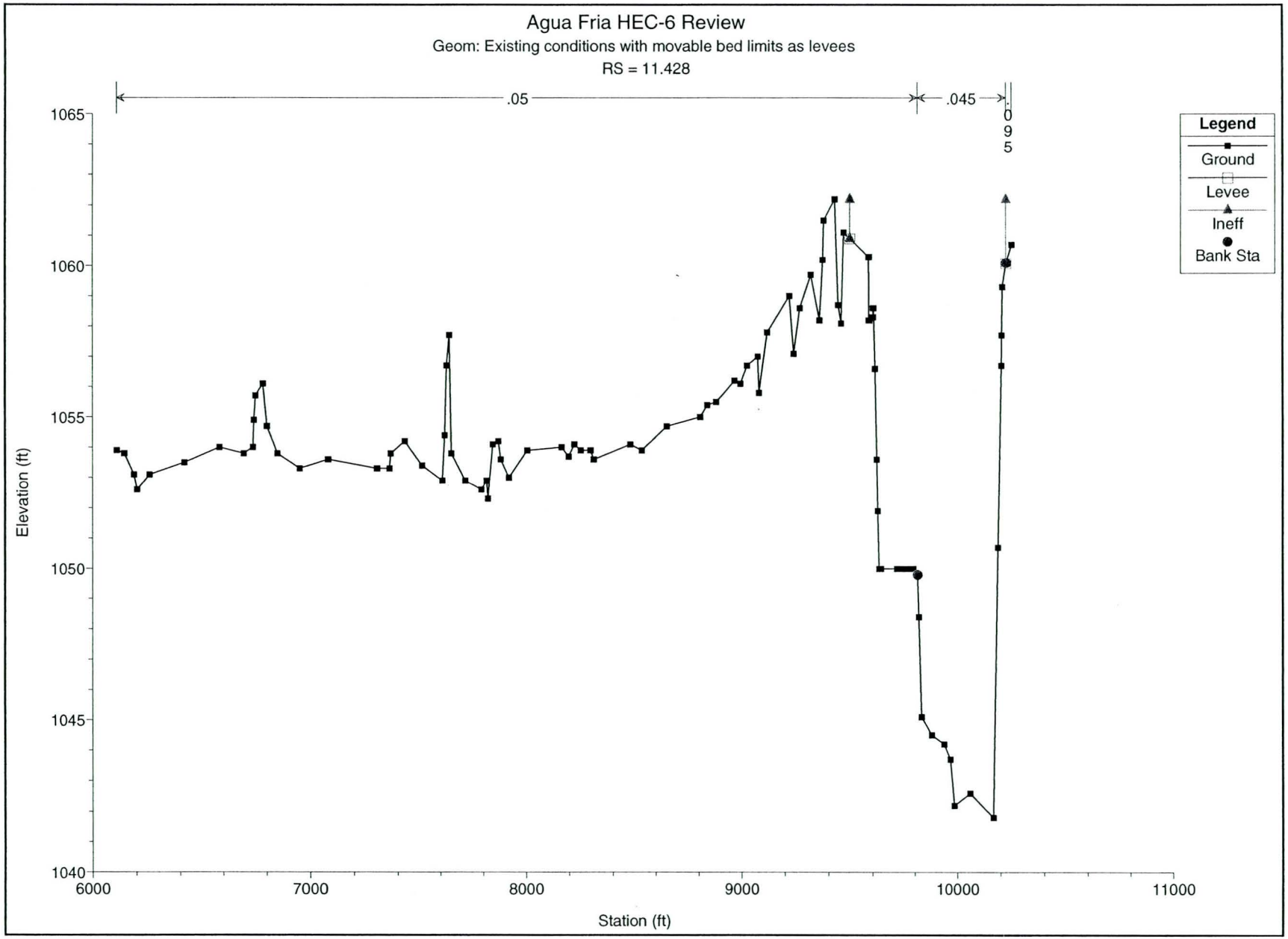

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 12.47
.045
.035
.04
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1075
1070
1065
1060
1055
1050
4000
5000
6000
7000
8000
9000
10000
11000
12000
Station (ft)

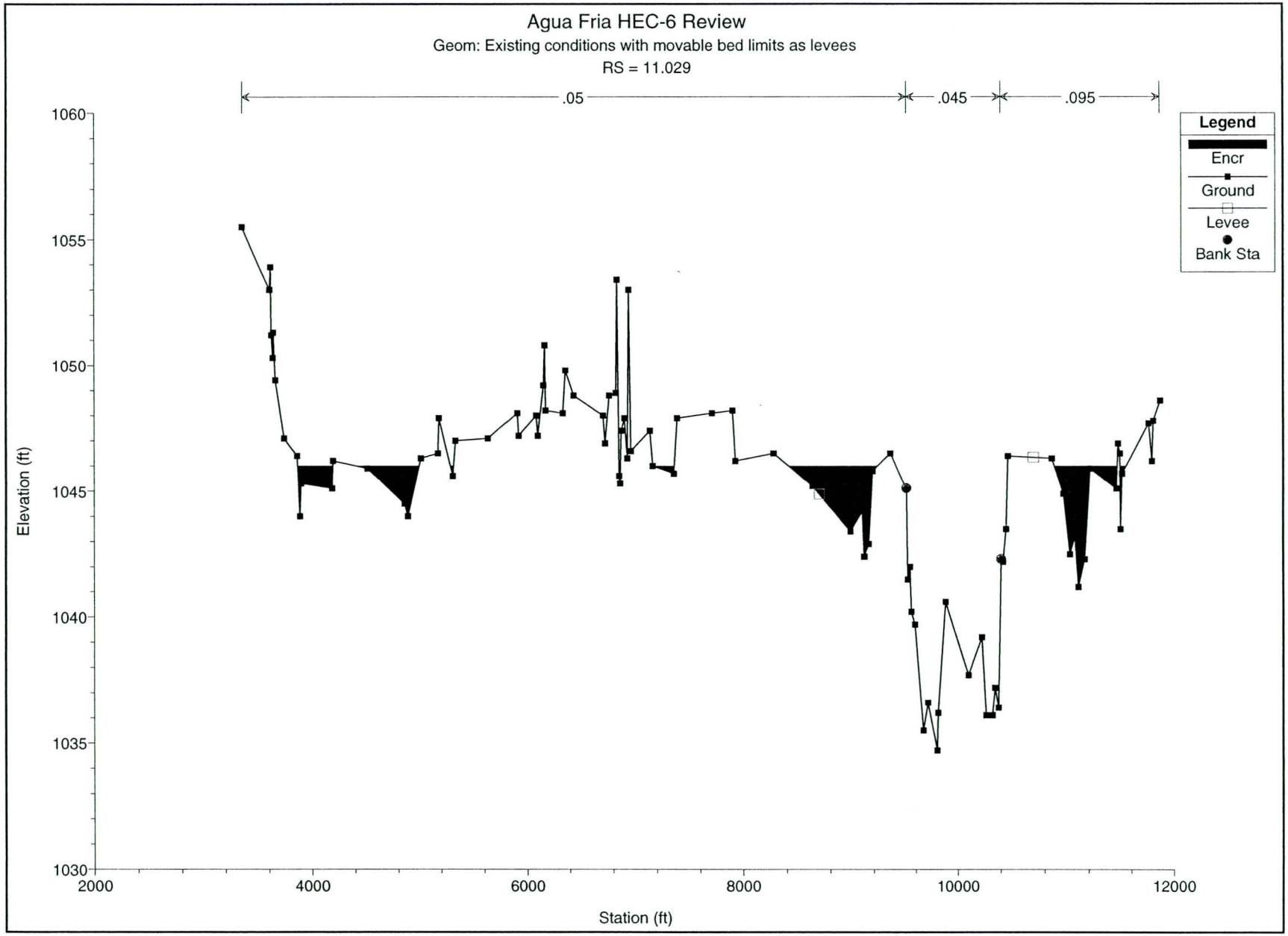

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 12.42
.15
.035
.055
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1075
1070
1065
1060
1055
1050
6000
7000
8000
9000
10000
11000
Station (ft)

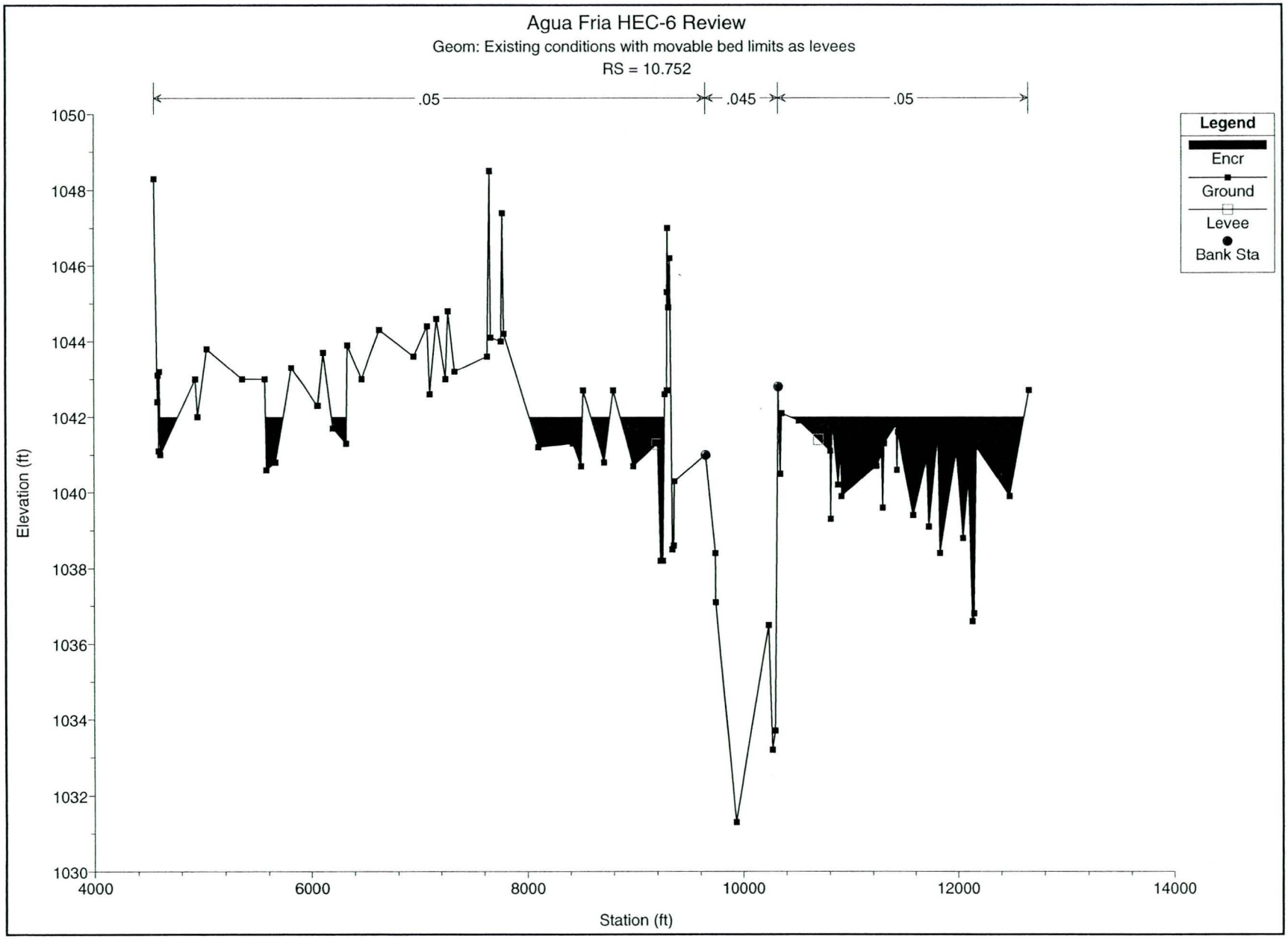

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 12.359
.15
.035
.055
Legend
Ground
Levee
Ineff
Bank Sta
1075
1070
1065
1060
1055
1050
Elevation (ft)
6000
7000
8000
9000
10000
11000
Station (ft)

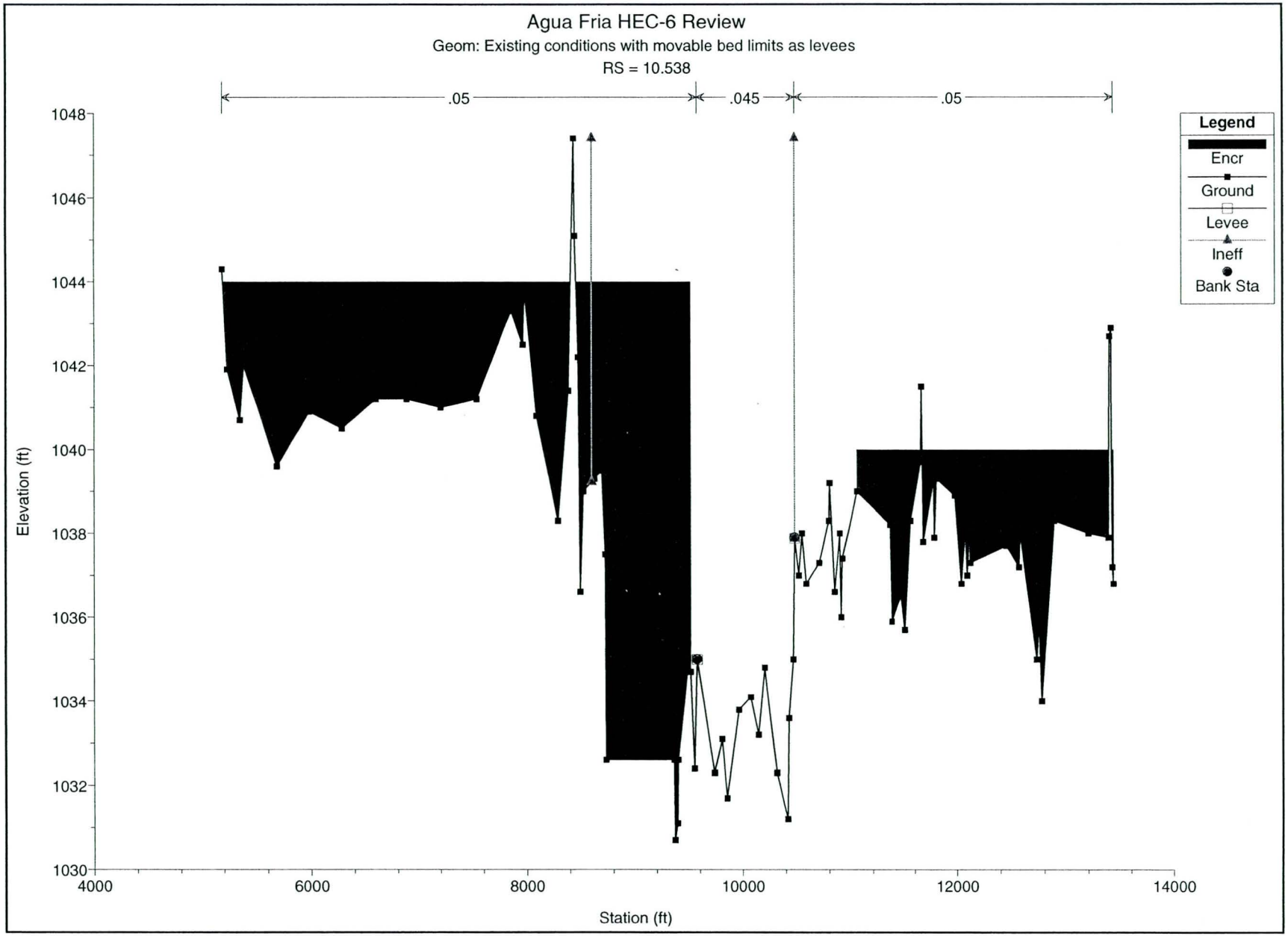

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 11.847
.15
.035
.055
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1070
1060
1050
1040
1030
1020
5000
6000
7000
8000
9000
10000
11000
Station (ft)

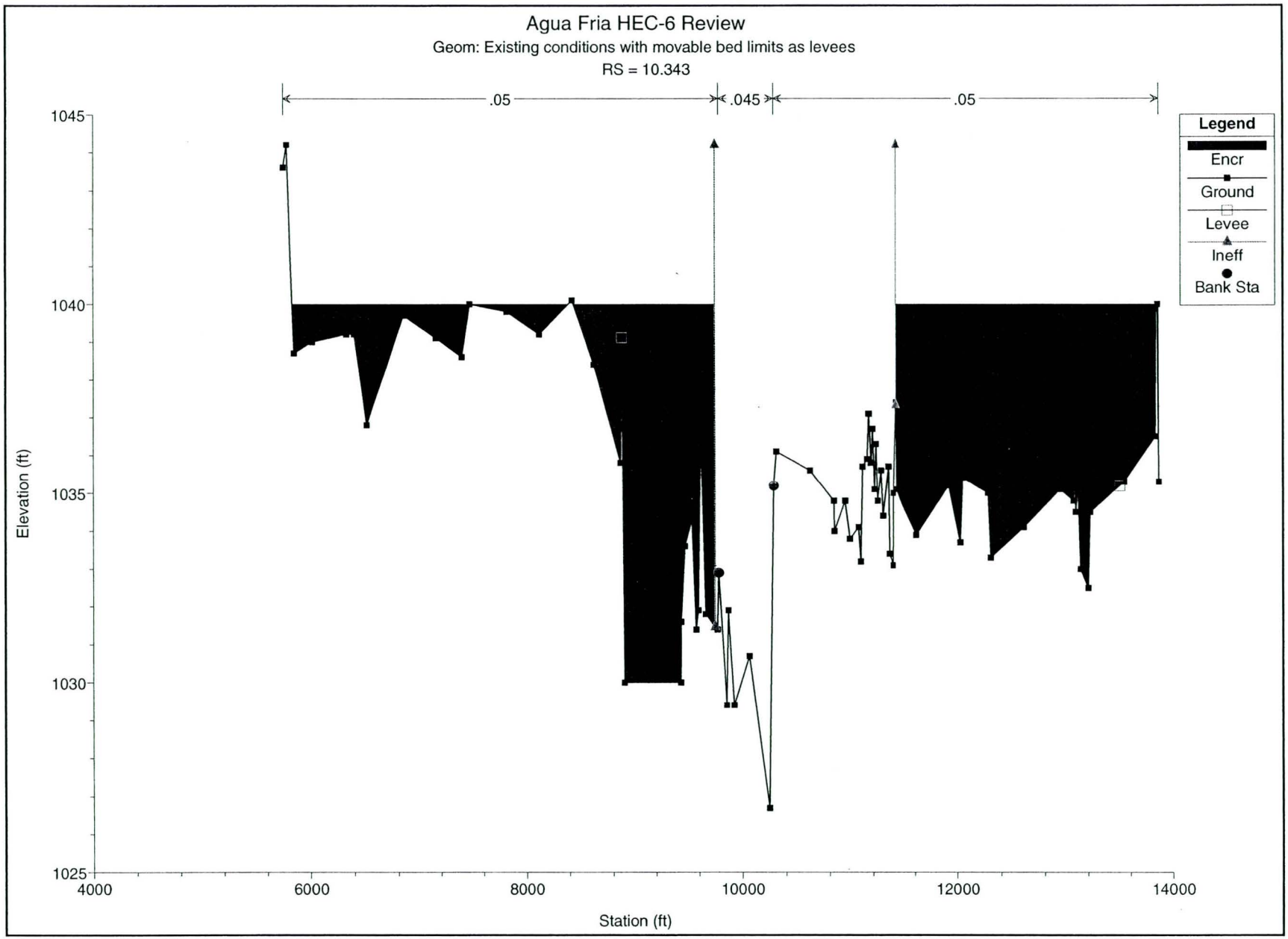

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 11.557
.15
.035
.055
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1070
1060
1050
1040
1030
1020
5000
6000
7000
8000
9000
10000
11000
Station (ft)

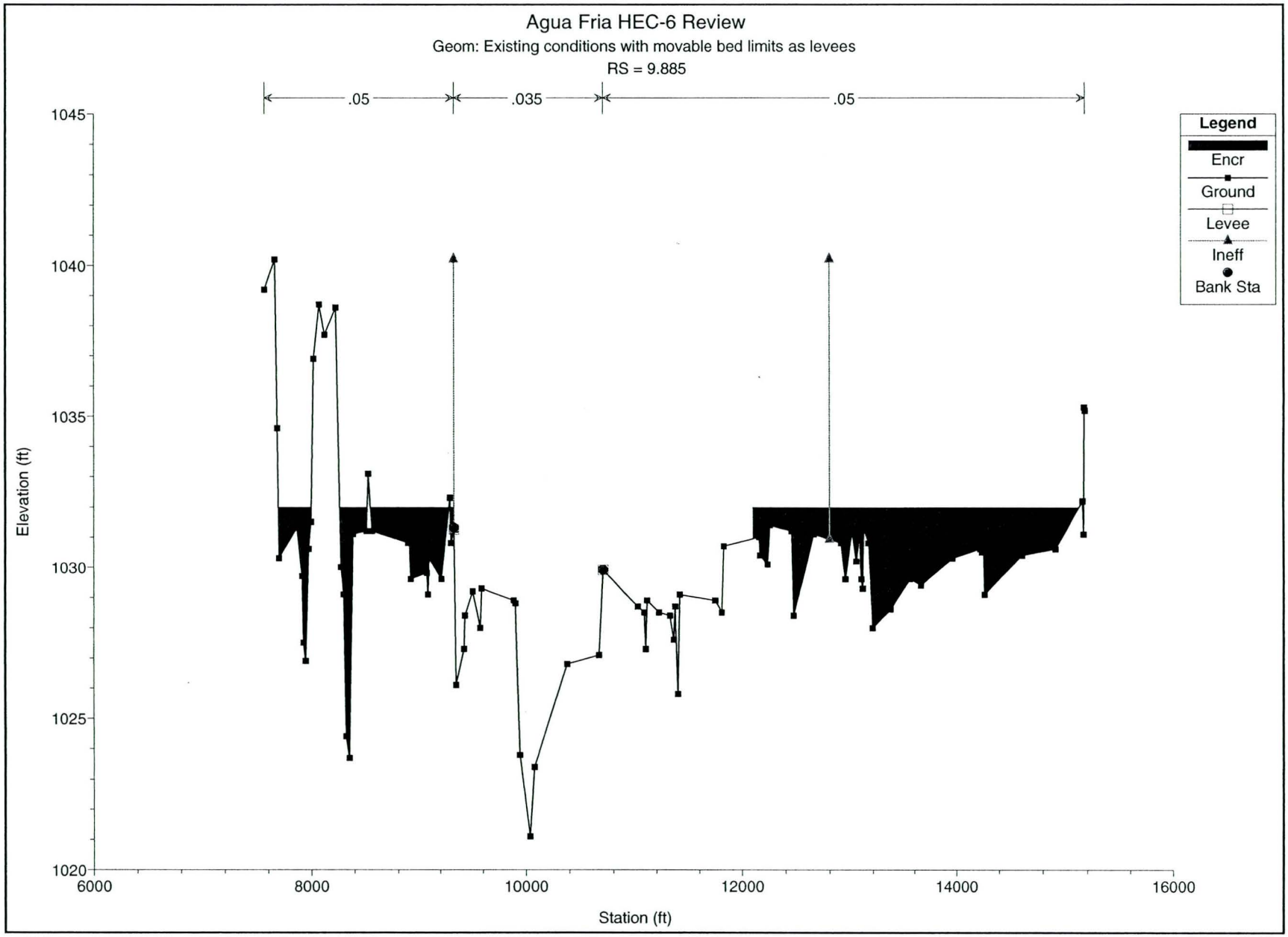

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 11.428
.05
.045
.095
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1065
1060
1055
1050
1045
1040
6000
7000
8000
9000
10000
11000
Station (ft)

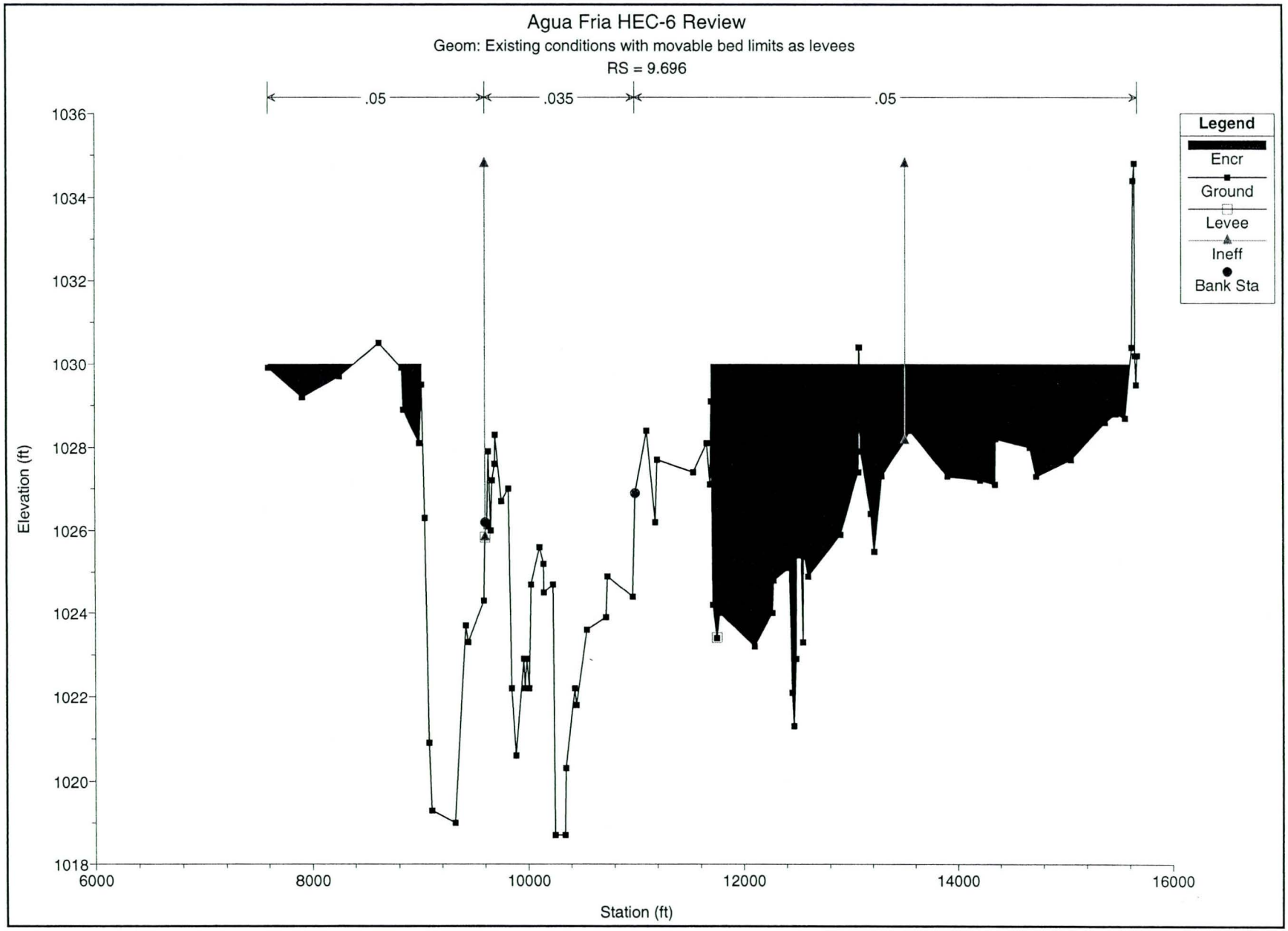

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 11.029
.05
.045
.095
Legend
Encr
Ground
Levee
Bank Sta
Elevation (ft)
1060
1055
1050
1045
1040
1035
1030
2000
4000
6000
8000
10000
12000
Station (ft)

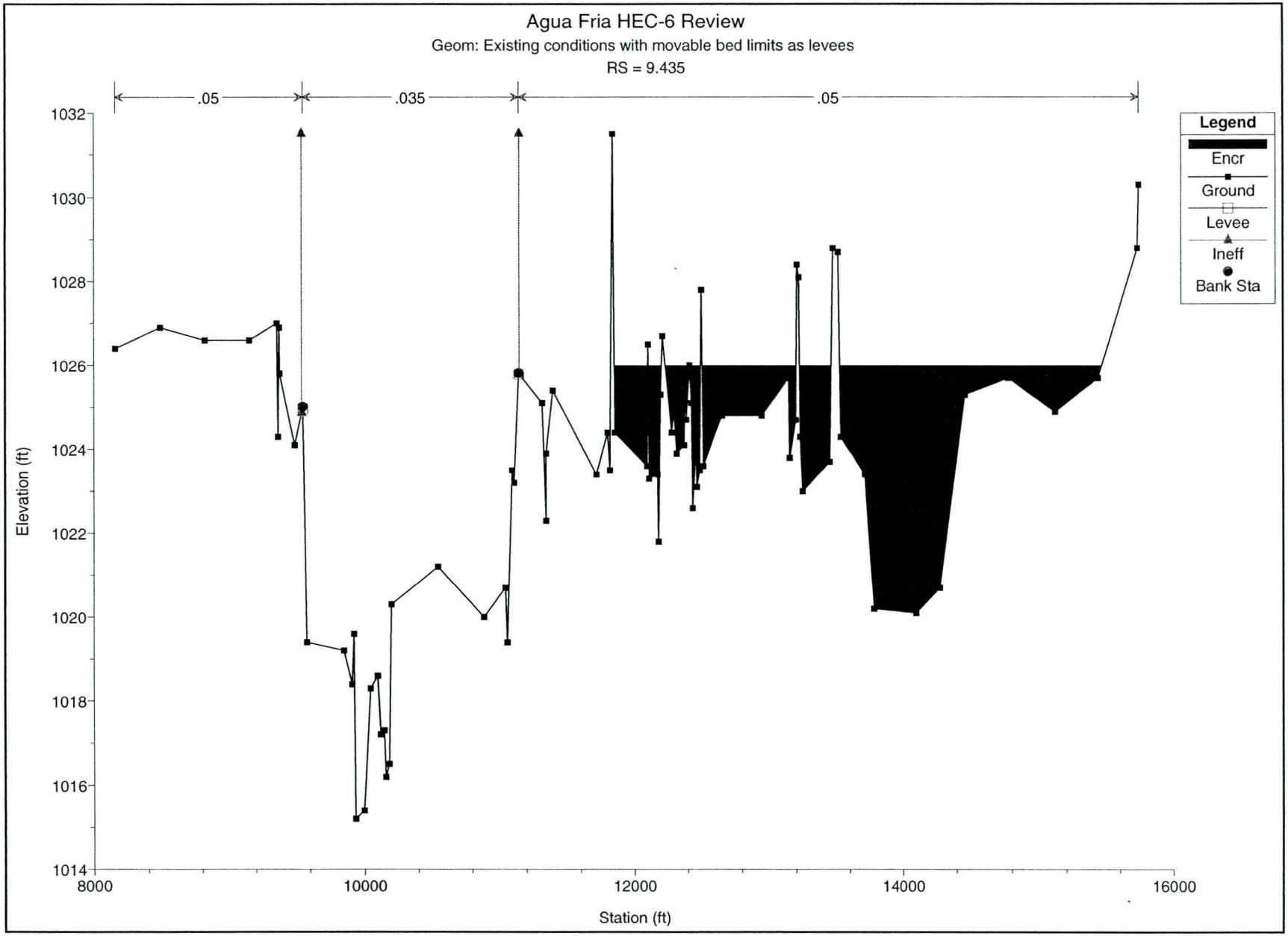

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 10.752
.05
.045
.05
Legend
Encr
Ground
Levee
Bank Sta
Elevation (ft)
1050
1048
1046
1044
1042
1040
1038
1036
1034
1032
1030
4000
6000
8000
10000
12000
14000
Station (ft)

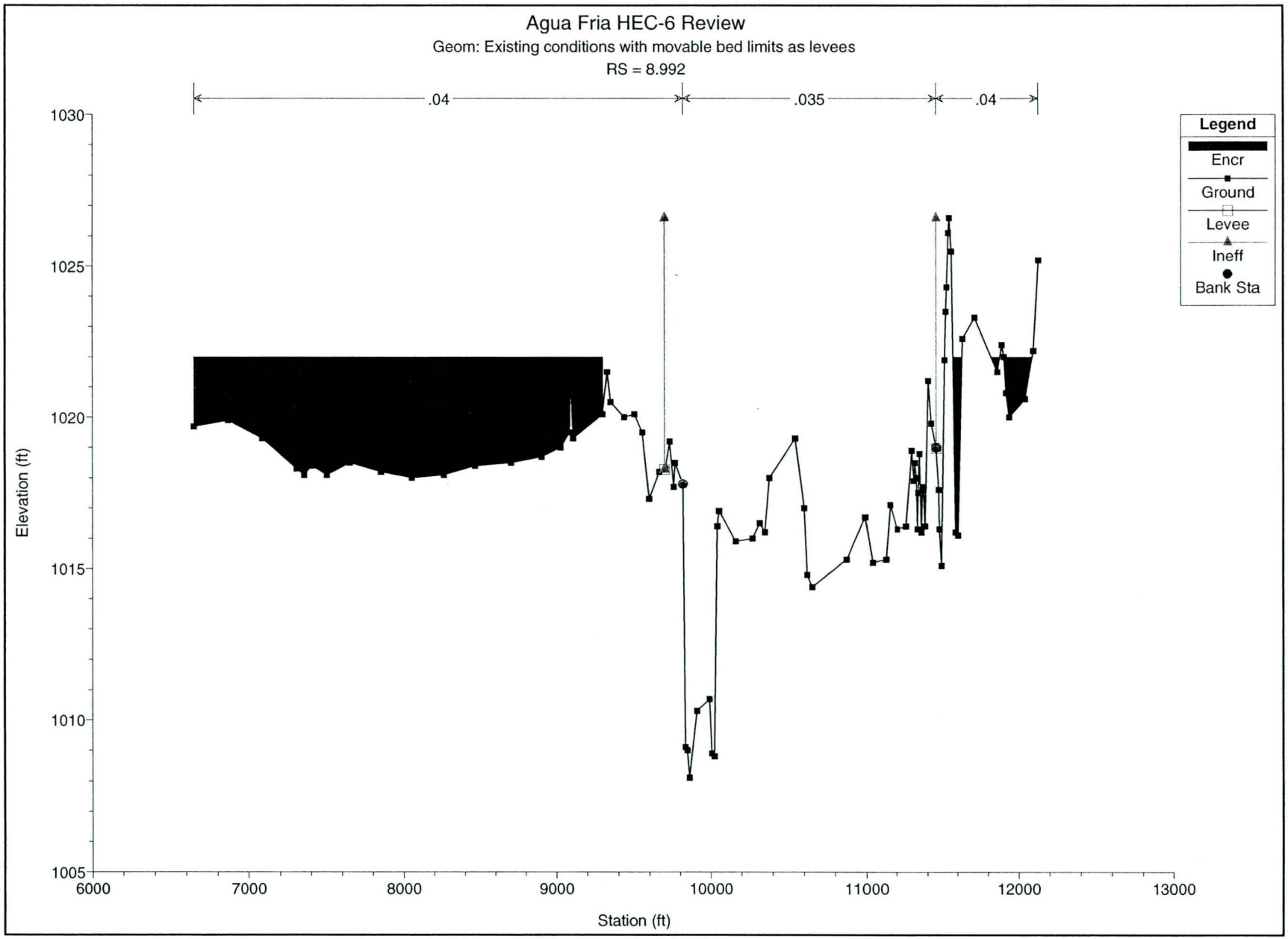

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 10.538
.05
.045
.05
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1048
1046
1044
1042
1040
1038
1036
1034
1032
1030
4000
6000
8000
10000
12000
14000
Station (ft)

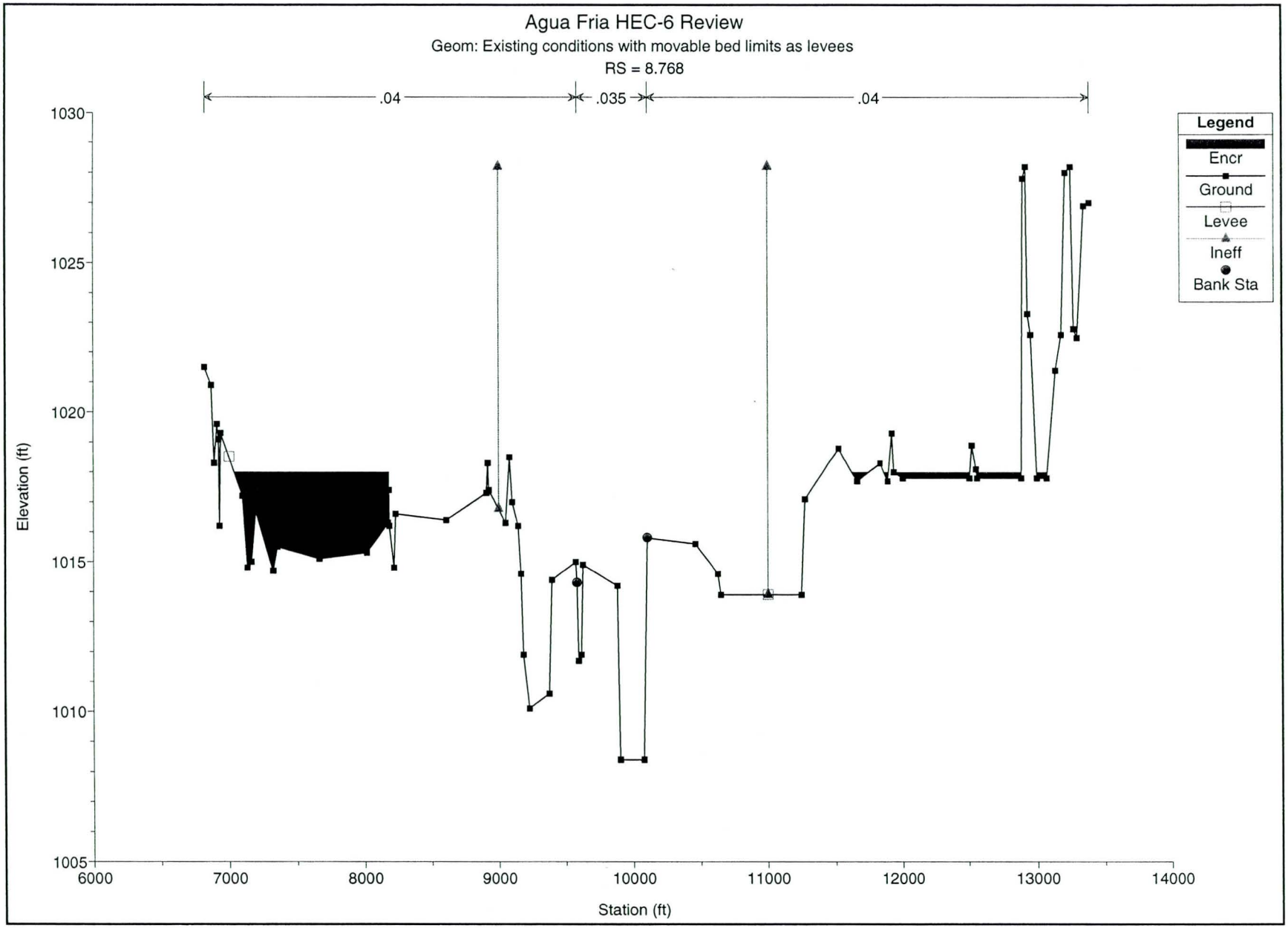

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 10.343
.05
.045
.05
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1045
1040
1035
1030
1025
4000
6000
8000
10000
12000
14000
Station (ft)

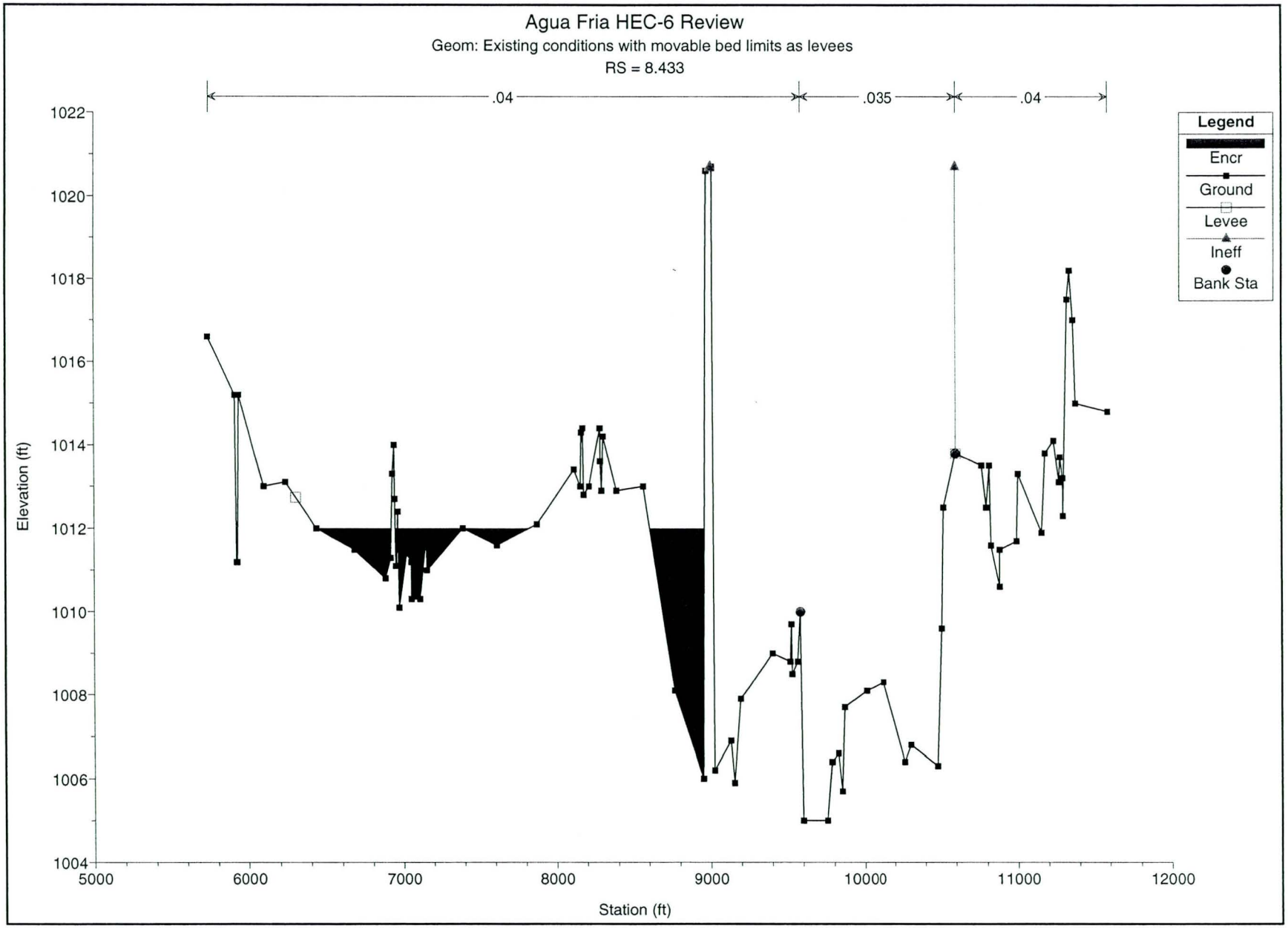

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 9.885
.05
.035
.05
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1045
1040
1035
1030
1025
1020
6000
8000
10000
12000
14000
16000
Station (ft)

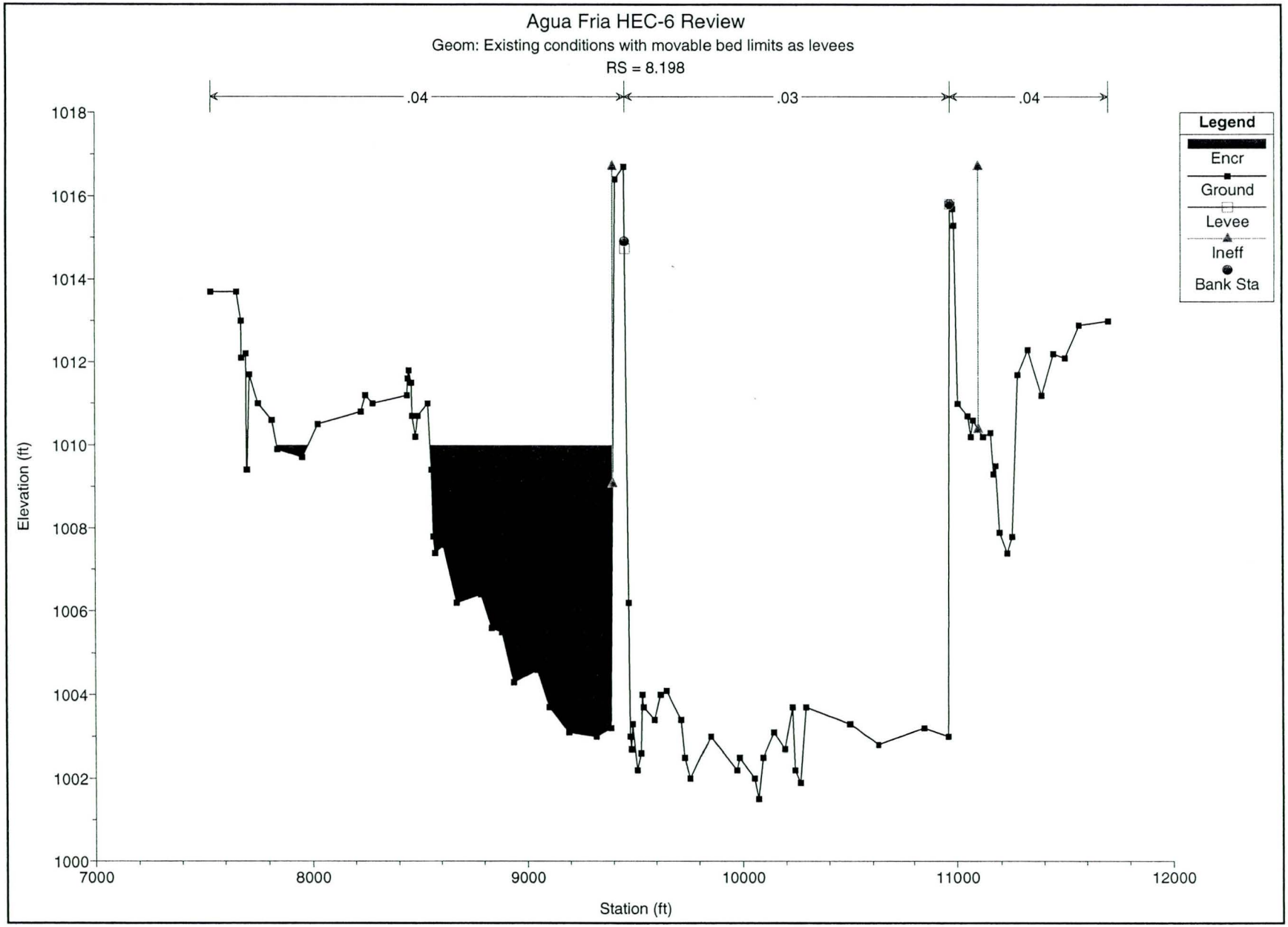

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 9.696
.05
.035
.05
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1036
1034
1032
1030
1028
1026
1024
1022
1020
1018
6000
8000
10000
12000
14000
16000
Station (ft)

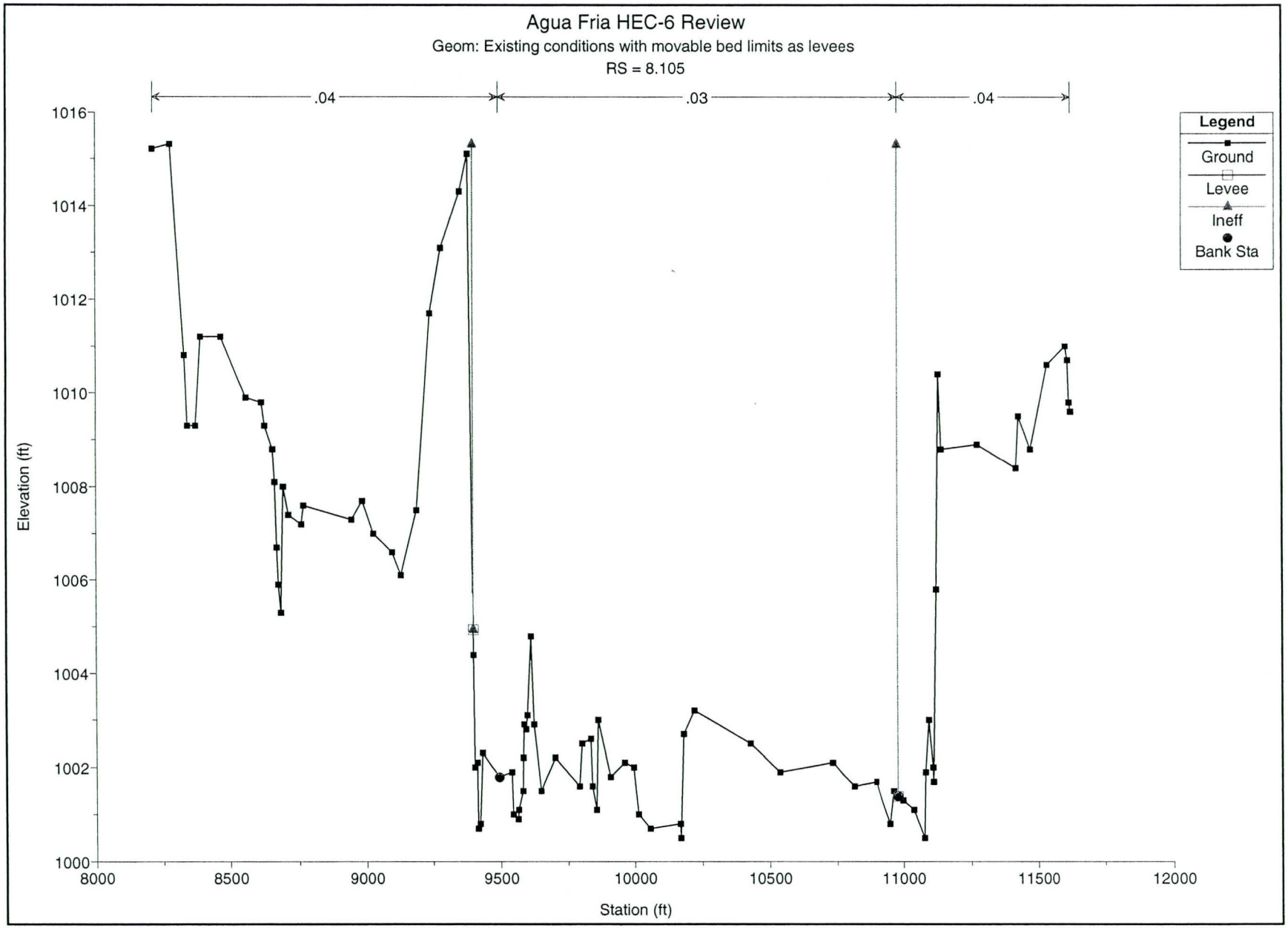

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 9.435
.05
.035
.05
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1032
1030
1028
1026
1024
1022
1020
1018
1016
1014
8000
10000
12000
14000
16000
Station (ft)

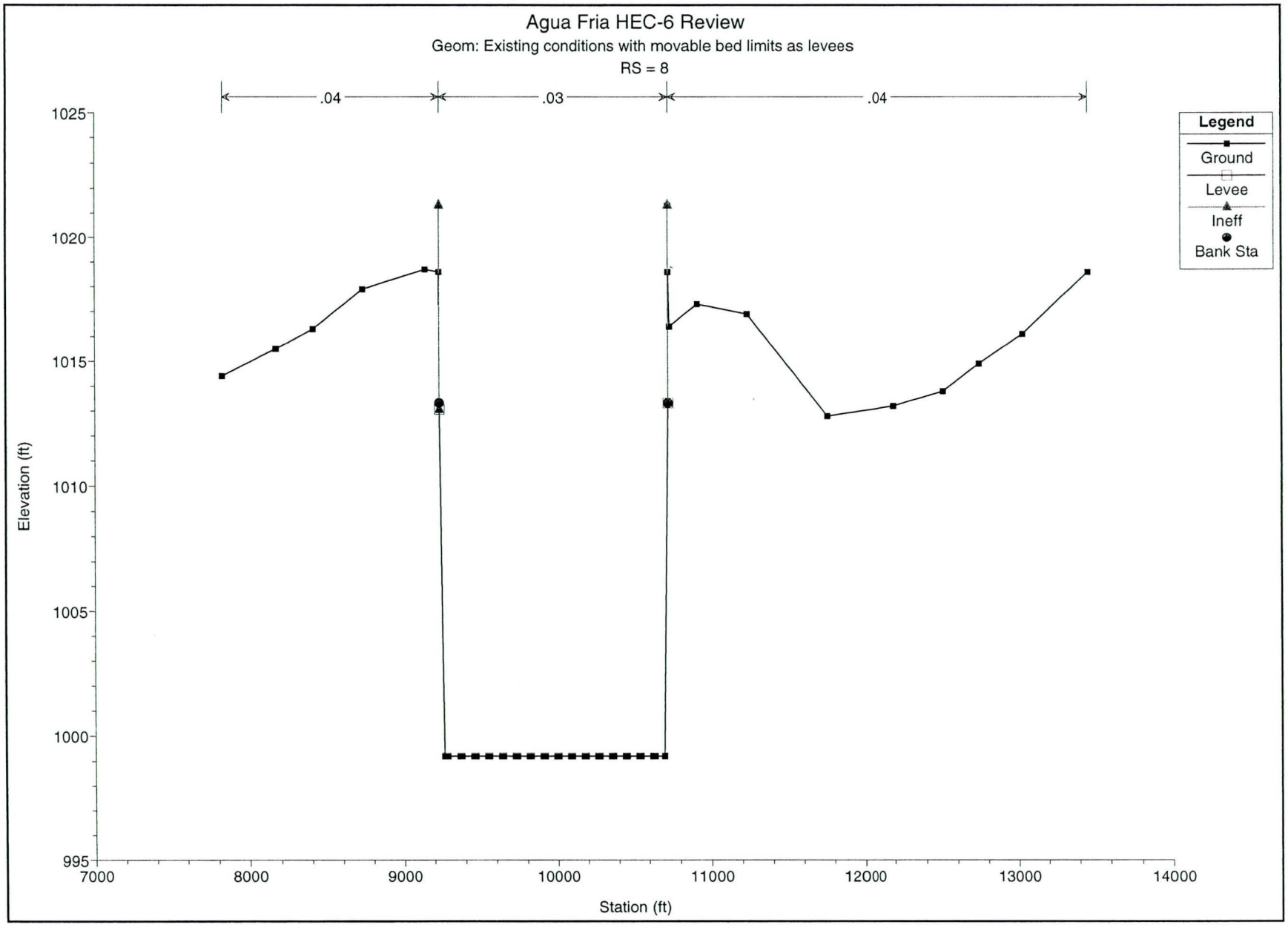

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 8.992
.04
.035
.04
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1030
1025
1020
1015
1010
1005
6000
7000
8000
9000
10000
11000
12000
13000
Station (ft)

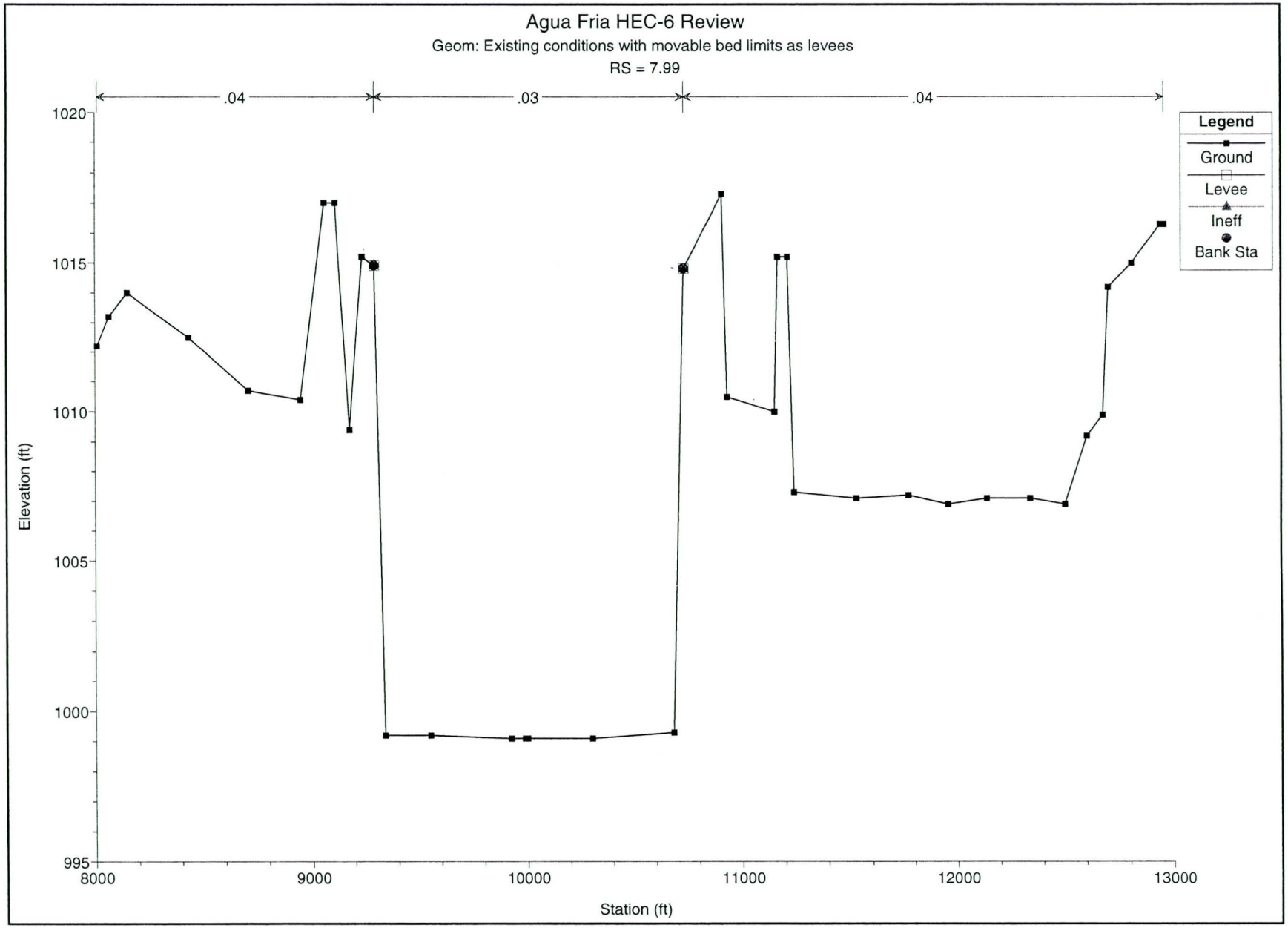

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 8.768
.04
.035
.04
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1030
1025
1020
1015
1010
1005
6000
7000
8000
9000
10000
11000
12000
13000
14000
Station (ft)

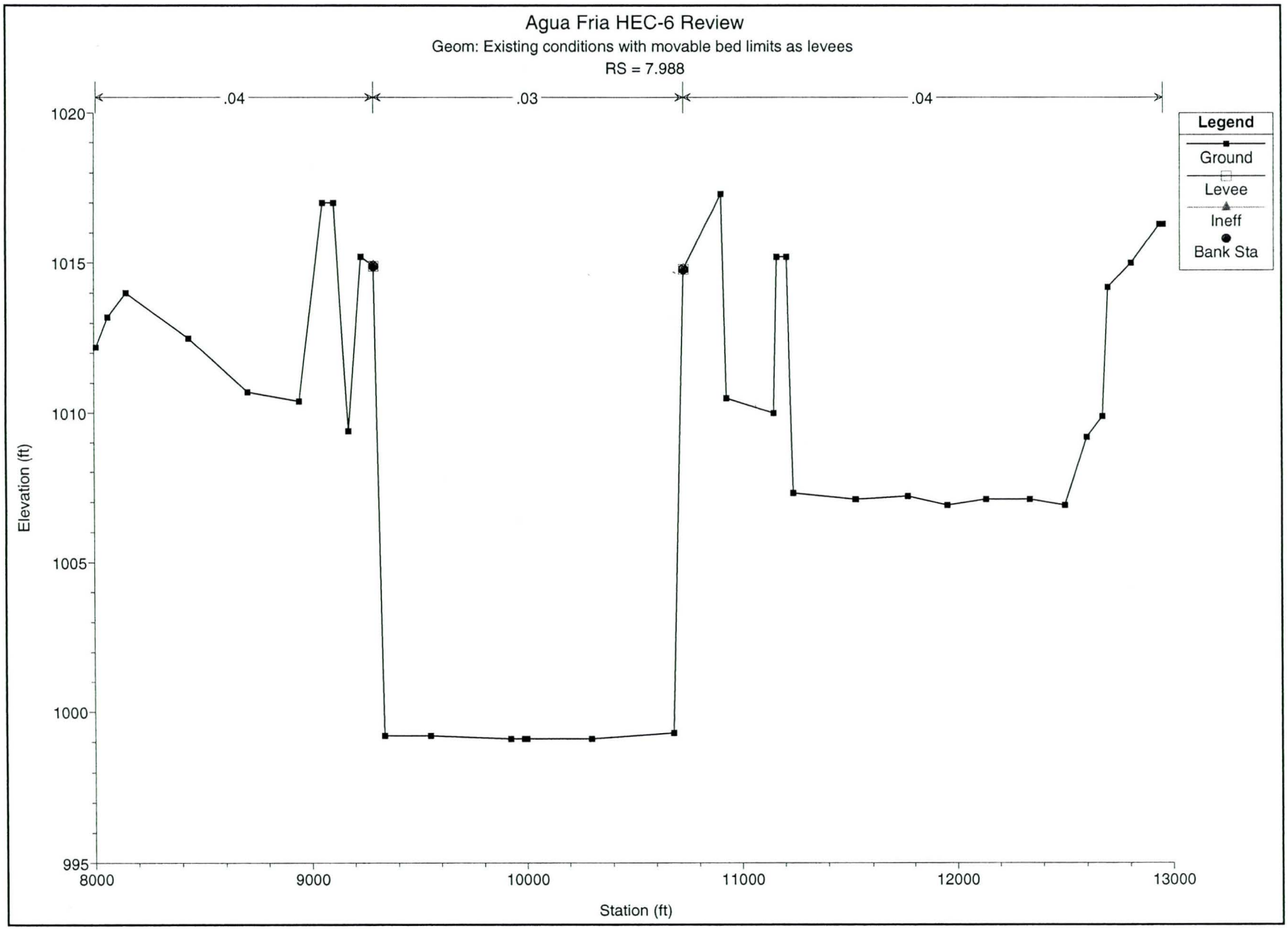

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 8.433
.04
.035
.04
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1022
1020
1018
1016
1014
1012
1010
1008
1006
1004
5000
6000
7000
8000
9000
10000
11000
12000
Station (ft)

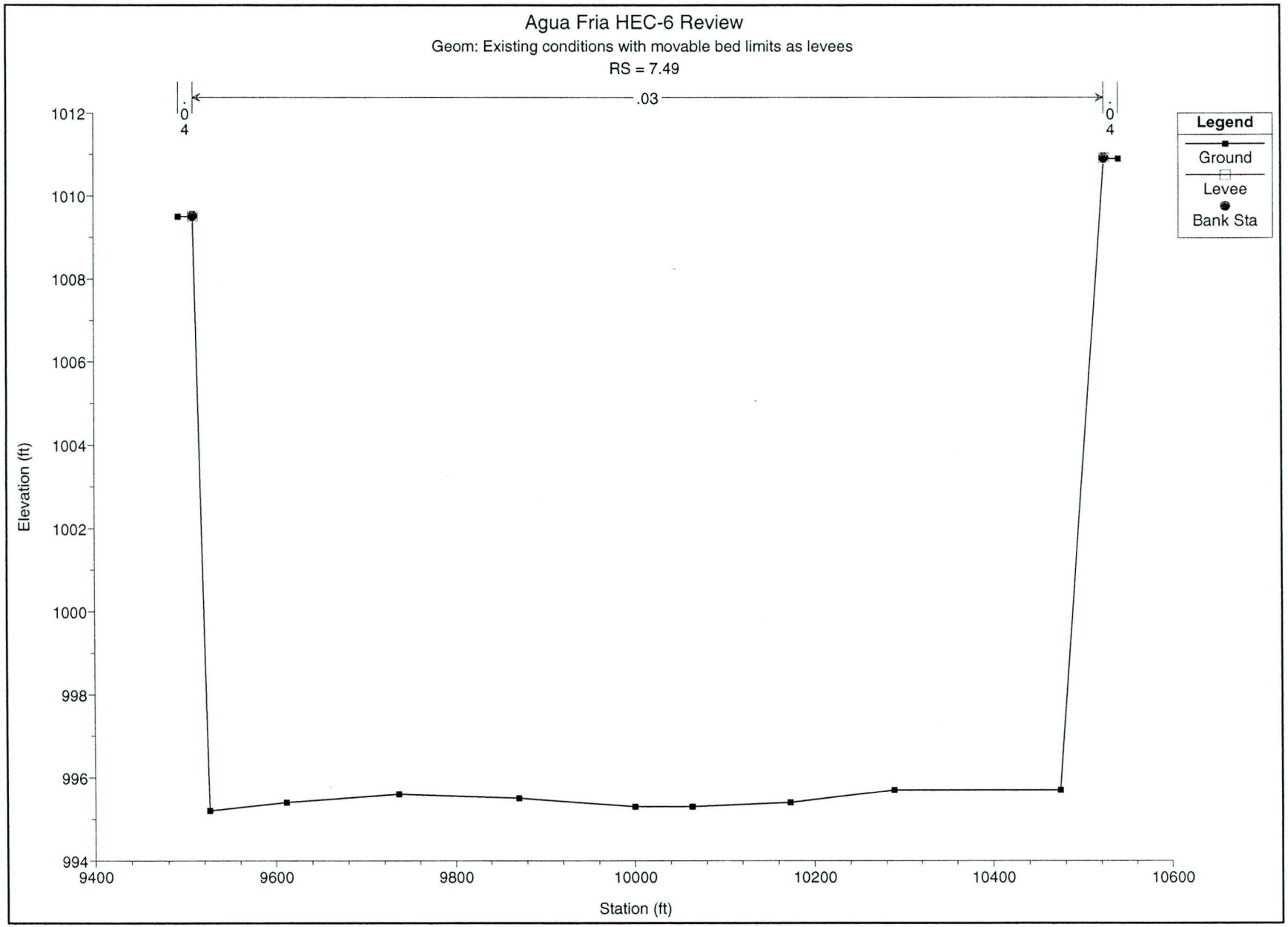

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 8.198
.04
.03
.04
Legend
Encr
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1018
1016
1014
1012
1010
1008
1006
1004
1002
1000
7000
8000
9000
10000
11000
12000
Station (ft)

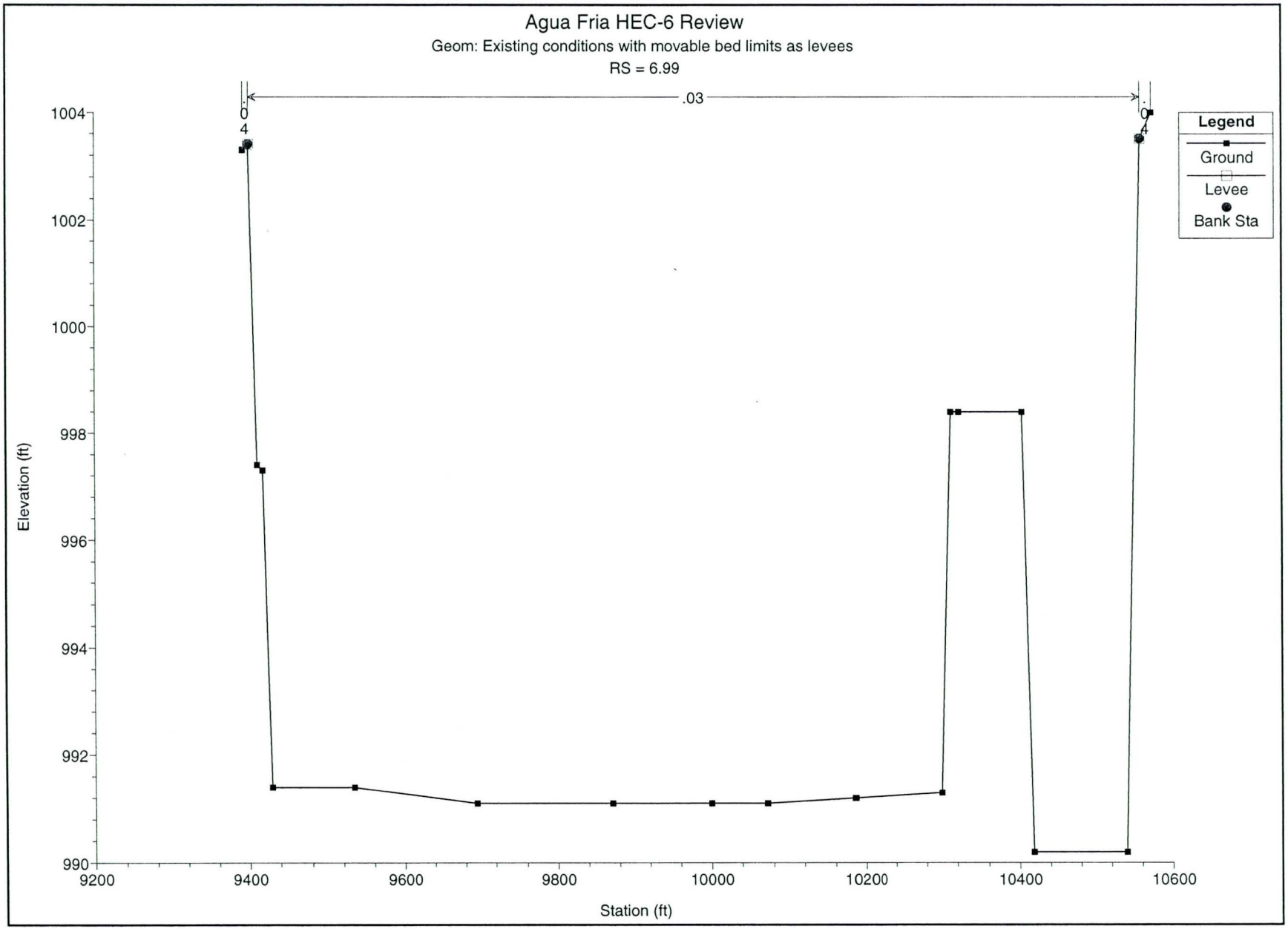

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 8.105
.04
.03
.04
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1016
1014
1012
1010
1008
1006
1004
1002
1000
8000
8500
9000
9500
10000
10500
11000
11500
12000
Station (ft)

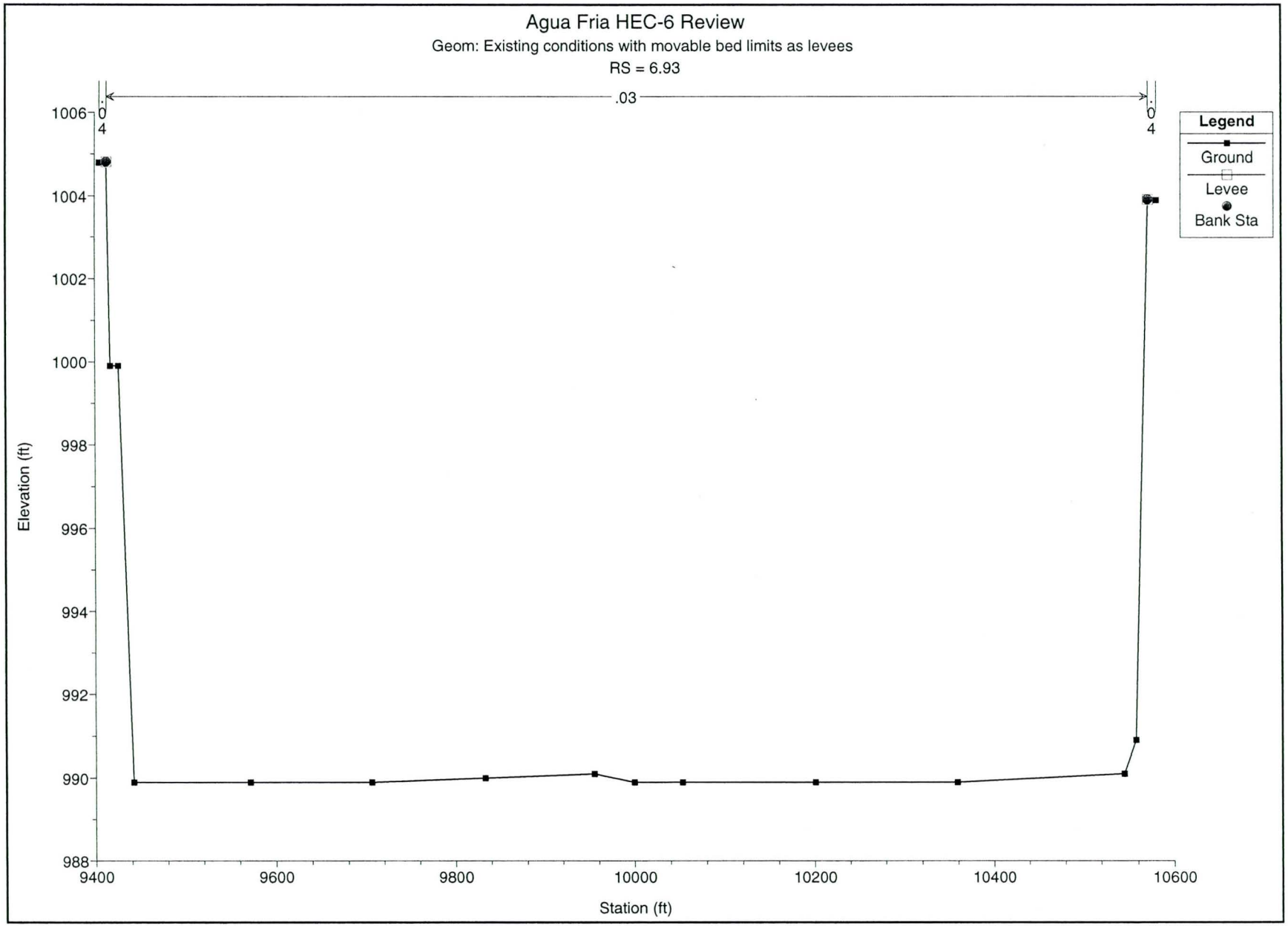

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 8
.04
.03
.04
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
1025
1020
1015
1010
1005
1000
995
7000
8000
9000
10000
11000
12000
13000
14000
Station (ft)

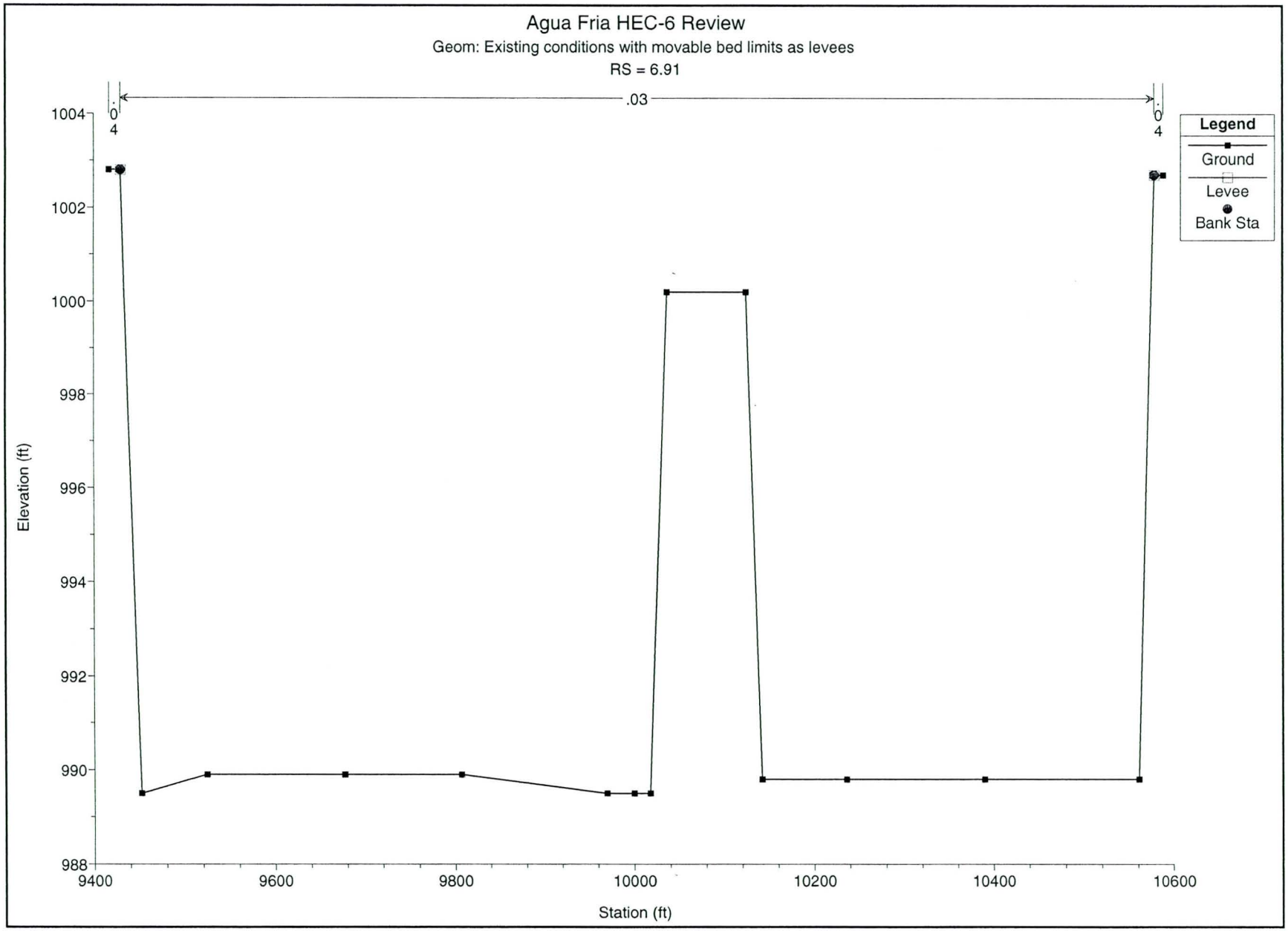

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 7.99
.04
.03
.04
Legend
Ground
Levee
Ineff
Bank Sta
1020
1015
1010
1005
1000
995
Elevation (ft)
8000
9000
10000
11000
12000
13000
Station (ft)

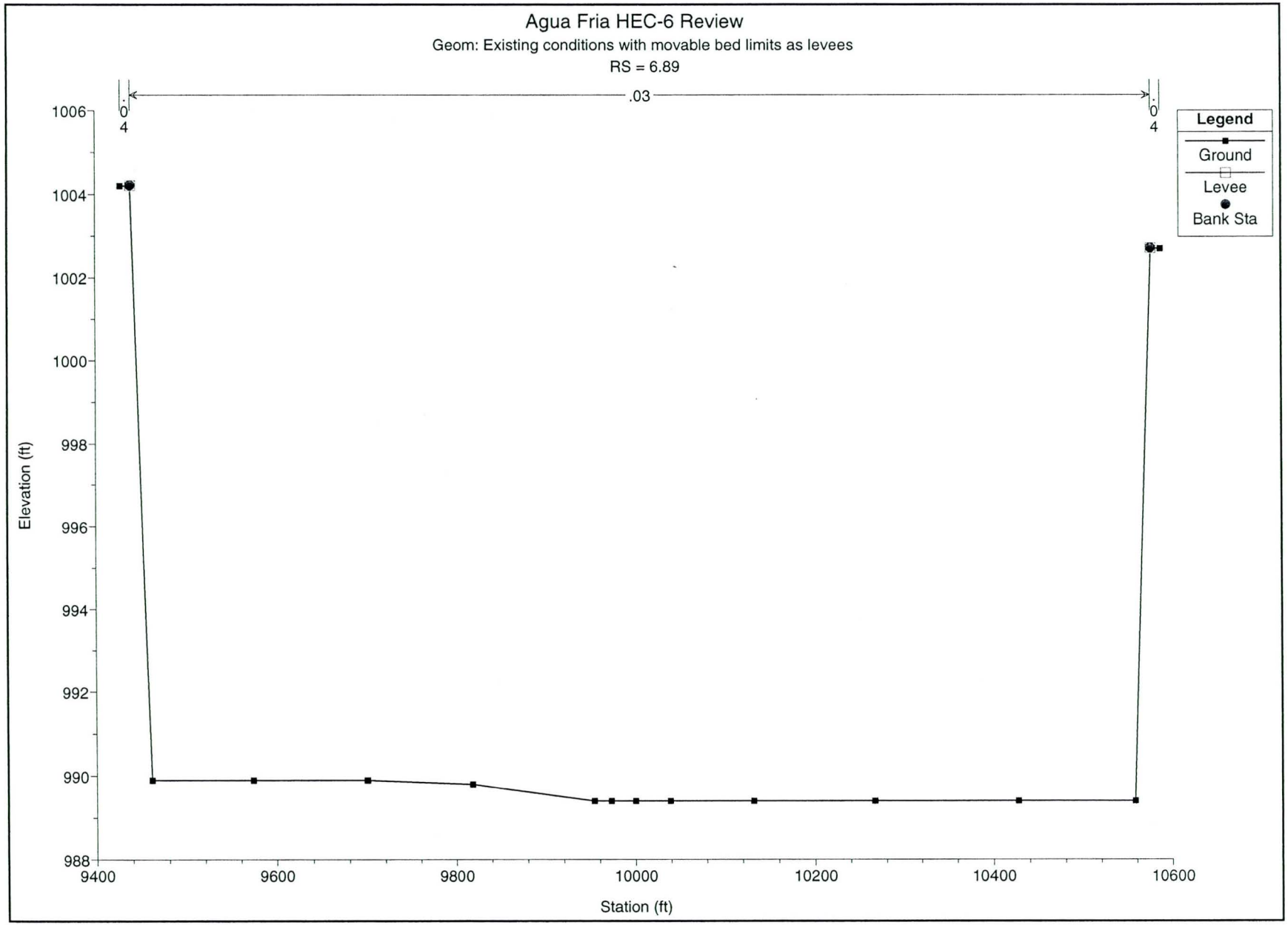

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 7.988
.04
.03
.04
Legend
Ground
Levee
Ineff
Bank Sta
1020
1015
1010
1005
1000
995
Elevation (ft)
8000
9000
10000
11000
12000
13000
Station (ft)

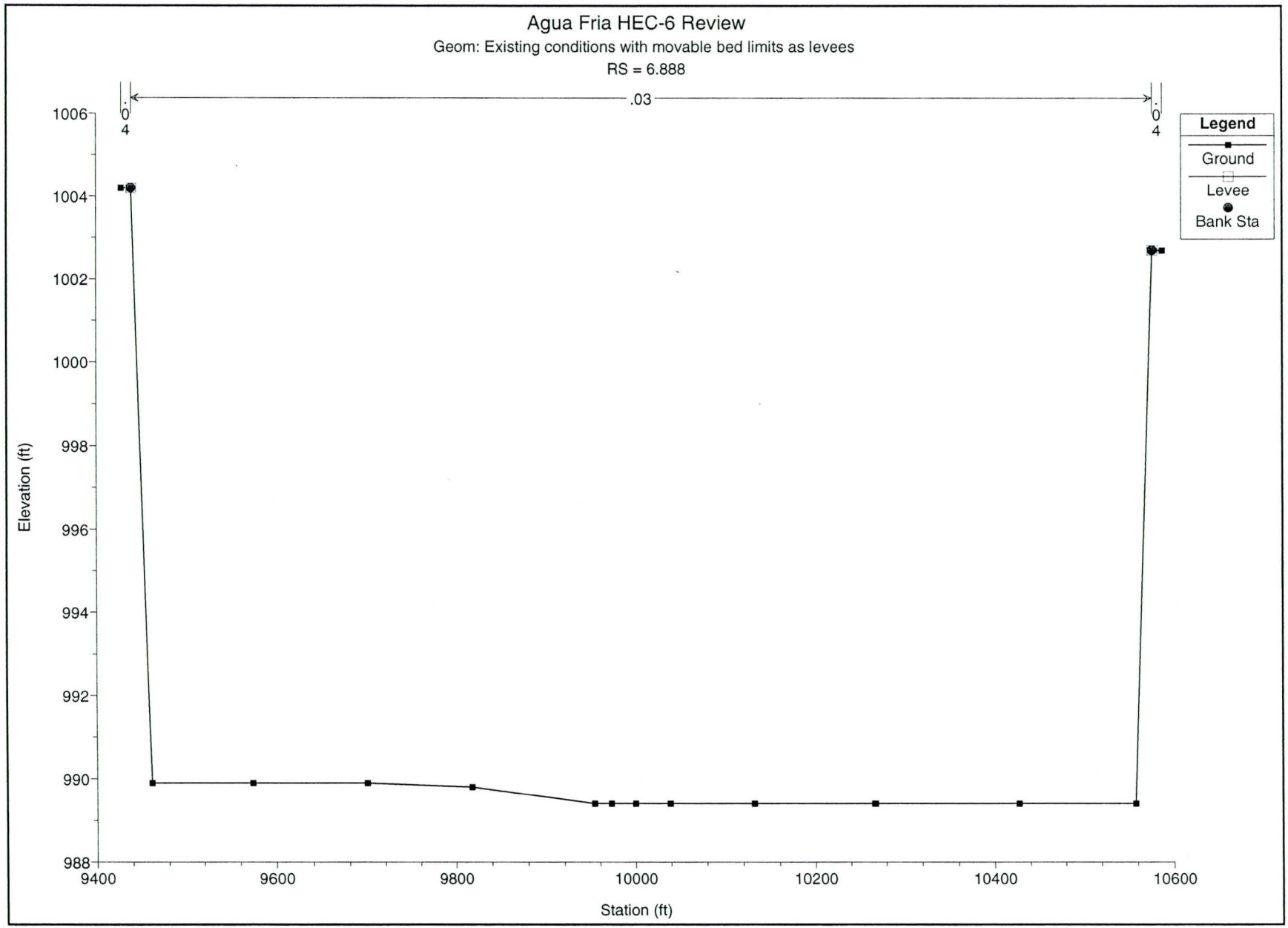

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 7.49
.04
.03
.04
Legend
Ground
Levee
Bank Sta
Elevation (ft)
1012
1010
1008
1006
1004
1002
1000
998
996
994
9400
9600
9800
10000
10200
10400
10600
Station (ft)

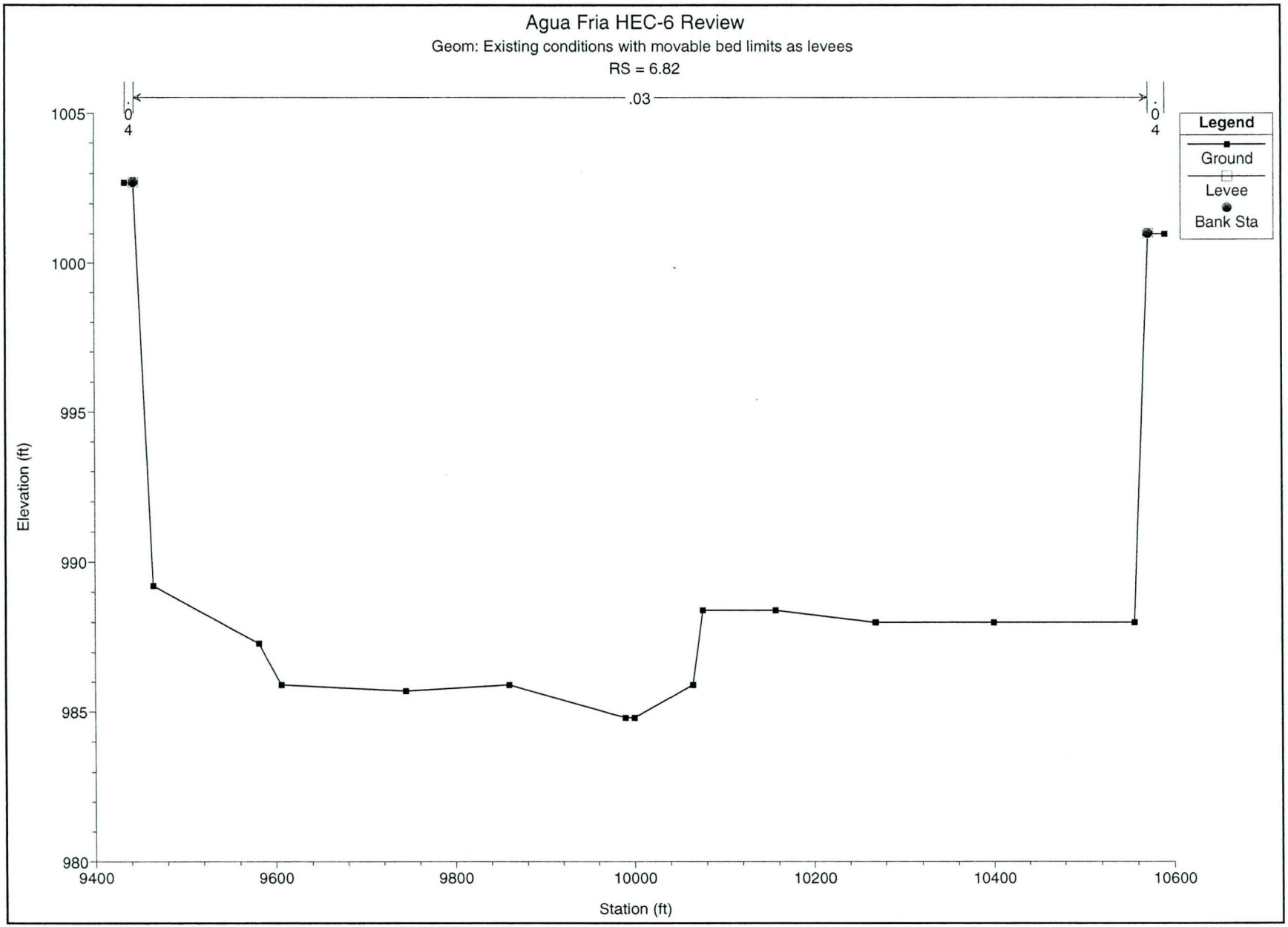

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 6.99
.03
.04
.04
Legend
Ground
Levee
Bank Sta
Elevation (ft)
1004
1002
1000
998
996
994
992
990
9200
9400
9600
9800
10000
10200
10400
10600
Station (ft)

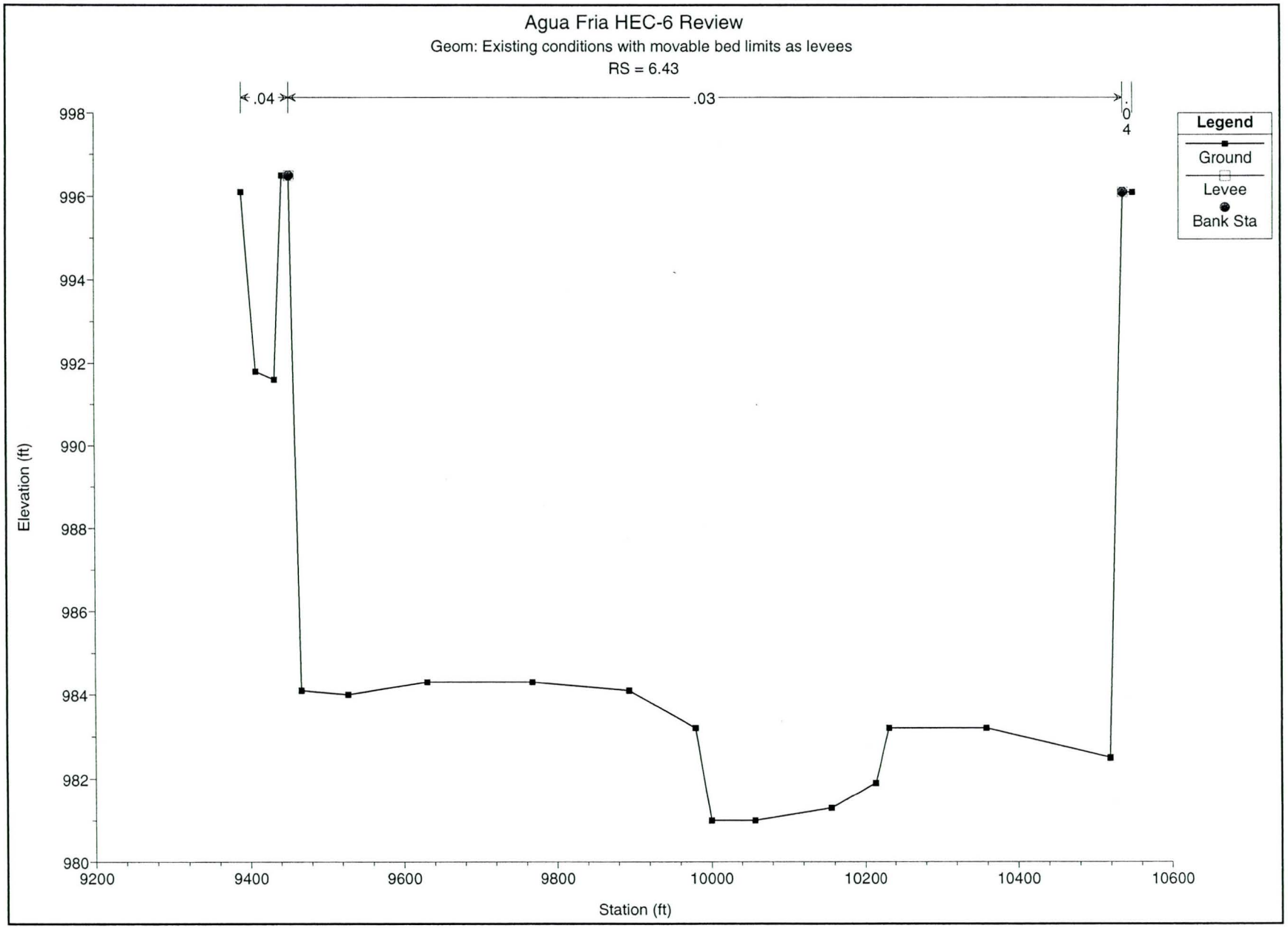

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 6.93
.03
.04
.04
Legend
Ground
Levee
Bank Sta
Elevation (ft)
1006
1004
1002
1000
998
996
994
992
990
988
9400
9600
9800
10000
10200
10400
10600
Station (ft)

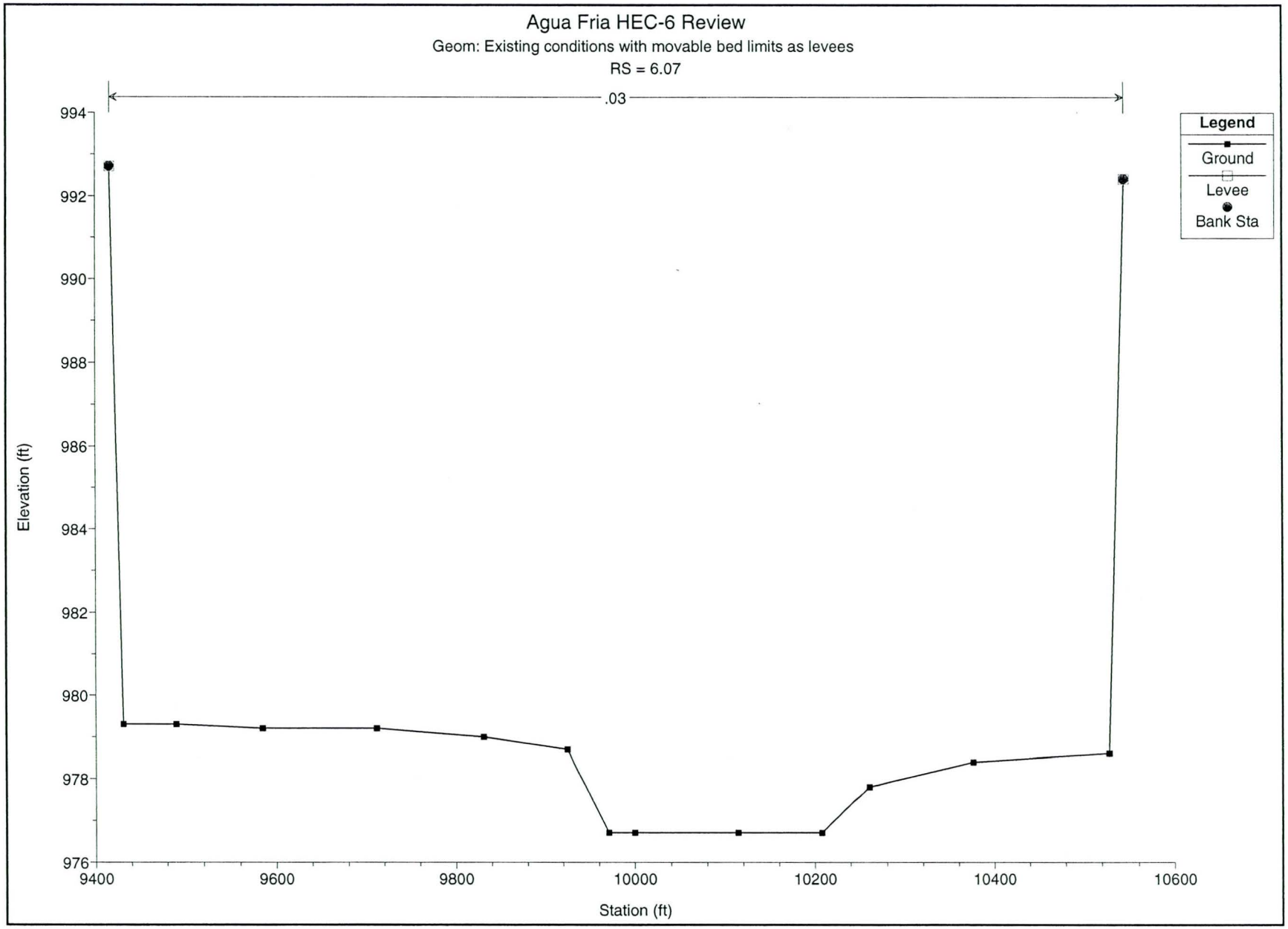

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 6.91
.03
.04
.04
Legend
Ground
Levee
Bank Sta
Elevation (ft)
1004
1002
1000
998
996
994
992
990
988
9400
9600
9800
10000
10200
10400
10600
Station (ft)

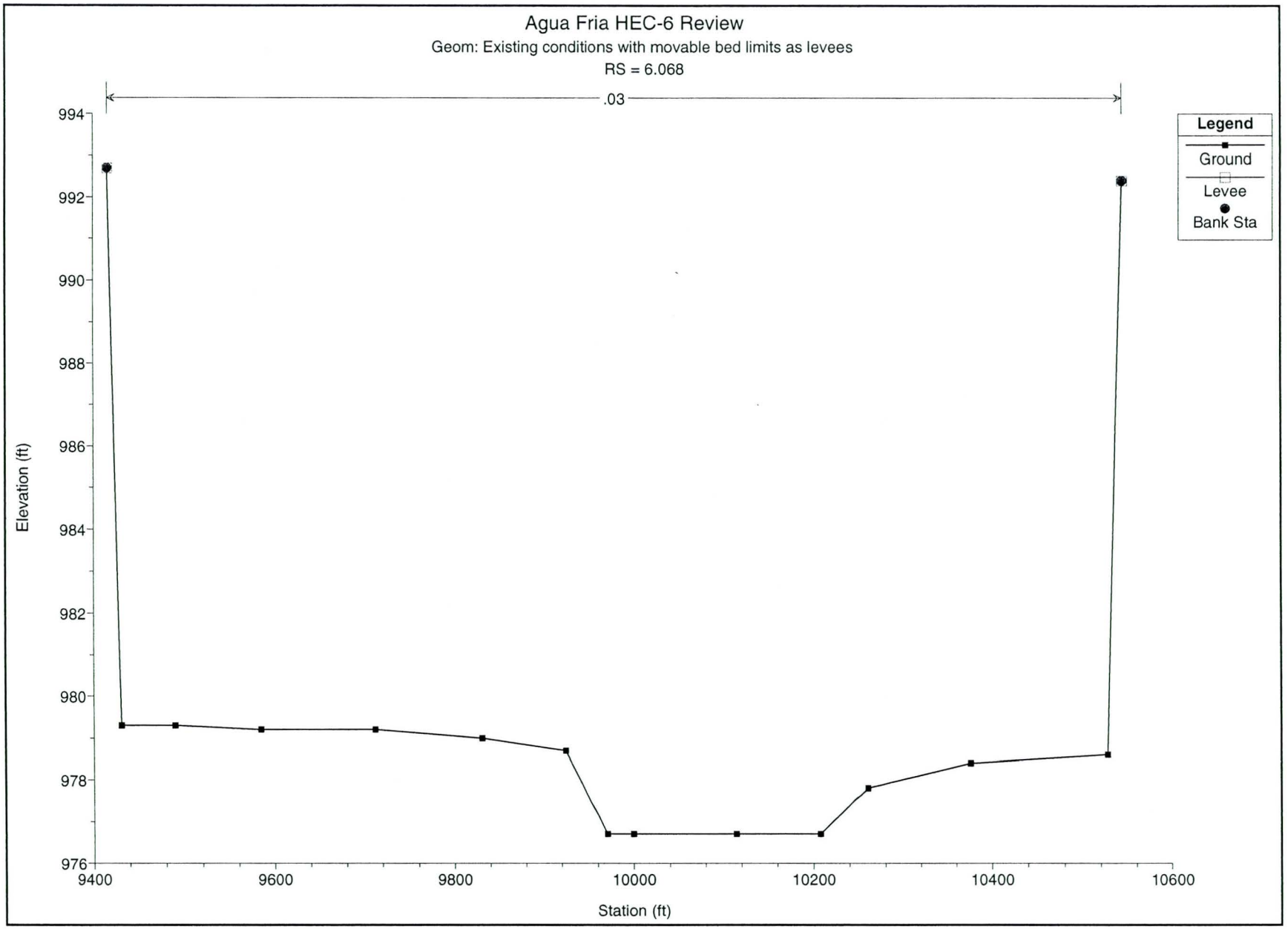

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 6.89
.03
.04
.04
Legend
Ground
Levee
Bank Sta
Elevation (ft)
1006
1004
1002
1000
998
996
994
992
990
988
9400
9600
9800
10000
10200
10400
10600
Station (ft)

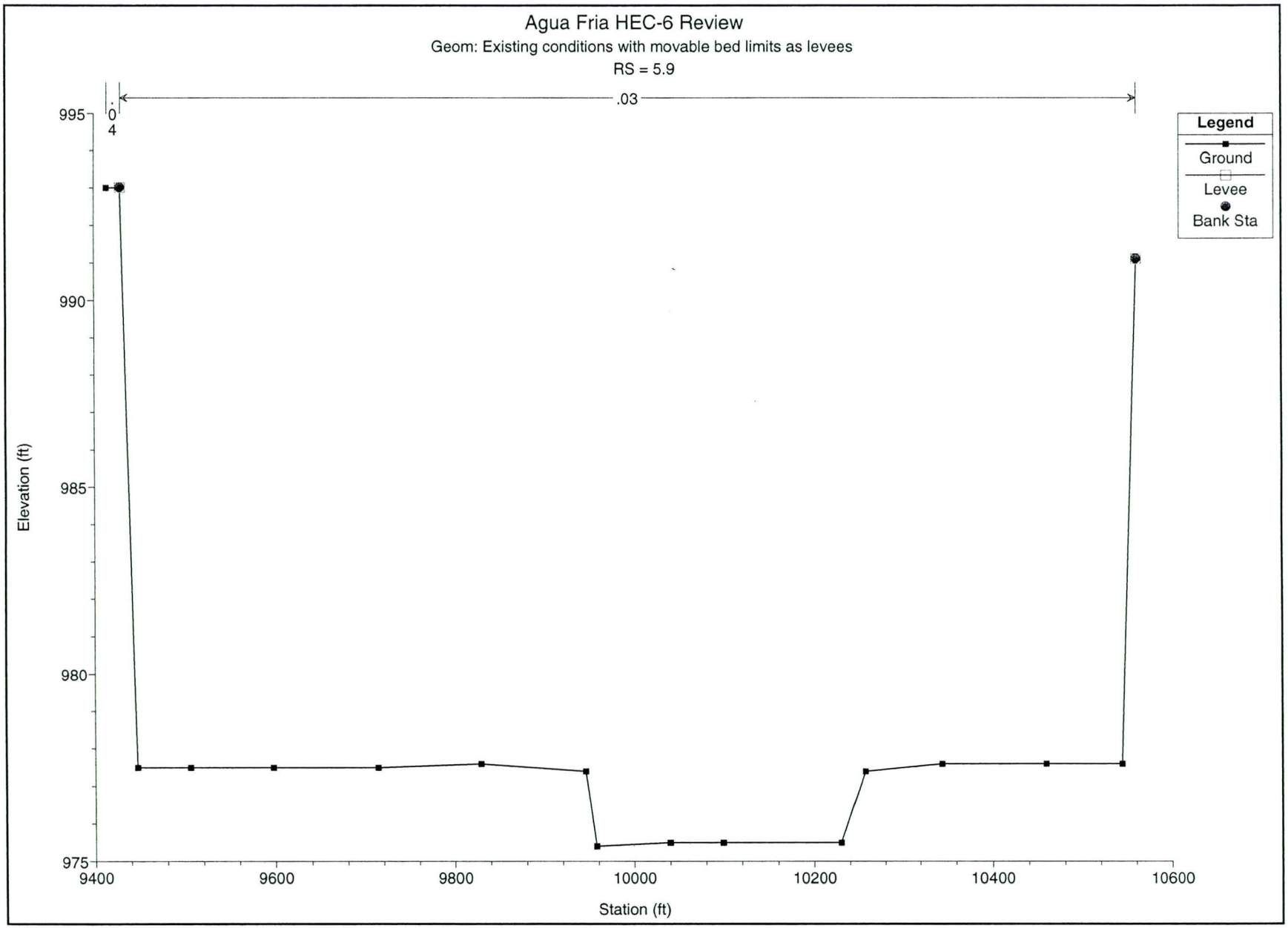

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 6.888
.04
.03
.04
Legend
Ground
Levee
Bank Sta
Elevation (ft)
1006
1004
1002
1000
998
996
994
992
990
988
9400
9600
9800
10000
10200
10400
10600
Station (ft)

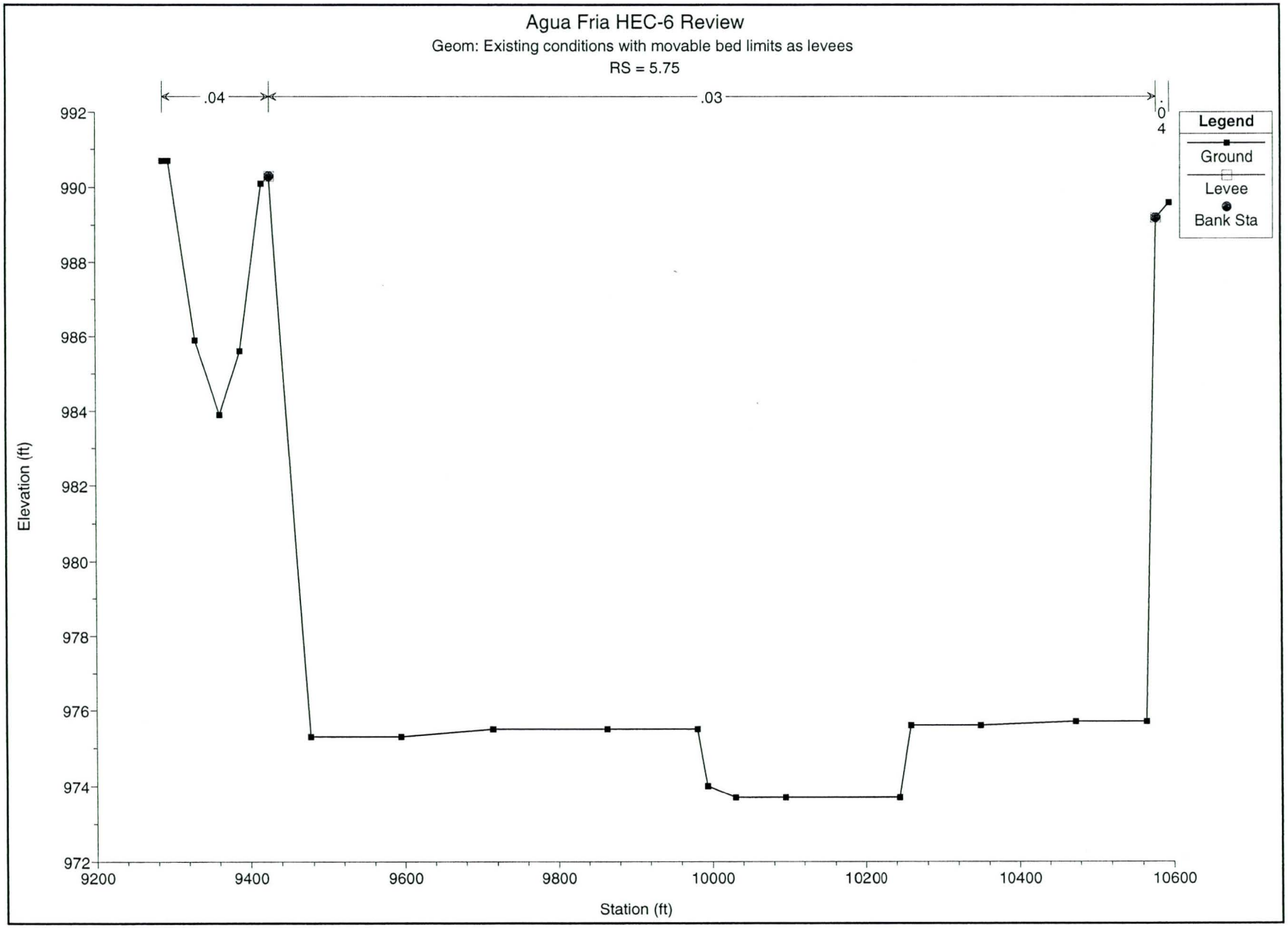

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 6.82
.03
.04
.04
Legend
Ground
Levee
Bank Sta
Elevation (ft)
1005
1000
995
990
985
980
9400
9600
9800
10000
10200
10400
10600
Station (ft)

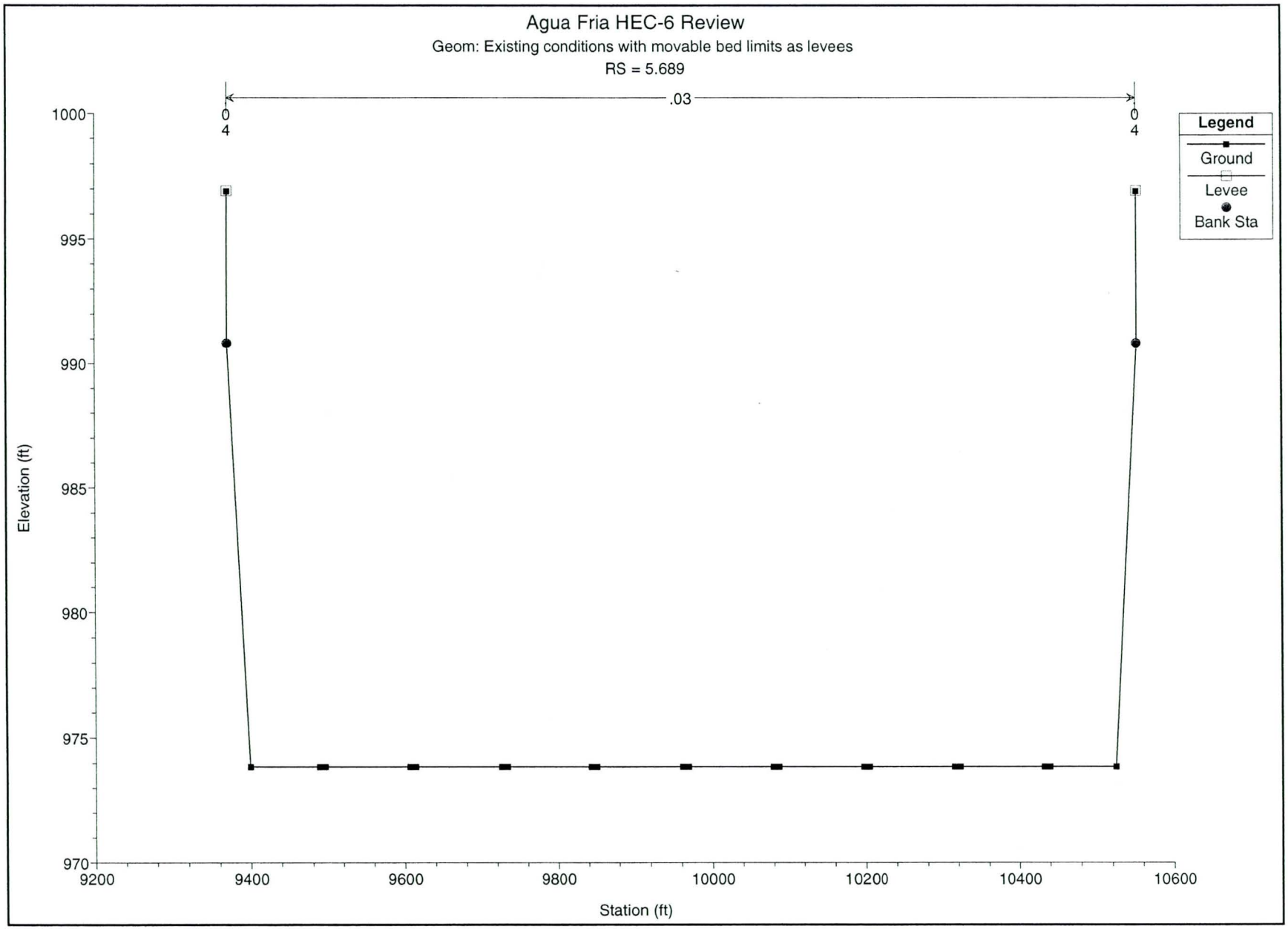

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 6.43
.04
.03
.04
Legend
Ground
Levee
Bank Sta
Elevation (ft)
998
996
994
992
990
988
986
984
982
980
9200
9400
9600
9800
10000
10200
10400
10600
Station (ft)

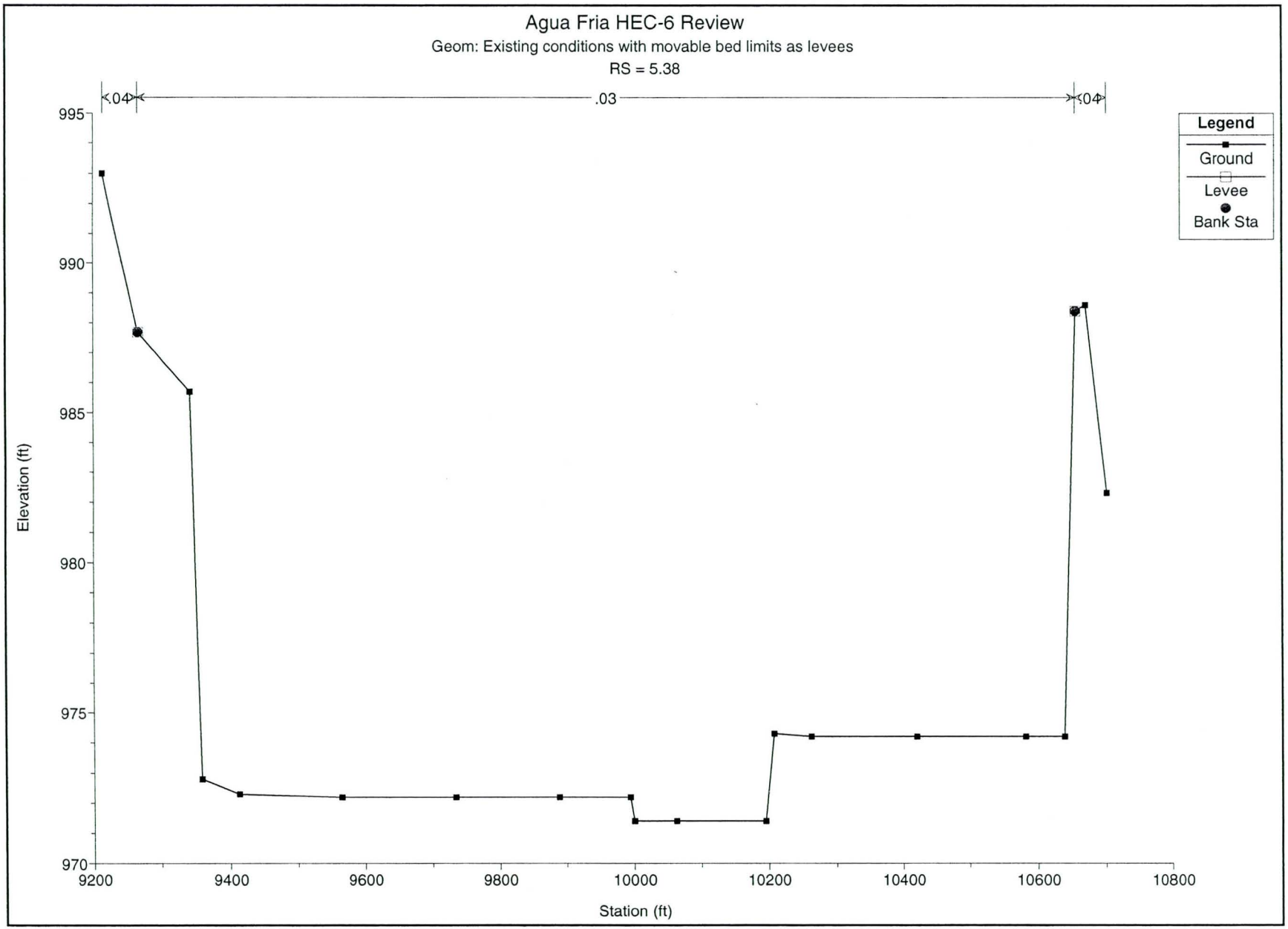

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 6.07
.03
Legend
Ground
Levee
Bank Sta
Elevation (ft)
994
992
990
988
986
984
982
980
978
976
9400
9600
9800
10000
10200
10400
10600
Station (ft)

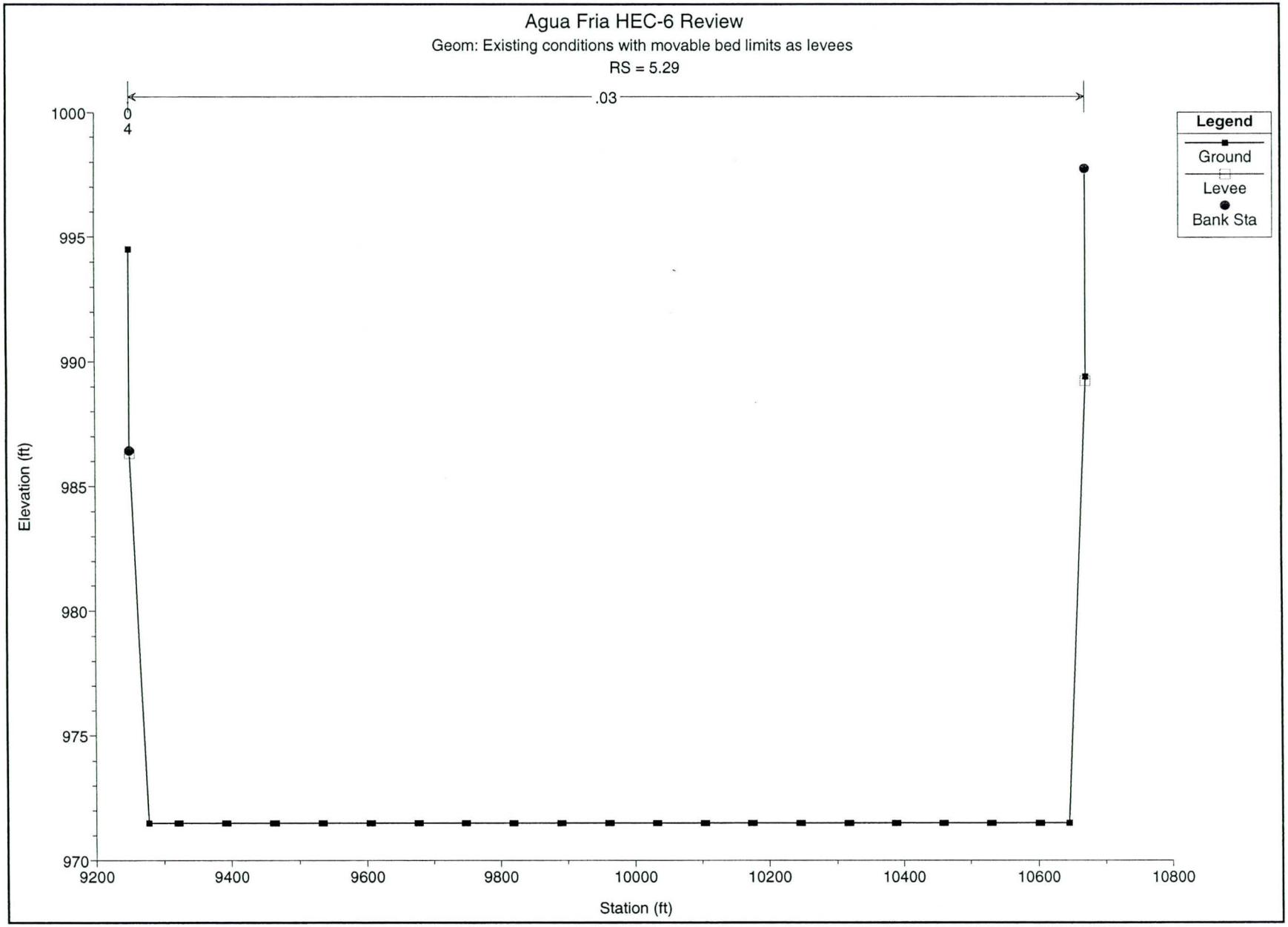

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 6.068
.03
Legend
Ground
Levee
Bank Sta
Elevation (ft)
994
992
990
988
986
984
982
980
978
976
9400
9600
9800
10000
10200
10400
10600
Station (ft)

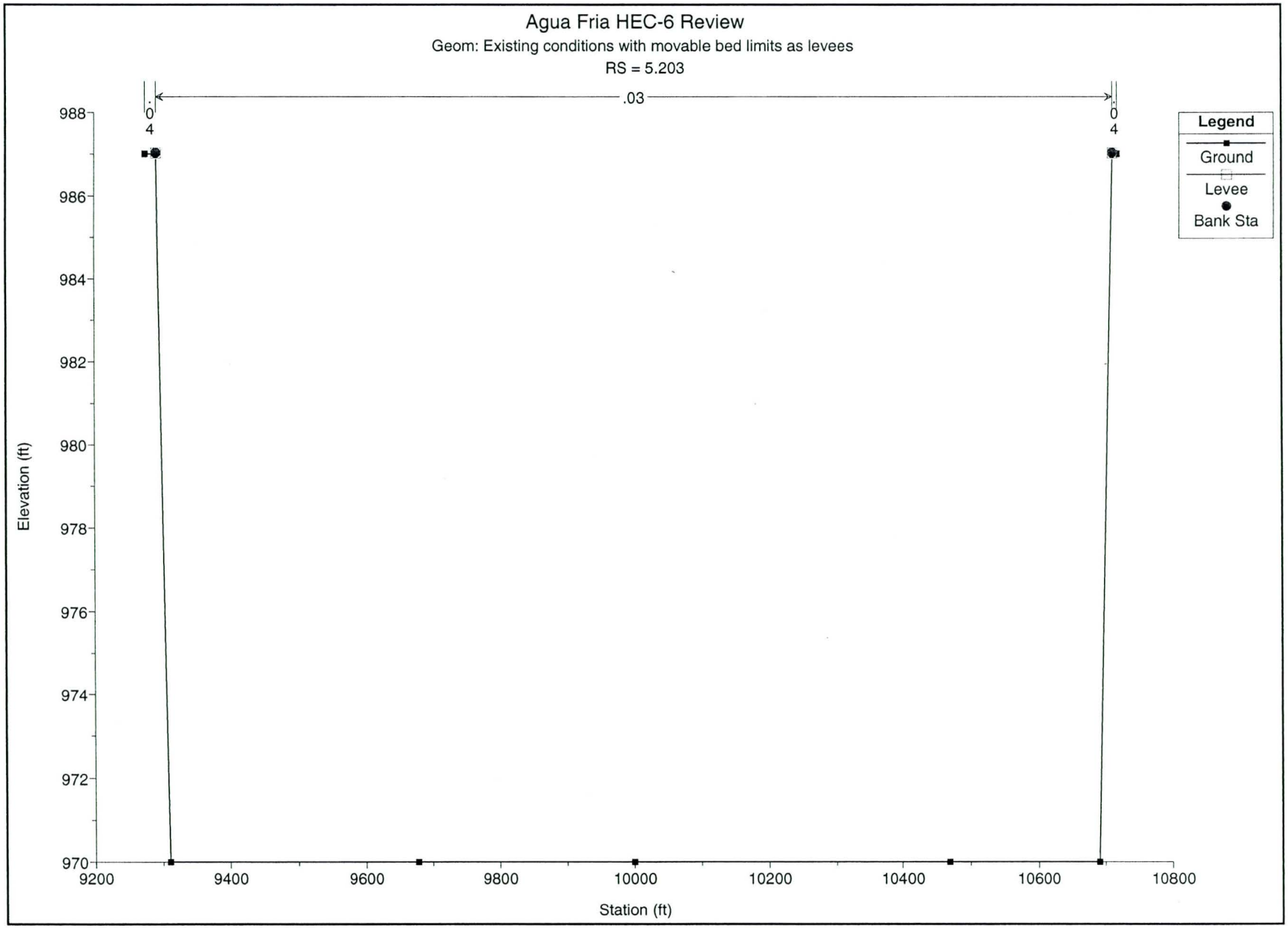

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 5.9
.04
.03
Legend
Ground
Levee
Bank Sta
Elevation (ft)
995
990
985
980
975
9400
9600
9800
10000
10200
10400
10600
Station (ft)

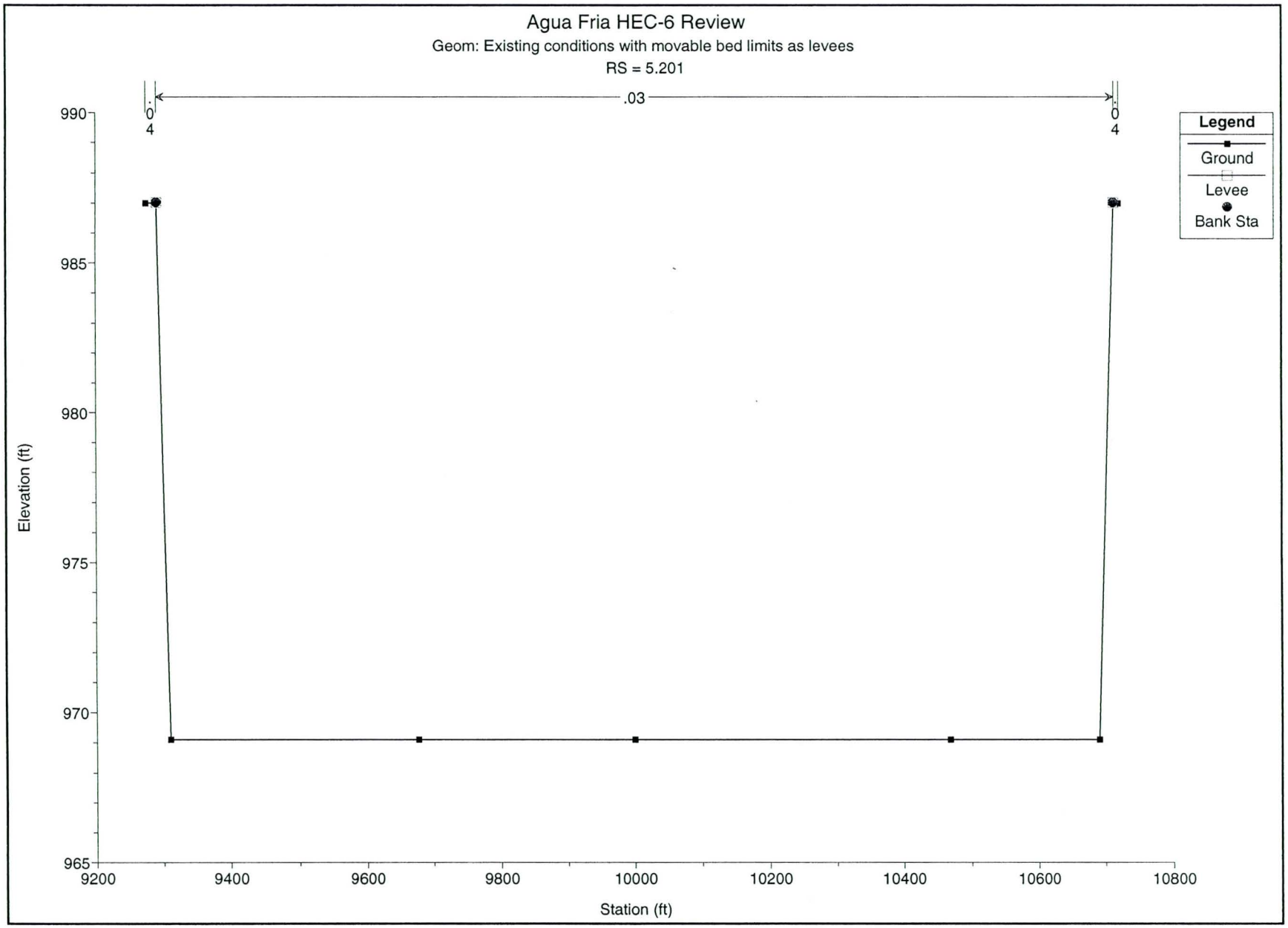

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 5.75
.04
.03
.04
Legend
Ground
Levee
Bank Sta
Elevation (ft)
992
990
988
986
984
982
980
978
976
974
972
9200
9400
9600
9800
10000
10200
10400
10600
Station (ft)

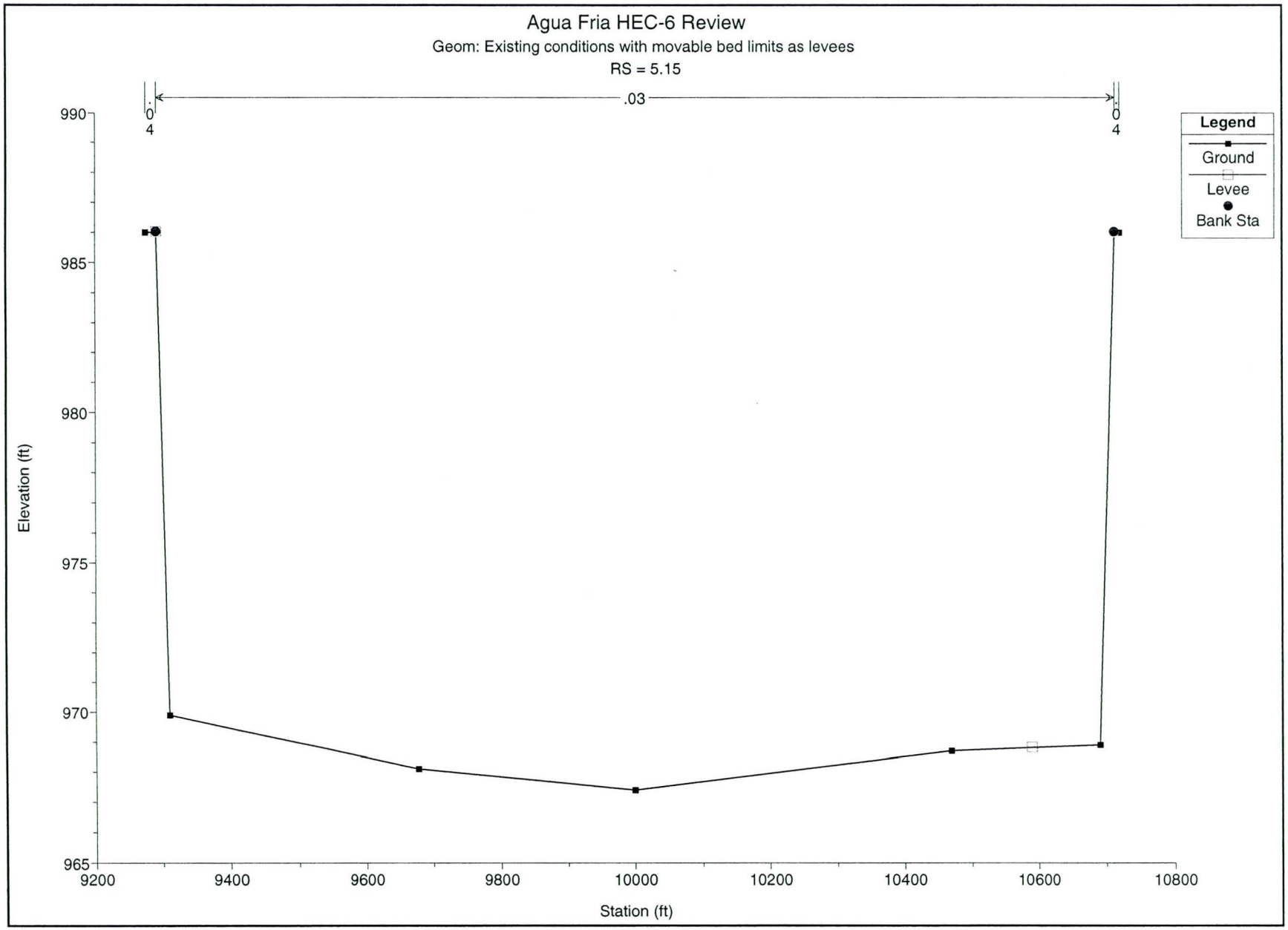

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 5.689
.03
0
4
0
4
Legend
Ground
Levee
Bank Sta
Elevation (ft)
1000
995
990
985
980
975
970
9200
9400
9600
9800
10000
10200
10400
10600
Station (ft)

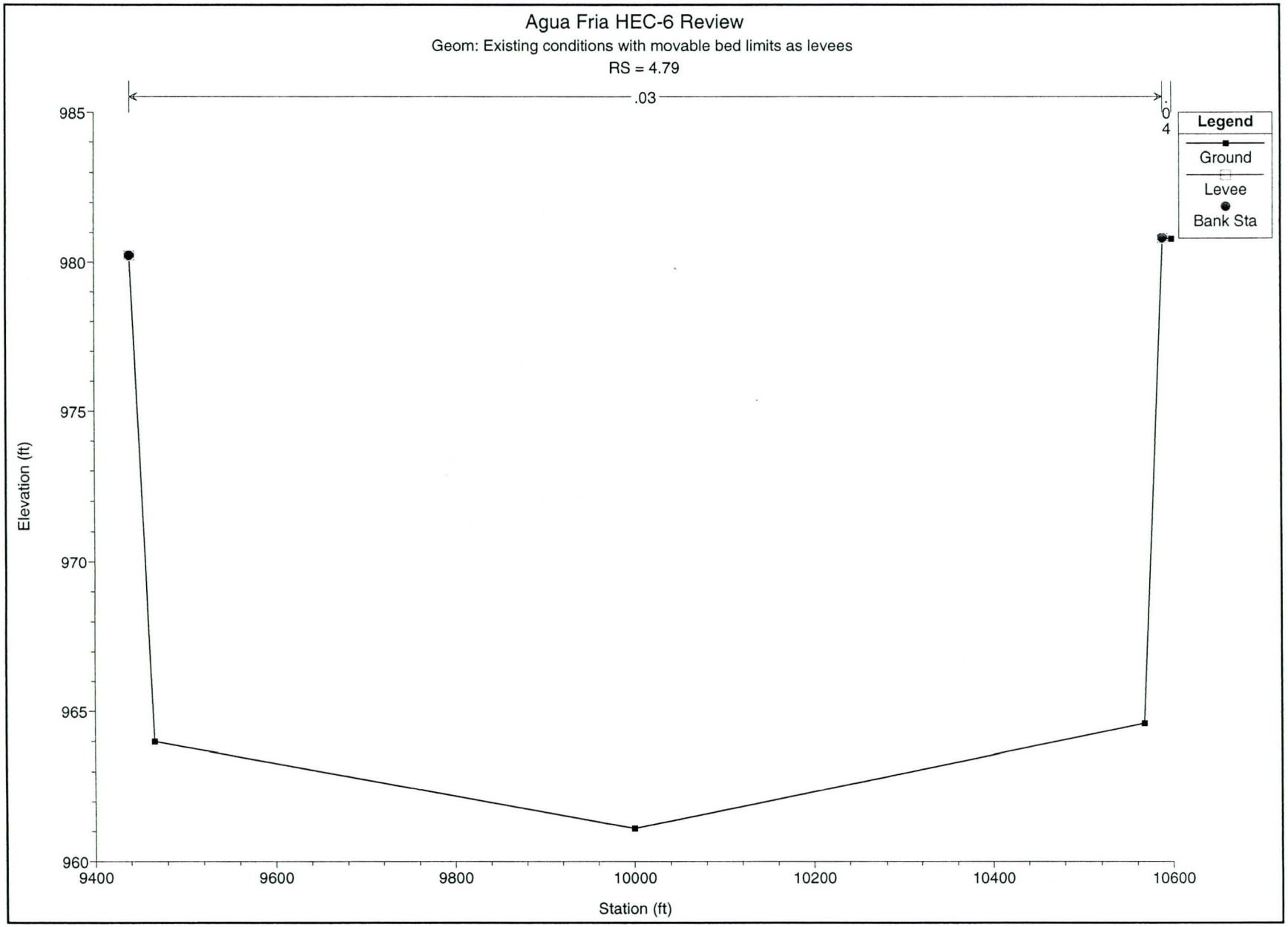

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 5.38
.04
.03
.04
Legend
Ground
Levee
Bank Sta
995
990
985
980
975
970
Elevation (ft)
9200
9400
9600
9800
10000
10200
10400
10600
10800
Station (ft)

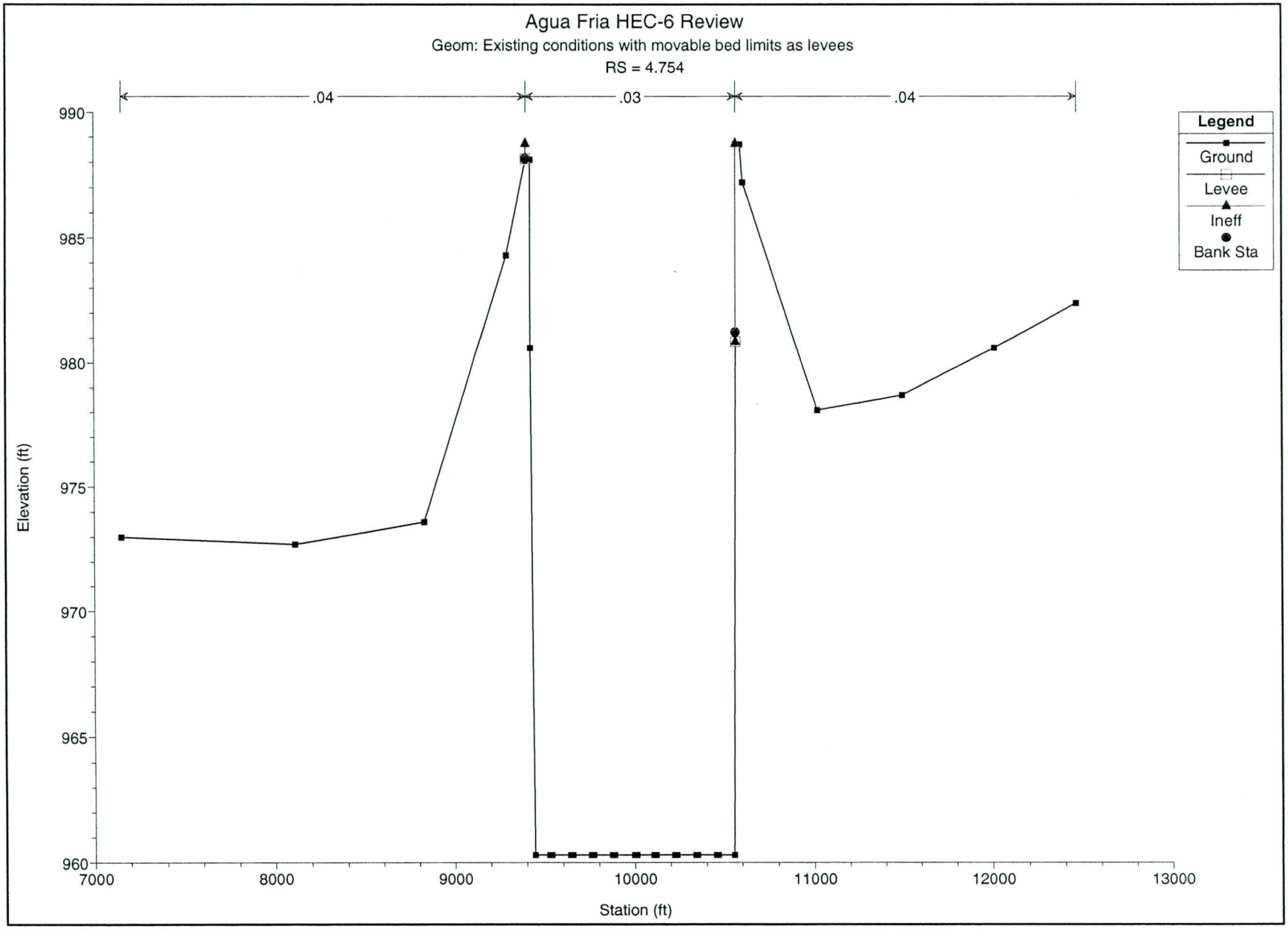

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 5.29
.03
0
4
Legend
Ground
Levee
Bank Sta
Elevation (ft)
1000
995
990
985
980
975
970
9200
9400
9600
9800
10000
10200
10400
10600
10800
Station (ft)

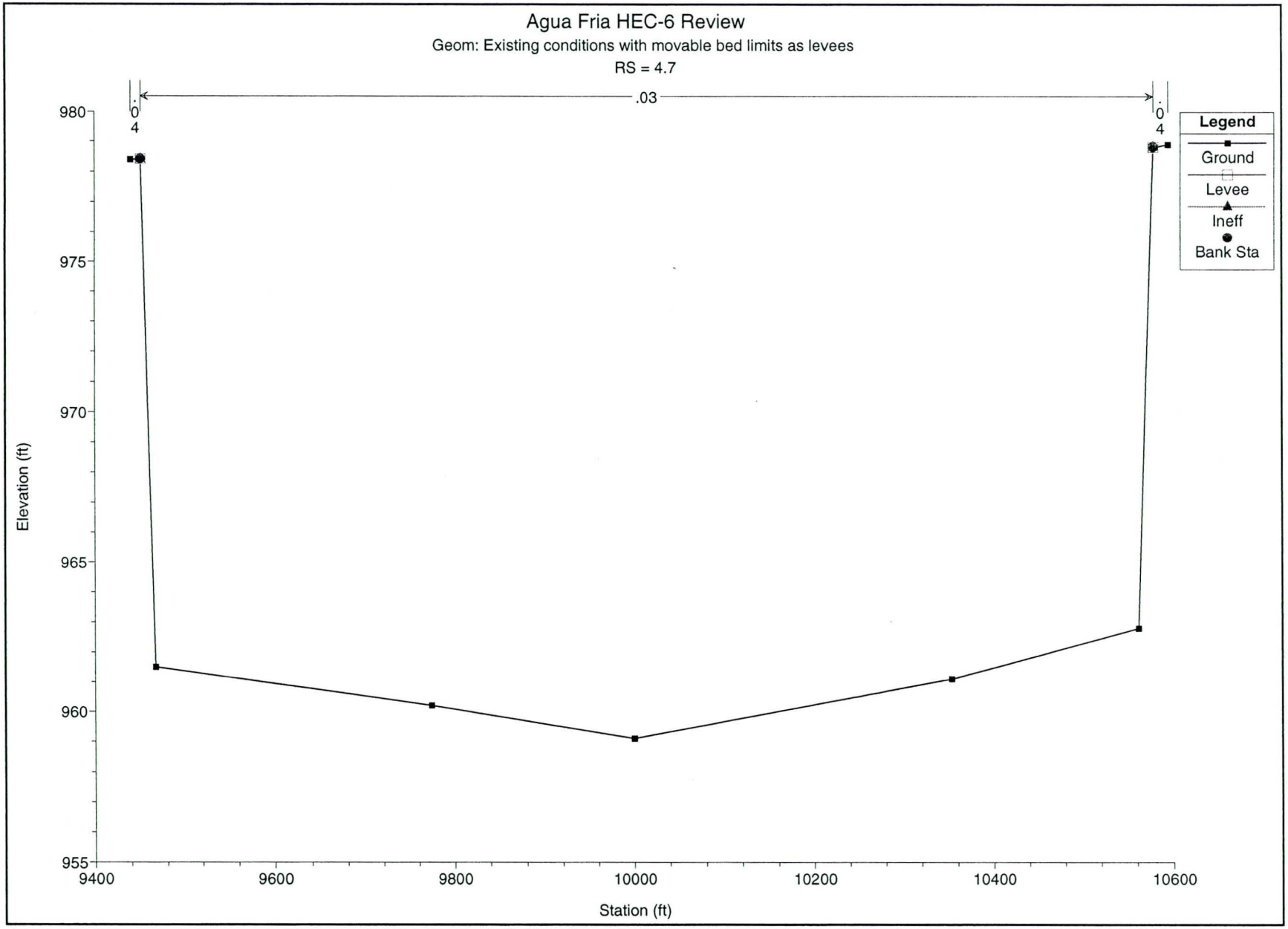

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 5.203
.03
0
4
0
4
Legend
Ground
Levee
Bank Sta
Elevation (ft)
988
986
984
982
980
978
976
974
972
970
9200
9400
9600
9800
10000
10200
10400
10600
10800
Station (ft)

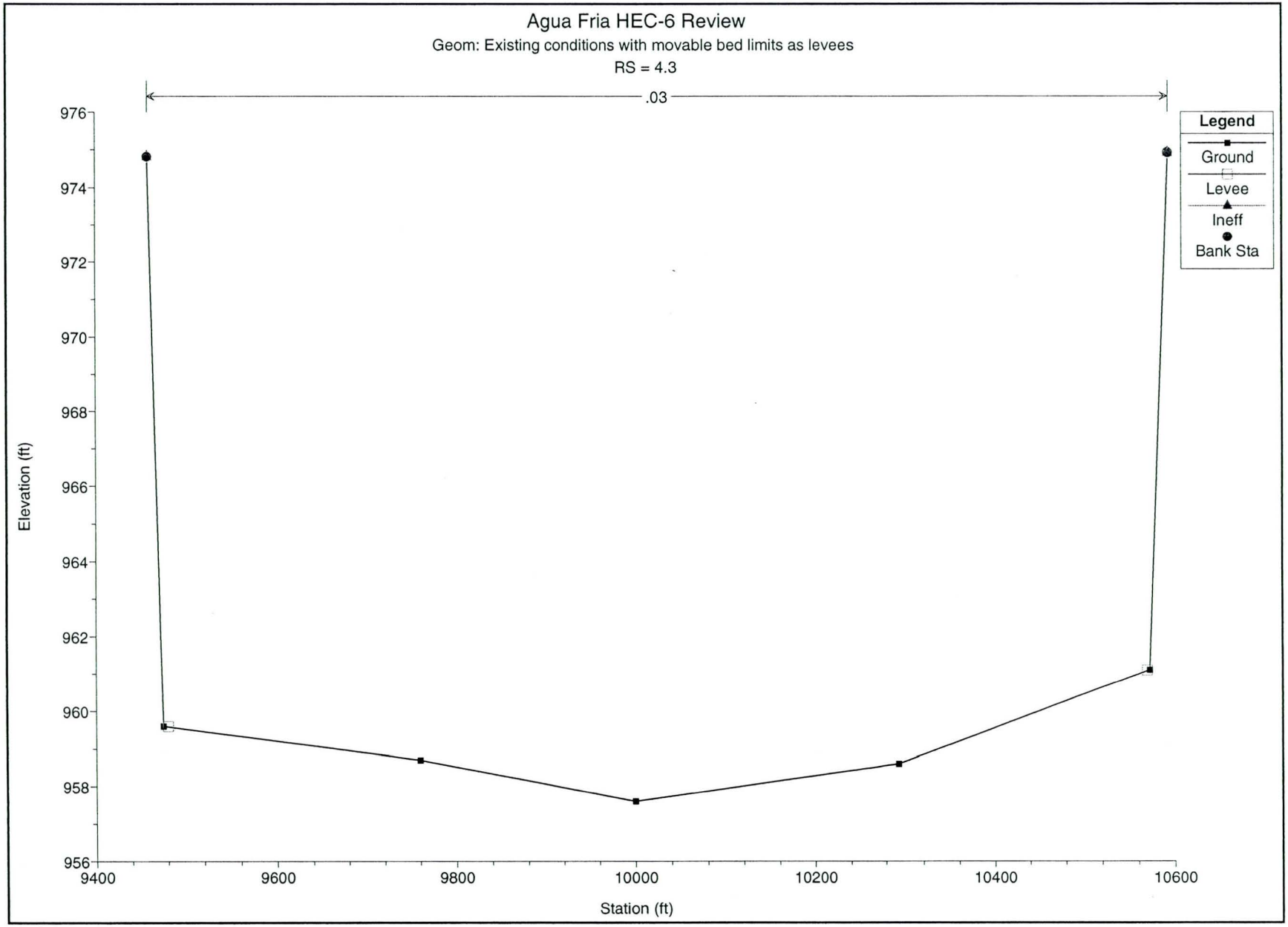

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 5.201
.03
0
4
0
4
Legend
Ground
Levee
Bank Sta
990
985
980
975
970
965
Elevation (ft)
9200
9400
9600
9800
10000
10200
10400
10600
10800
Station (ft)

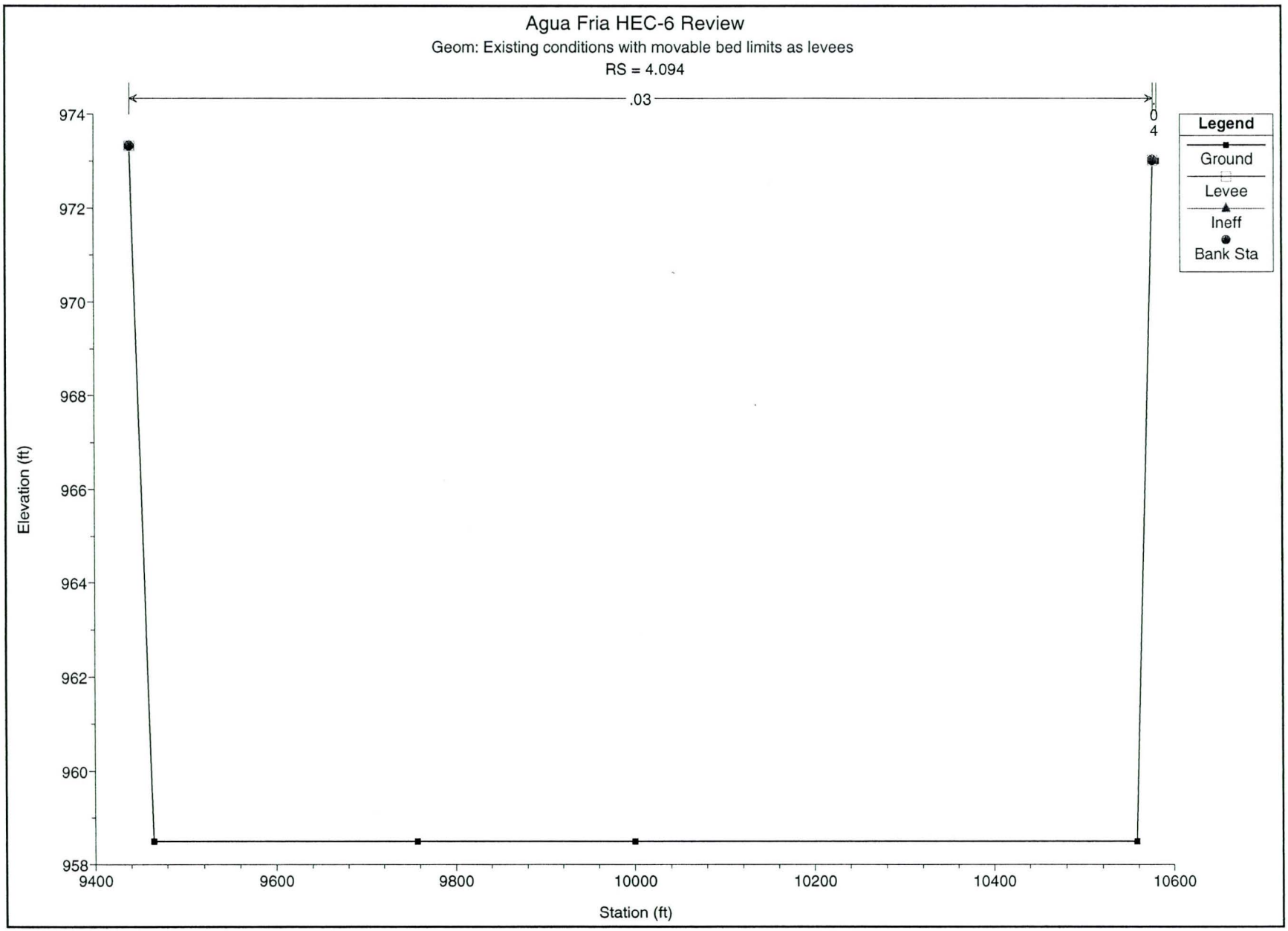

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 5.15
.03
0
4
0
4
Legend
Ground
Levee
Bank Sta
990
985
980
975
970
965
Elevation (ft)
9200
9400
9600
9800
10000
10200
10400
10600
10800
Station (ft)

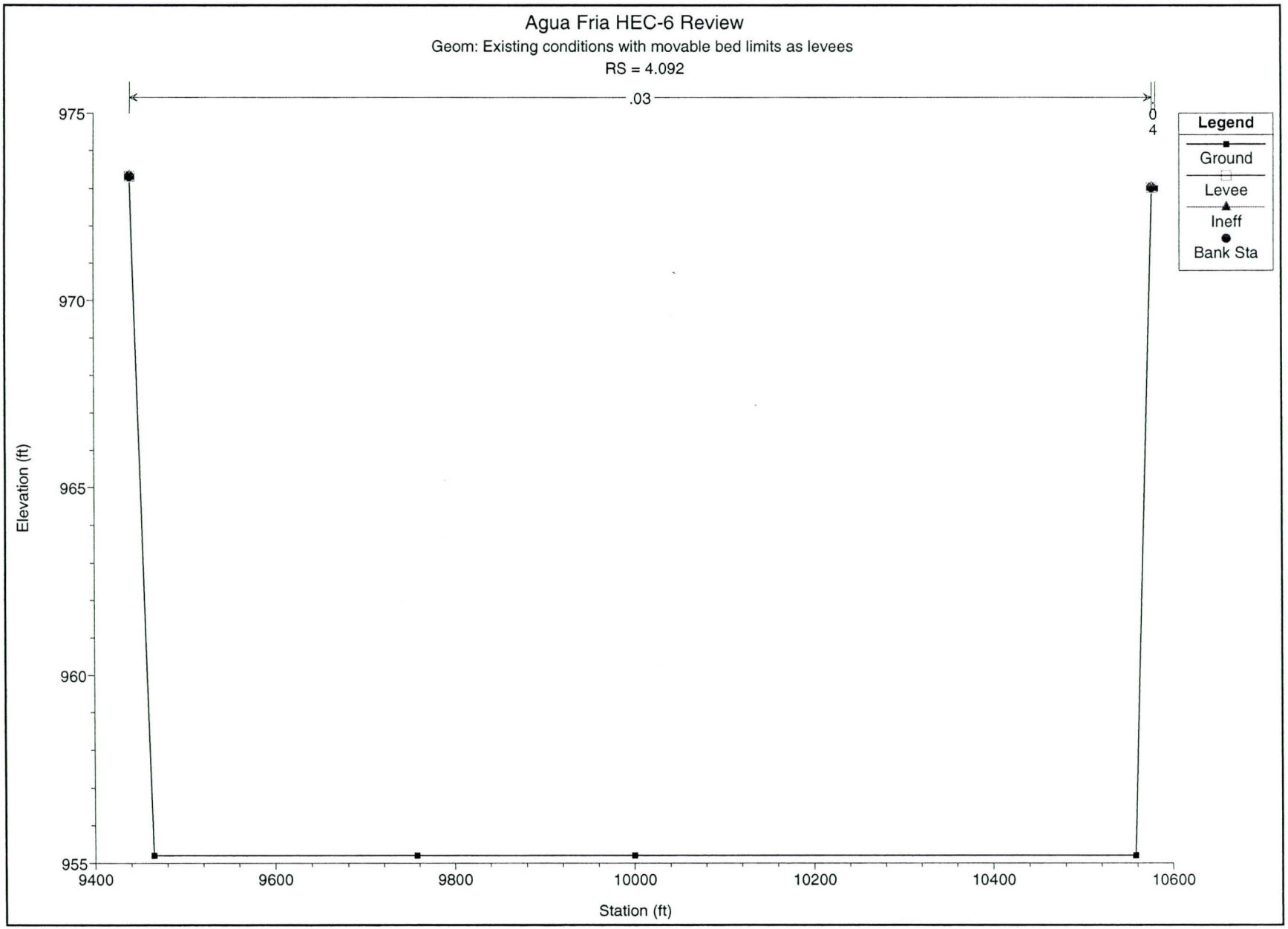

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 4.79
.03
.04
Legend
Ground
Levee
Bank Sta
Elevation (ft)
985
980
975
970
965
960
9400
9600
9800
10000
10200
10400
10600
Station (ft)

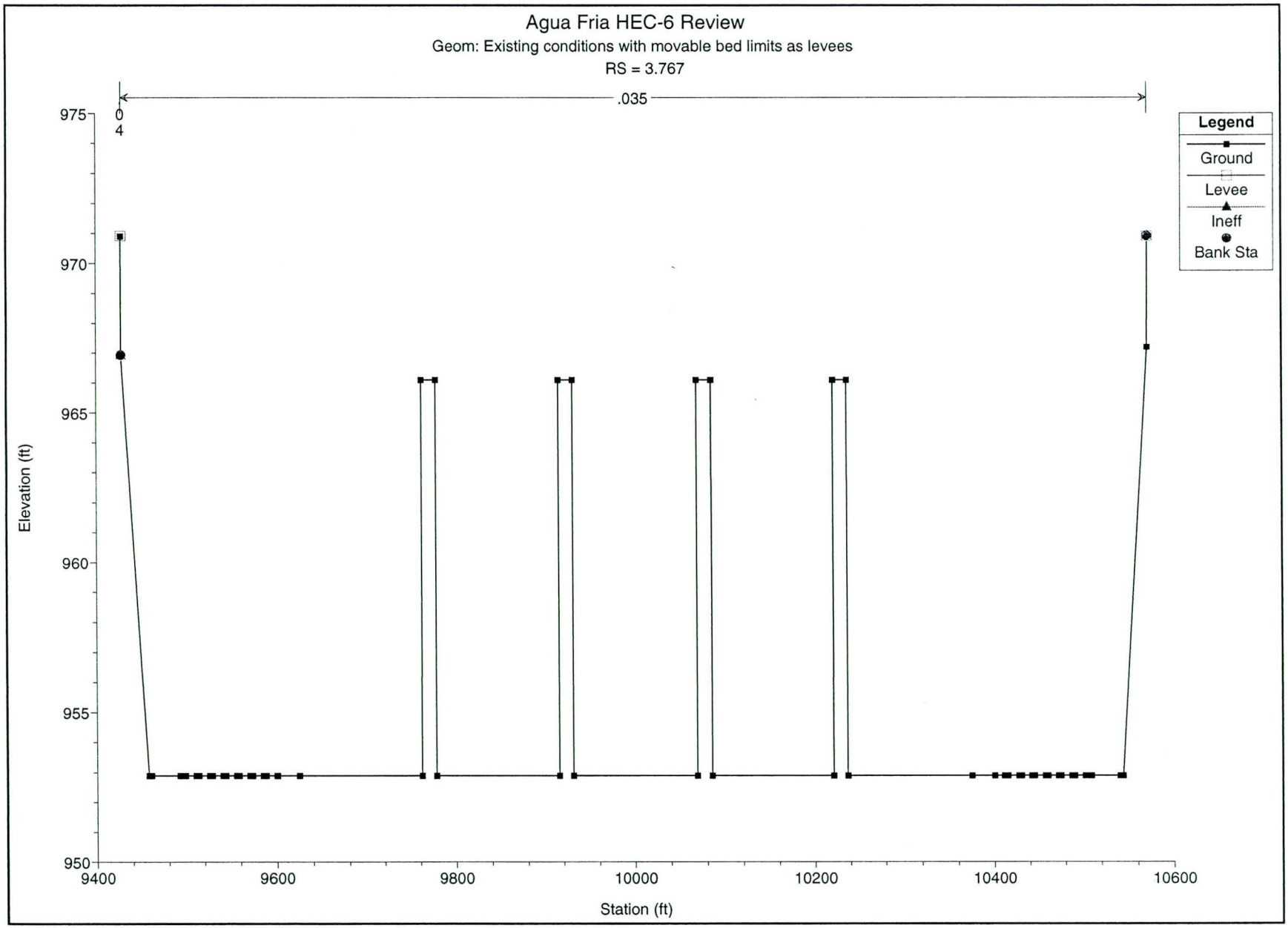

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 4.754
.04
.03
.04
Legend
Ground
Levee
Ineff
Bank Sta
990
985
980
975
970
965
960
Elevation (ft)
7000
8000
9000
10000
11000
12000
13000
Station (ft)

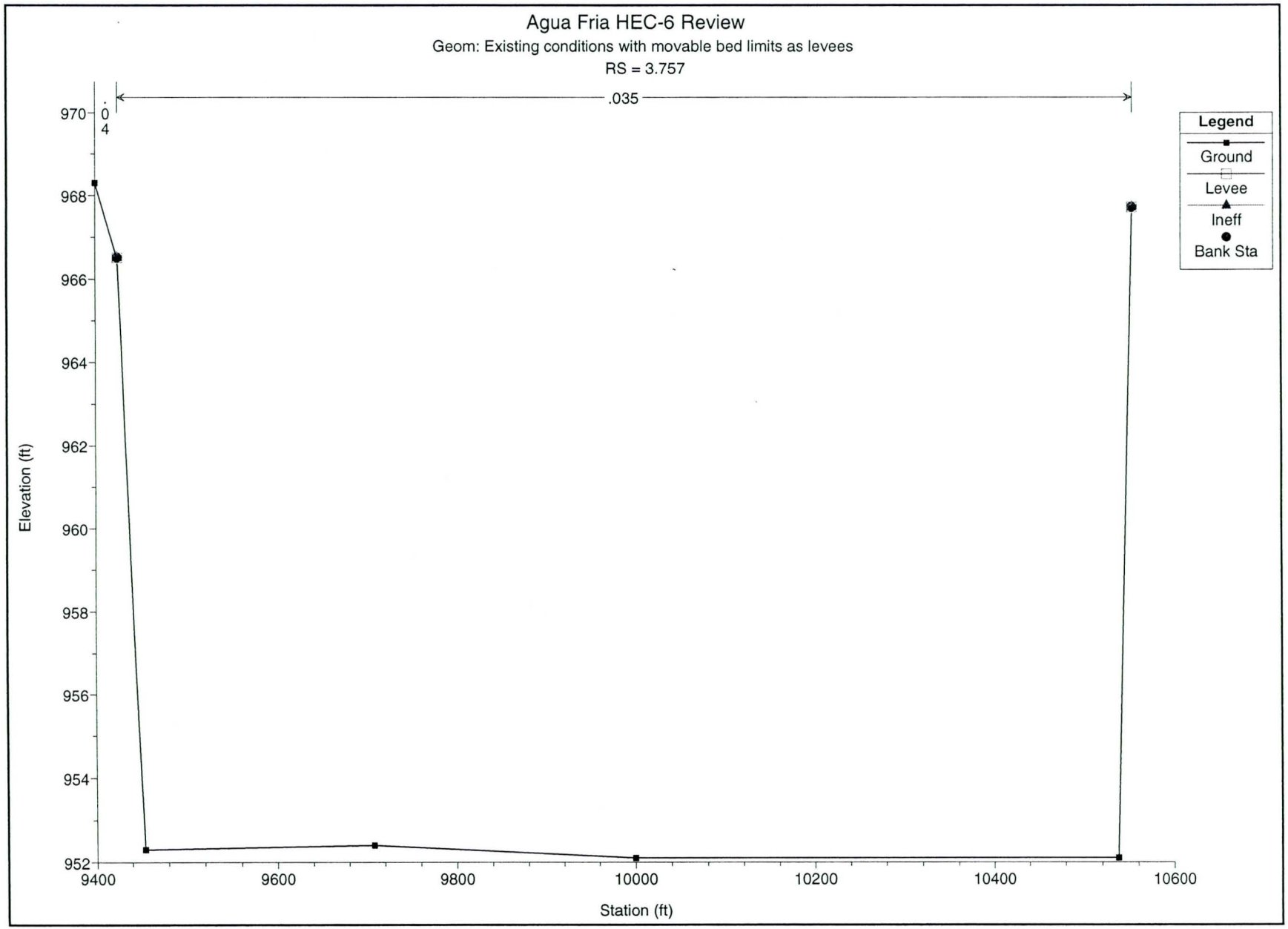

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 4.7
.03
.04
.04
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
980
975
970
965
960
955
9400
9600
9800
10000
10200
10400
10600
Station (ft)

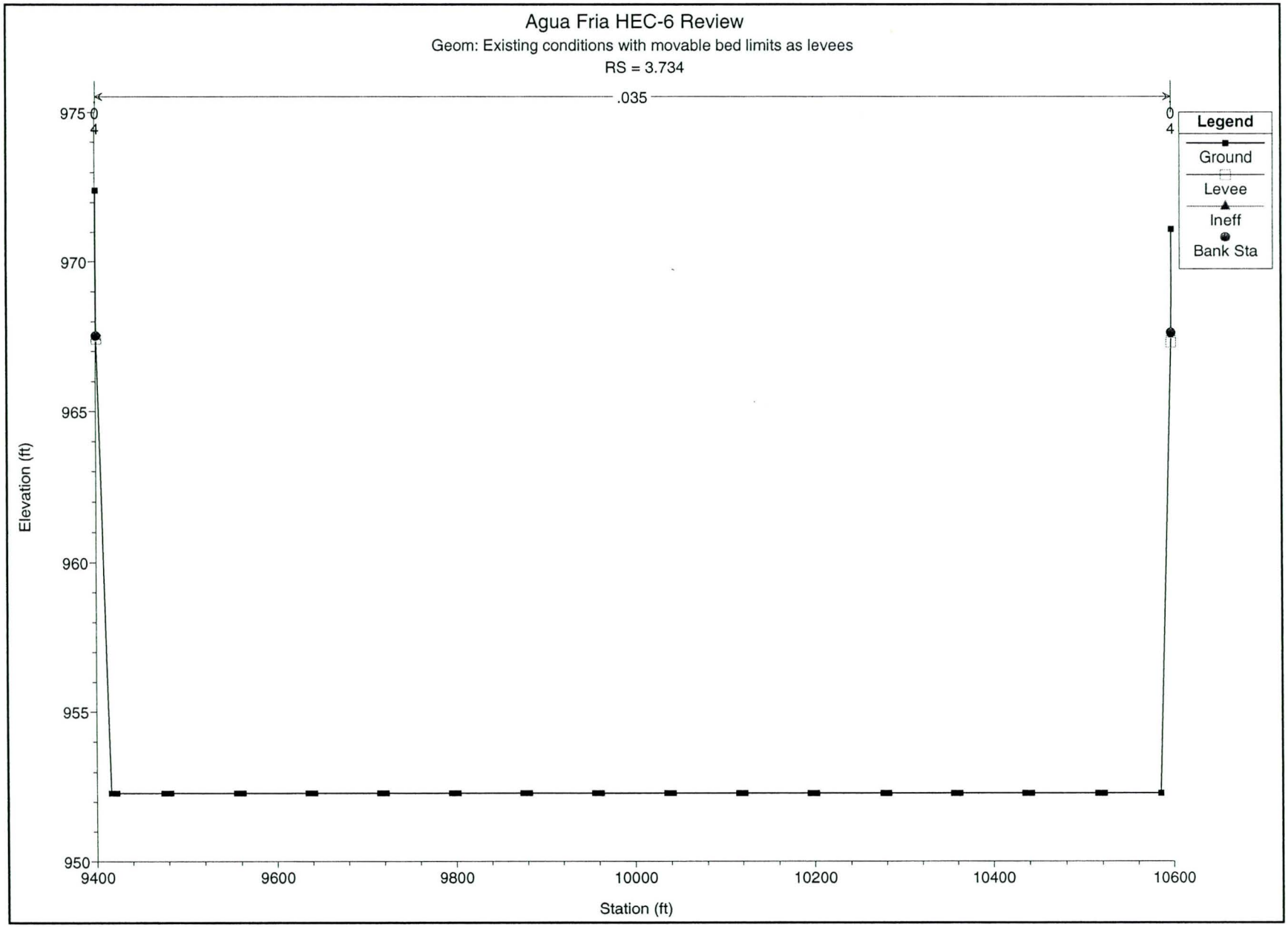

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 4.3
.03
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
976
974
972
970
968
966
964
962
960
958
956
9400
9600
9800
10000
10200
10400
10600
Station (ft)

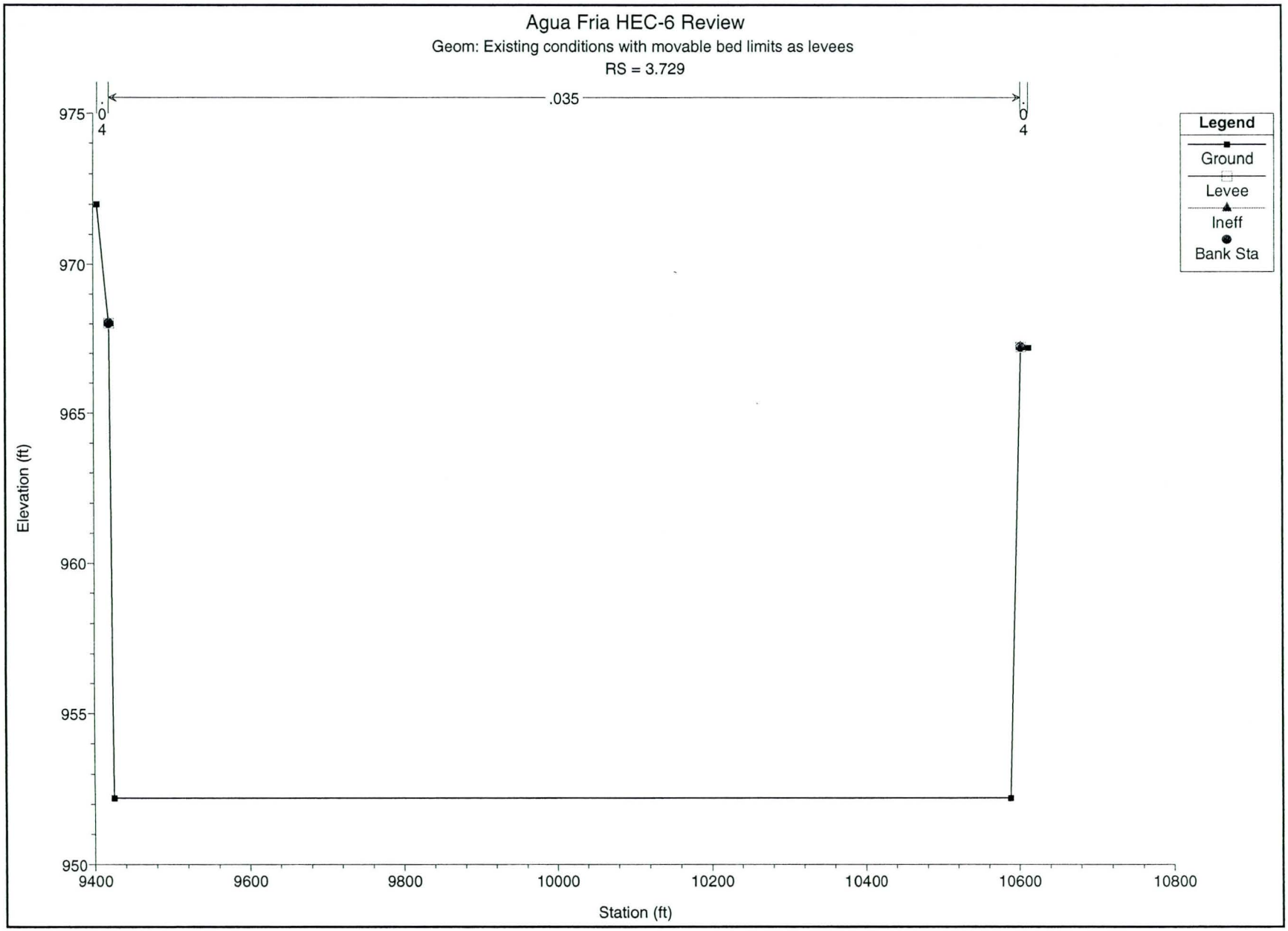

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 4.094
.03
0
4
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
974
972
970
968
966
964
962
960
958
9400
9600
9800
10000
10200
10400
10600
Station (ft)

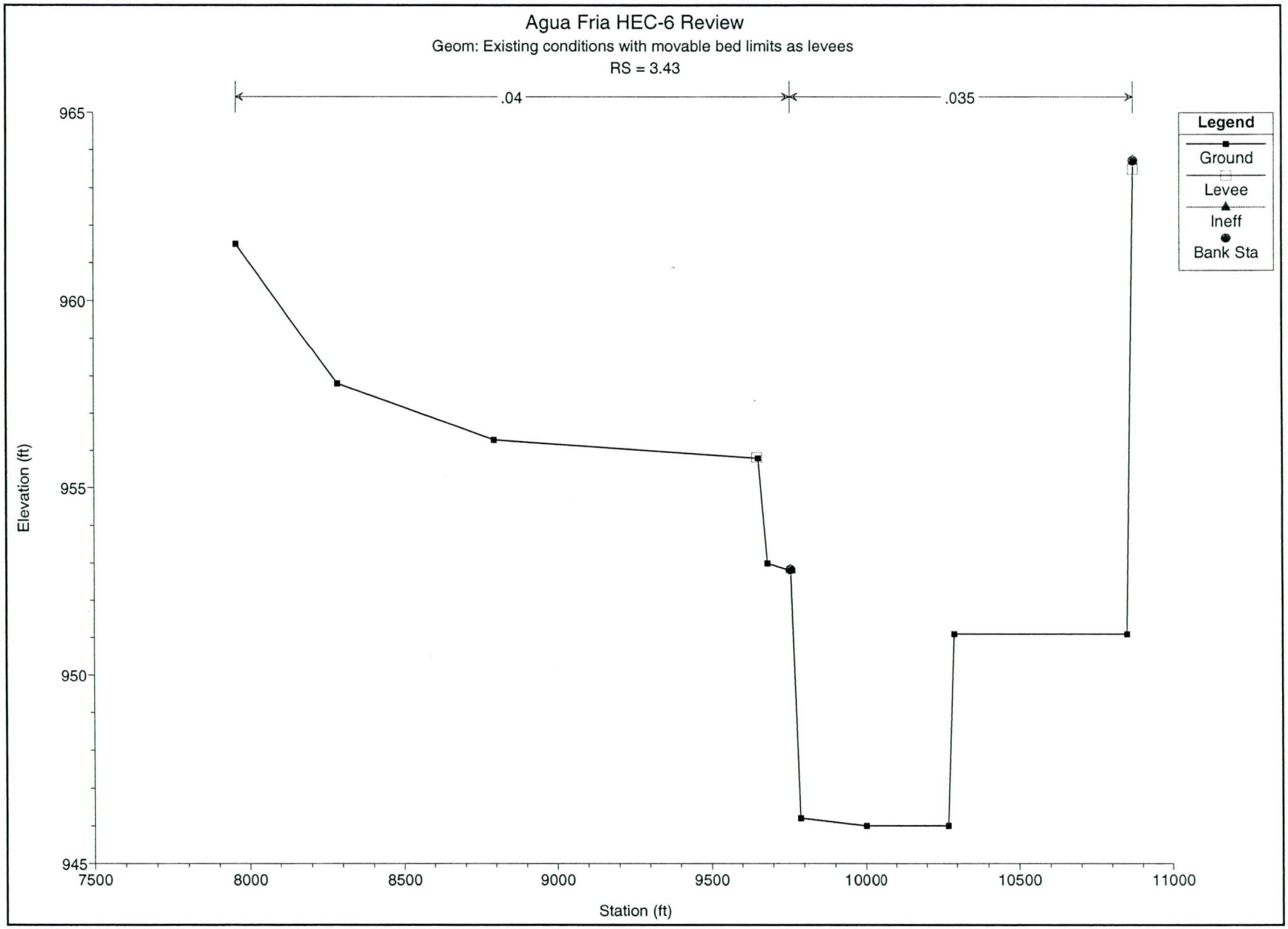

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 4.092
.03
0
4
Legend
Ground
Levee
Ineff
Bank Sta
975
970
965
960
955
Elevation (ft)
9400
9600
9800
10000
10200
10400
10600
Station (ft)

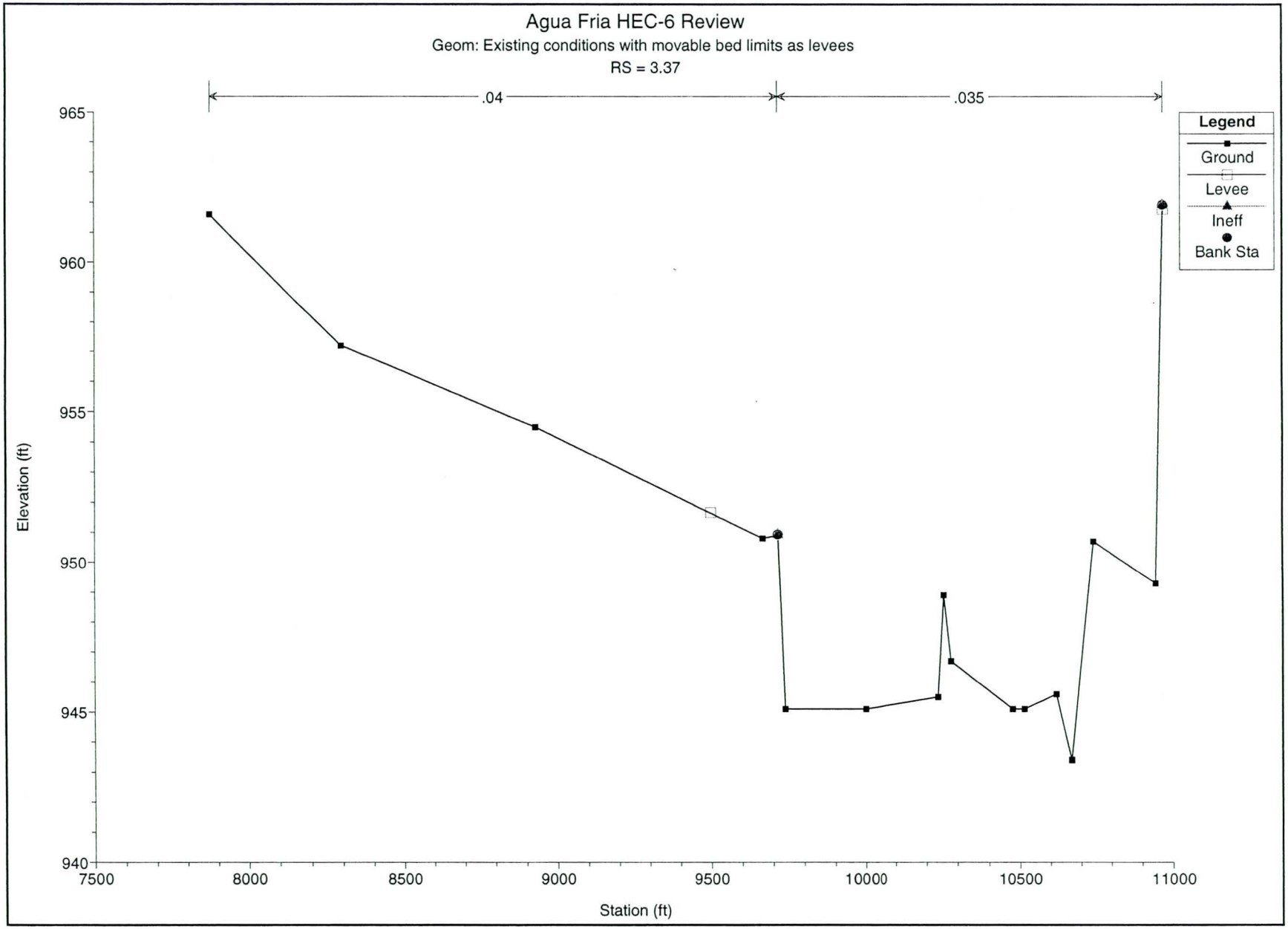

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 3.767
.035
0
4
Legend
Ground
Levee
Ineff
Bank Sta
975
970
965
960
955
950
Elevation (ft)
9400
9600
9800
10000
10200
10400
10600
Station (ft)

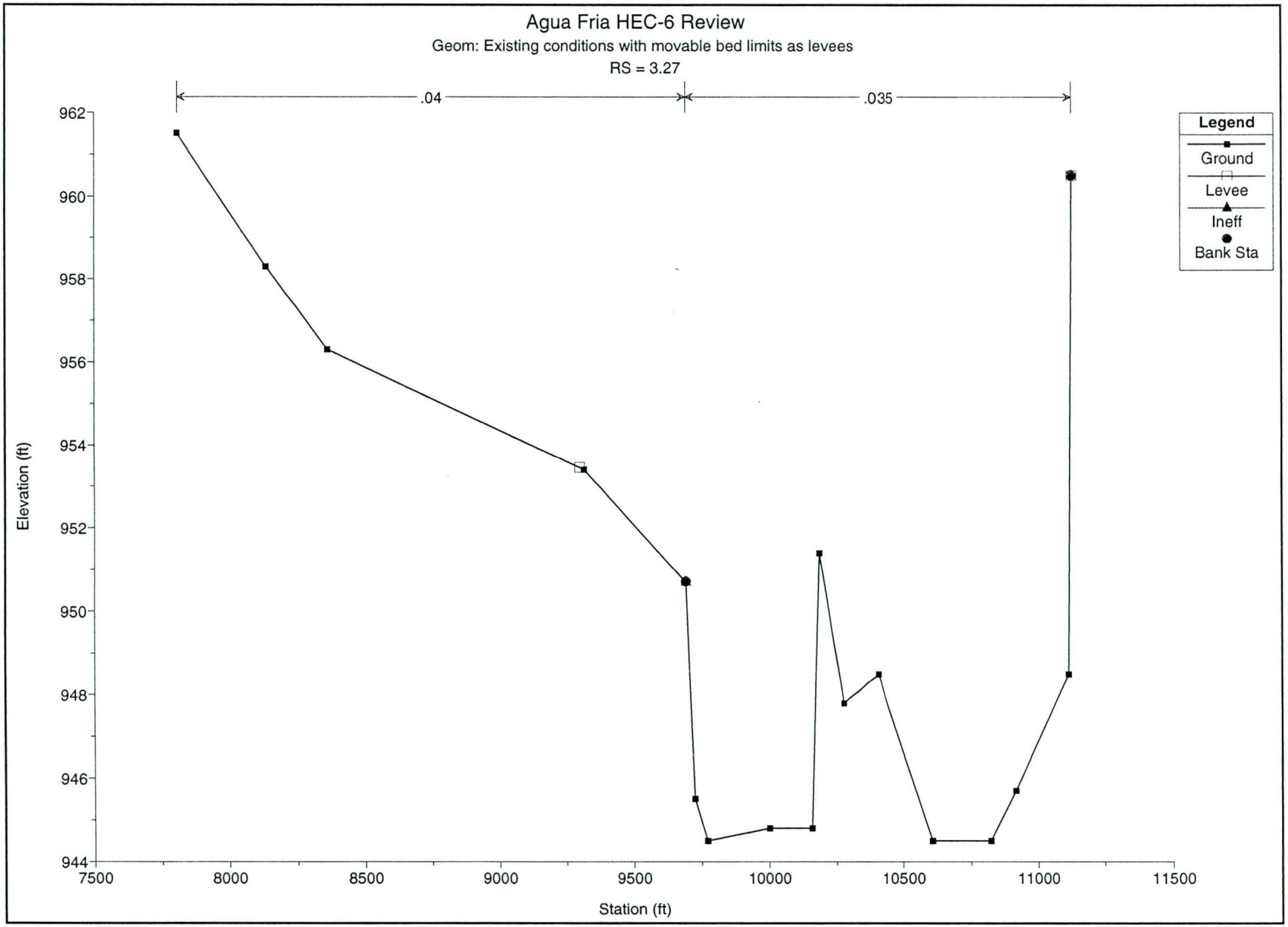

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 3.757
.035
.04
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
970
968
966
964
962
960
958
956
954
952
9400
9600
9800
10000
10200
10400
10600
Station (ft)

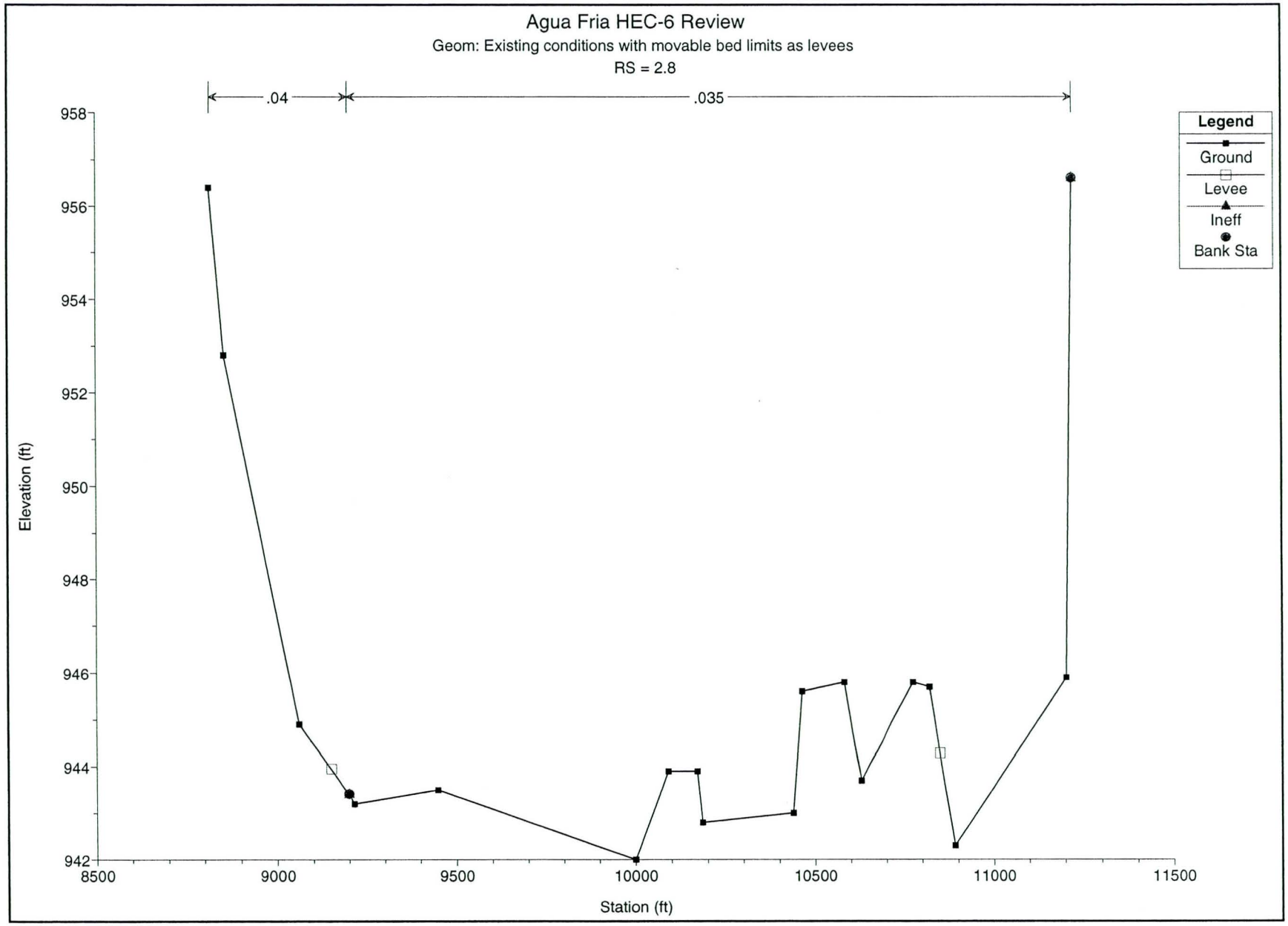

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 3.734
.035
0
4
0
4
Legend
Ground
Levee
Ineff
Bank Sta
975
970
965
960
955
950
Elevation (ft)
9400
9600
9800
10000
10200
10400
10600
Station (ft)

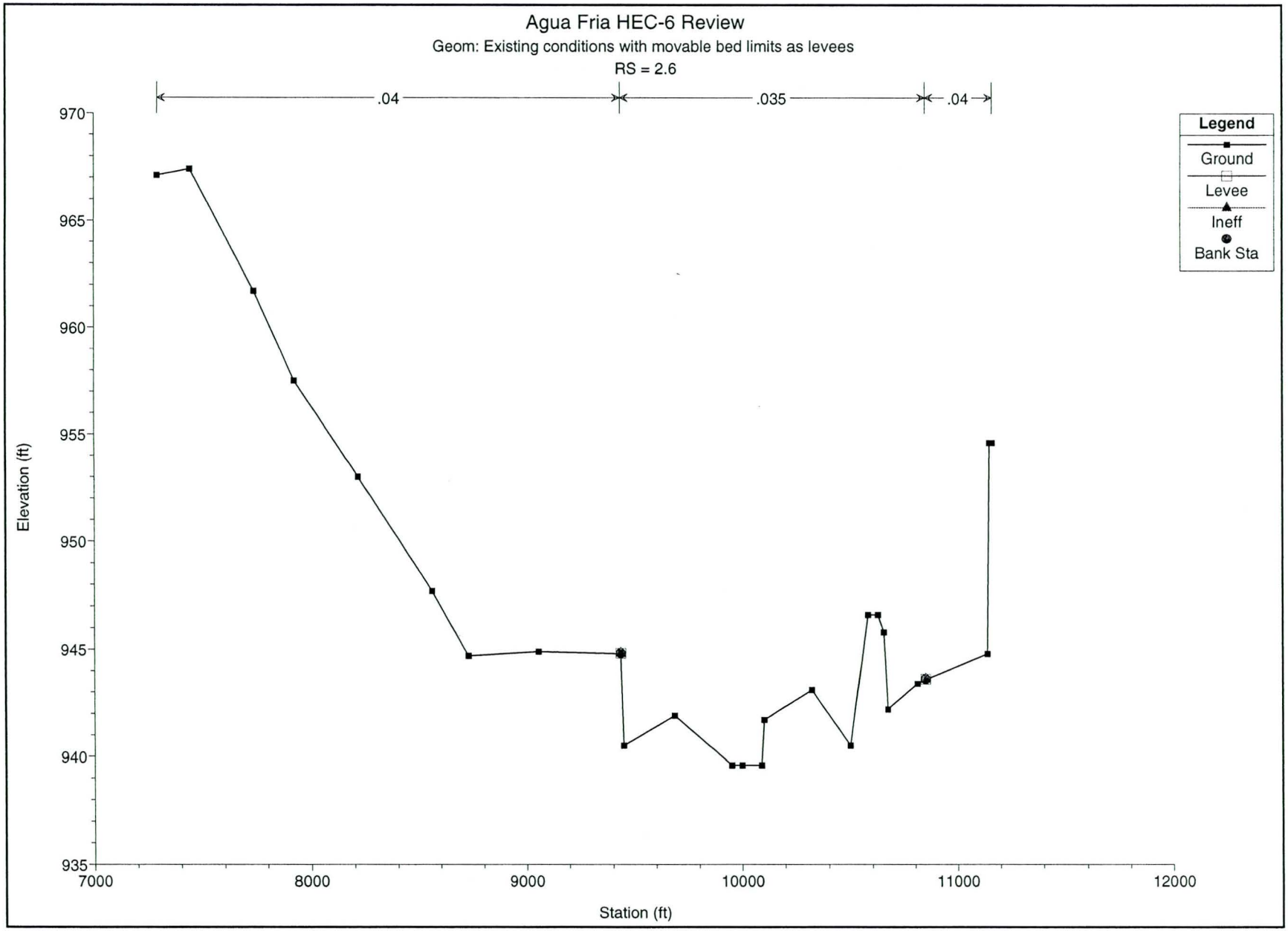

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 3.729
.035
.04
.04
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
975
970
965
960
955
950
9400
9600
9800
10000
10200
10400
10600
10800
Station (ft)

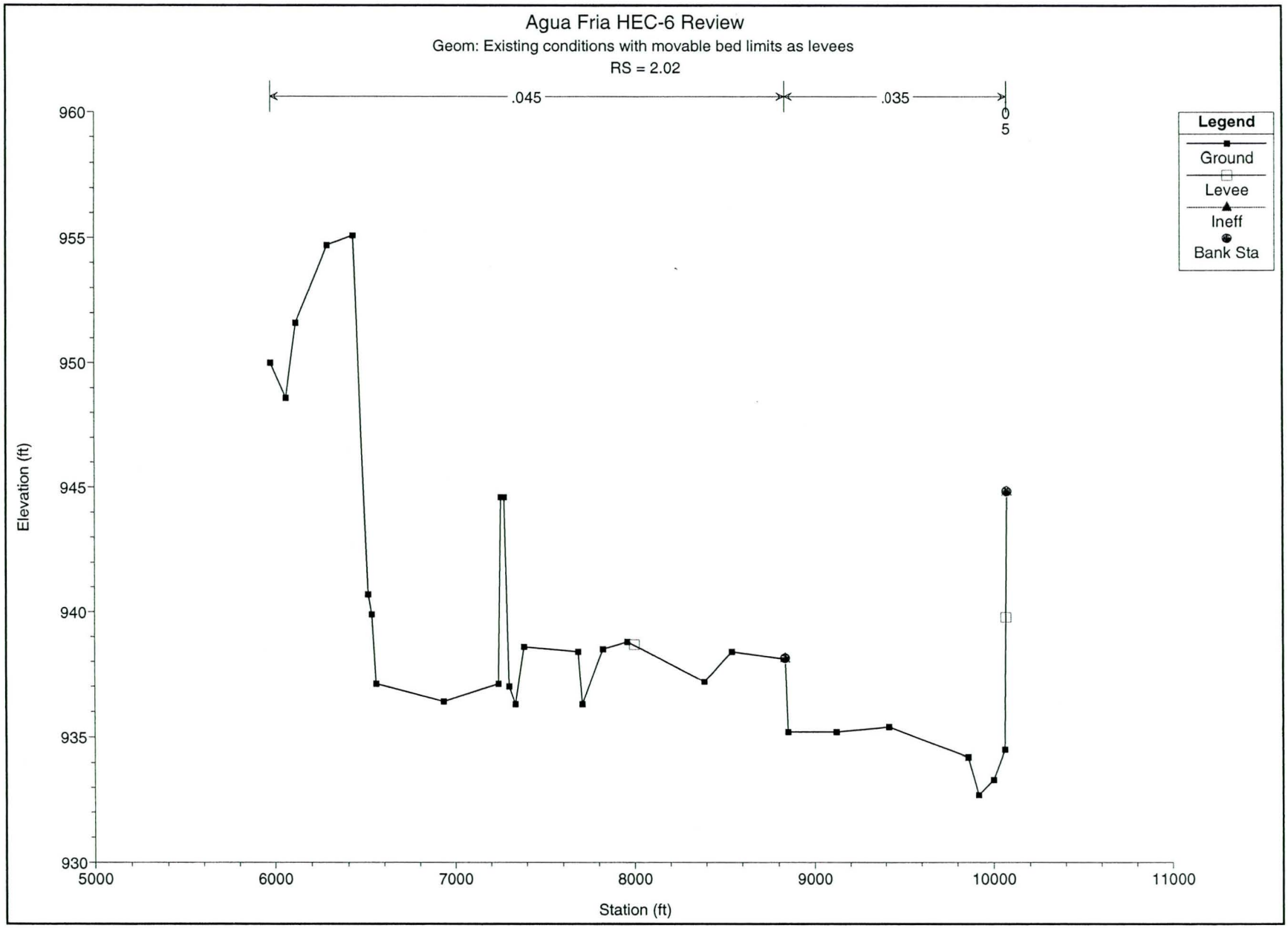

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 3.43
.04
.035
Legend
Ground
Levee
Ineff
Bank Sta
965
960
955
950
945
Elevation (ft)
7500
8000
8500
9000
9500
10000
10500
11000
Station (ft)

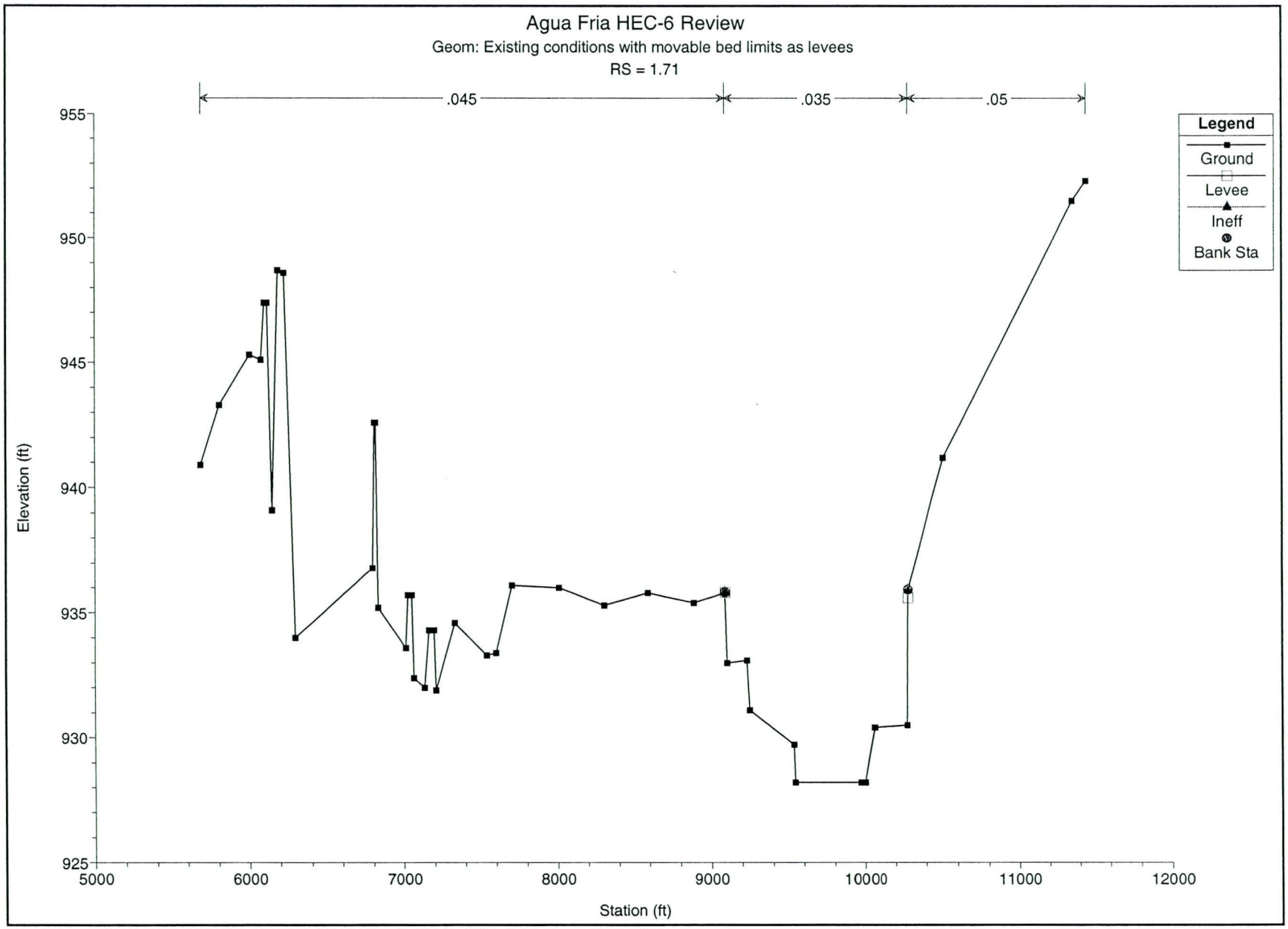

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 3.37
.04
.035
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
965
960
955
950
945
940
7500
8000
8500
9000
9500
10000
10500
11000
Station (ft)

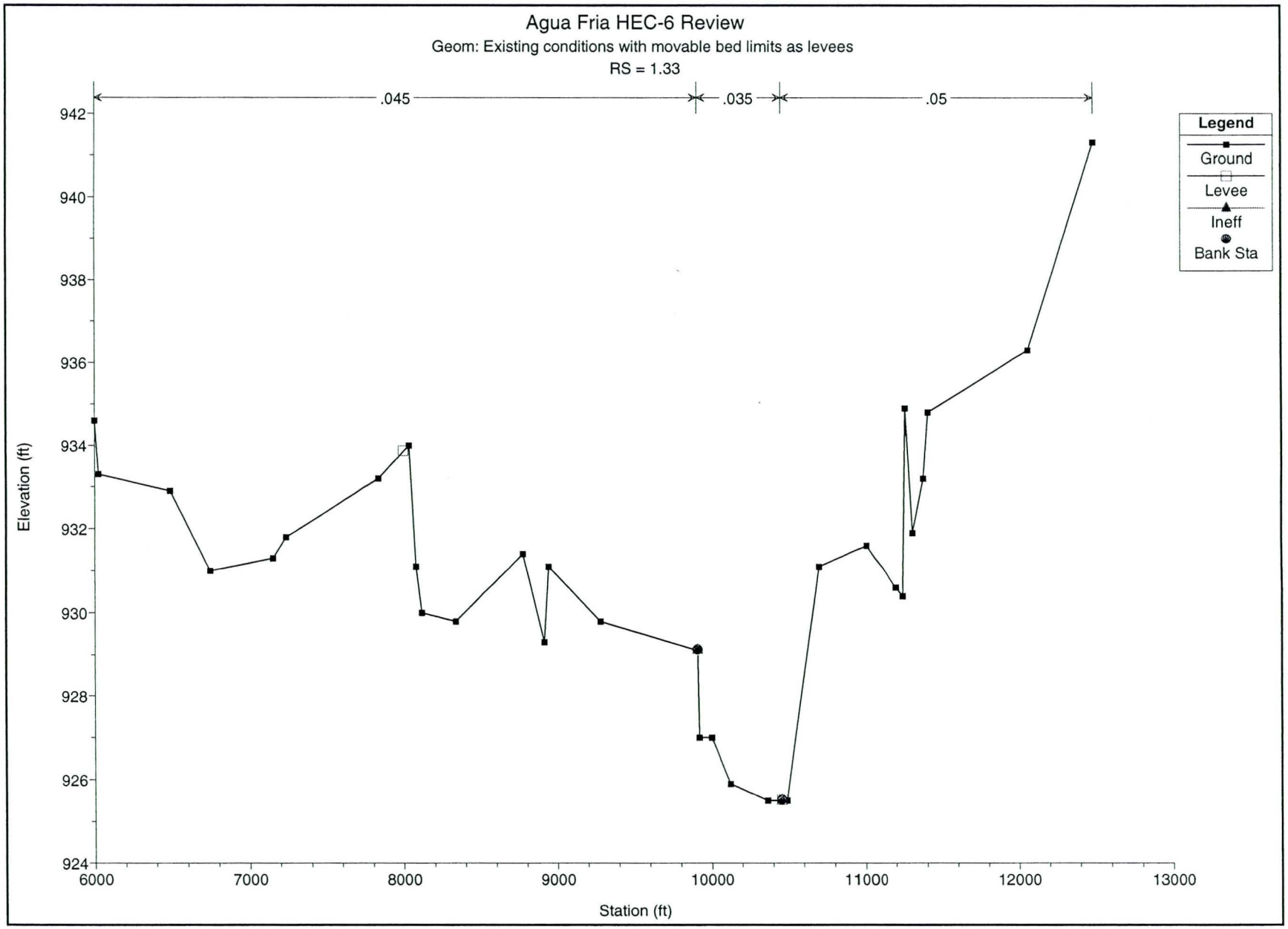

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 3.27
.04
.035
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
962
960
958
956
954
952
950
948
946
944
7500
8000
8500
9000
9500
10000
10500
11000
11500
Station (ft)

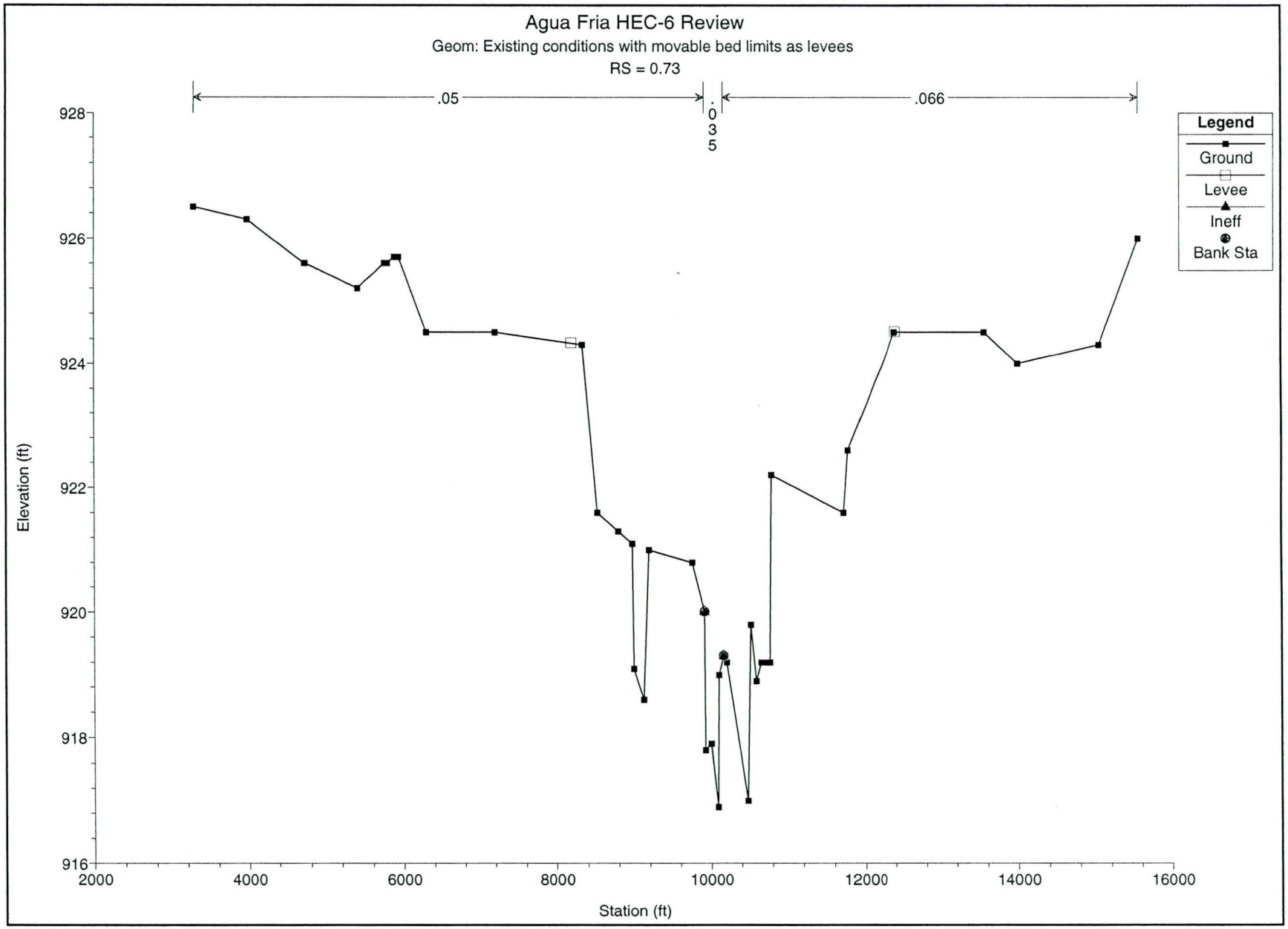

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 2.8
.04
.035
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
958
956
954
952
950
948
946
944
942
8500
9000
9500
10000
10500
11000
11500
Station (ft)

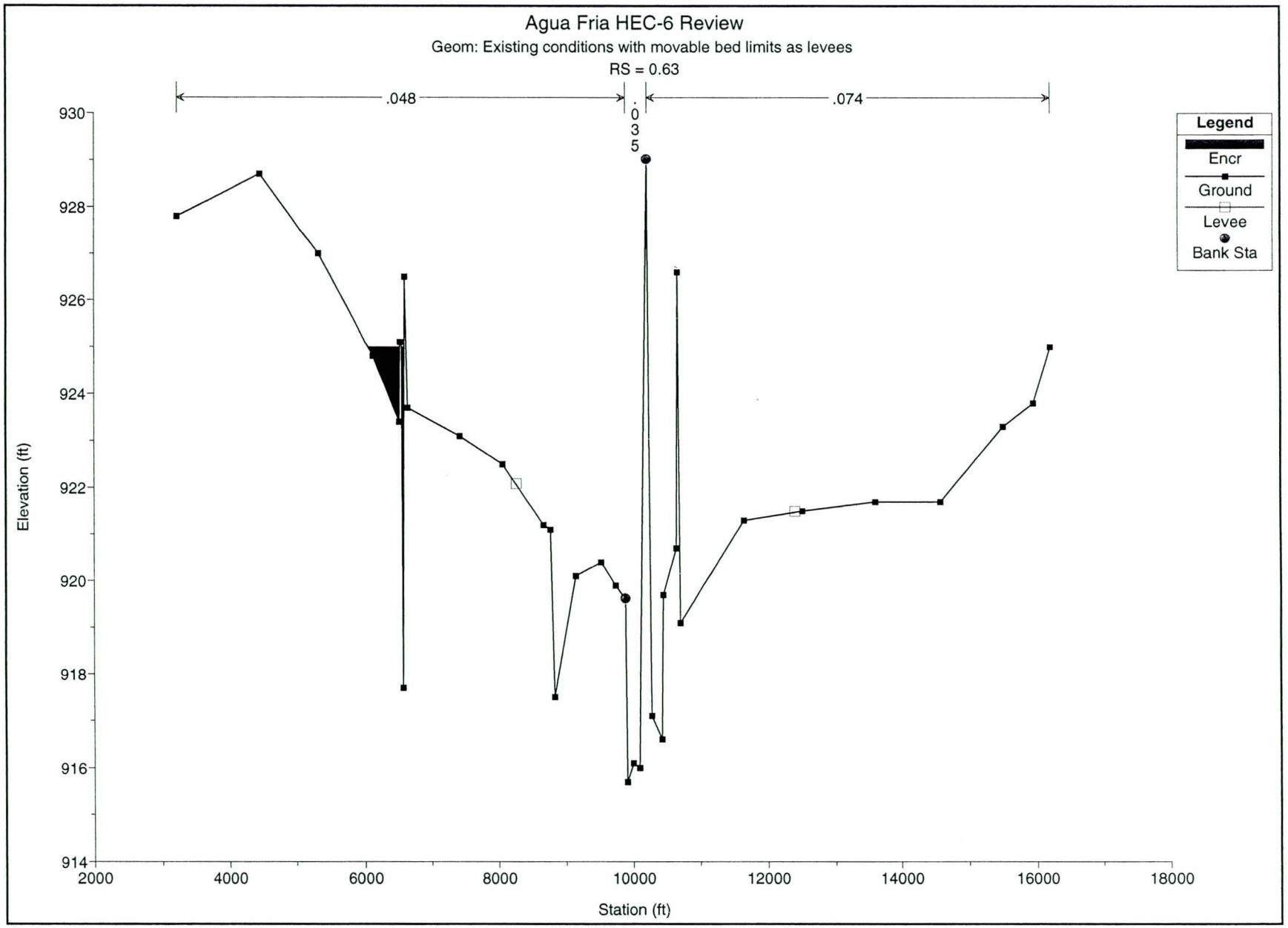

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 2.6
.04
.035
.04
Legend
Ground
Levee
Ineff
Bank Sta
970
965
960
955
950
945
940
935
Elevation (ft)
7000
8000
9000
10000
11000
12000
Station (ft)

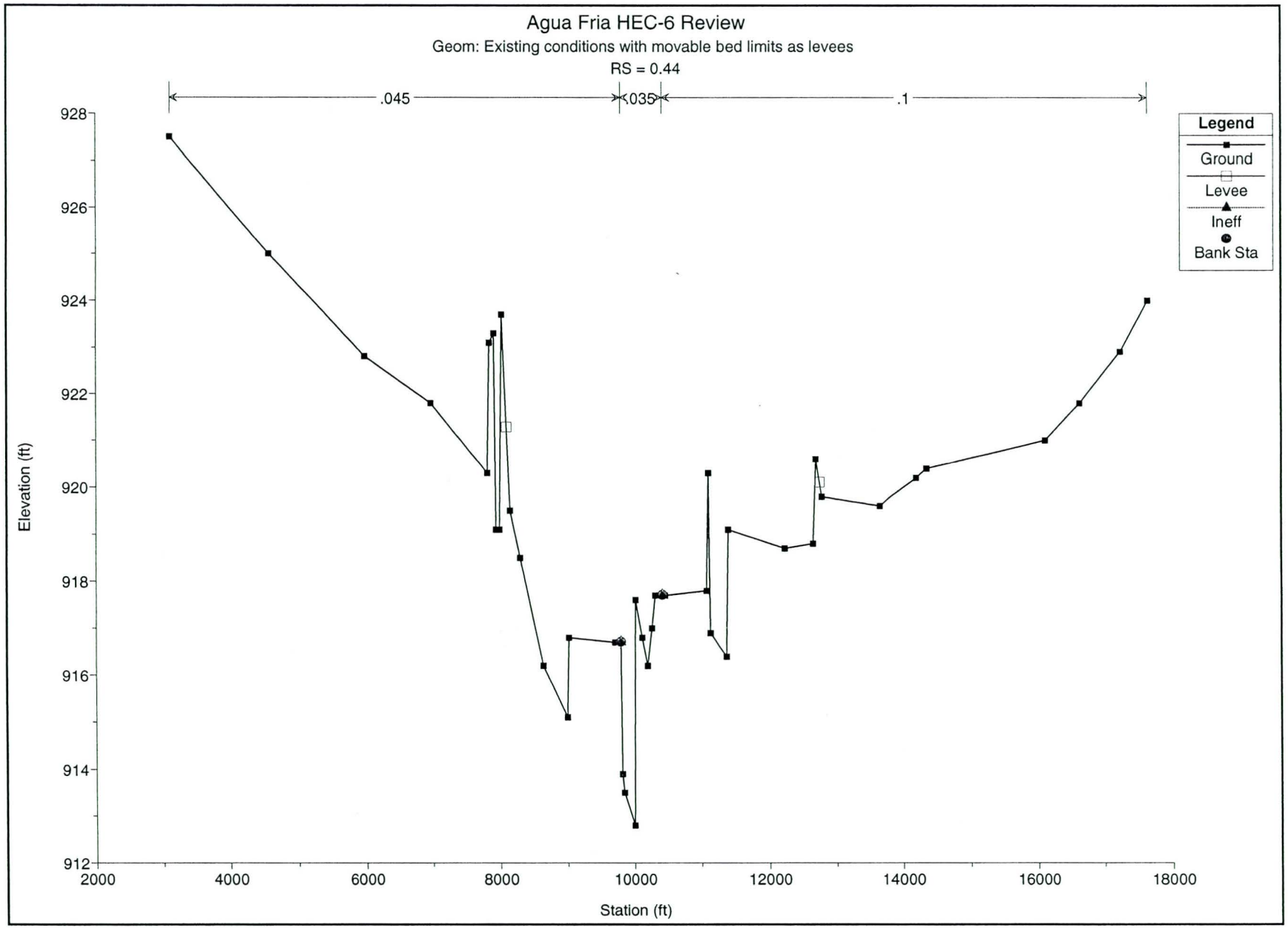

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 2.02
.045
.035
0
5
Legend
Ground
Levee
Ineff
Bank Sta
960
955
950
945
940
935
930
Elevation (ft)
5000
6000
7000
8000
9000
10000
11000
Station (ft)

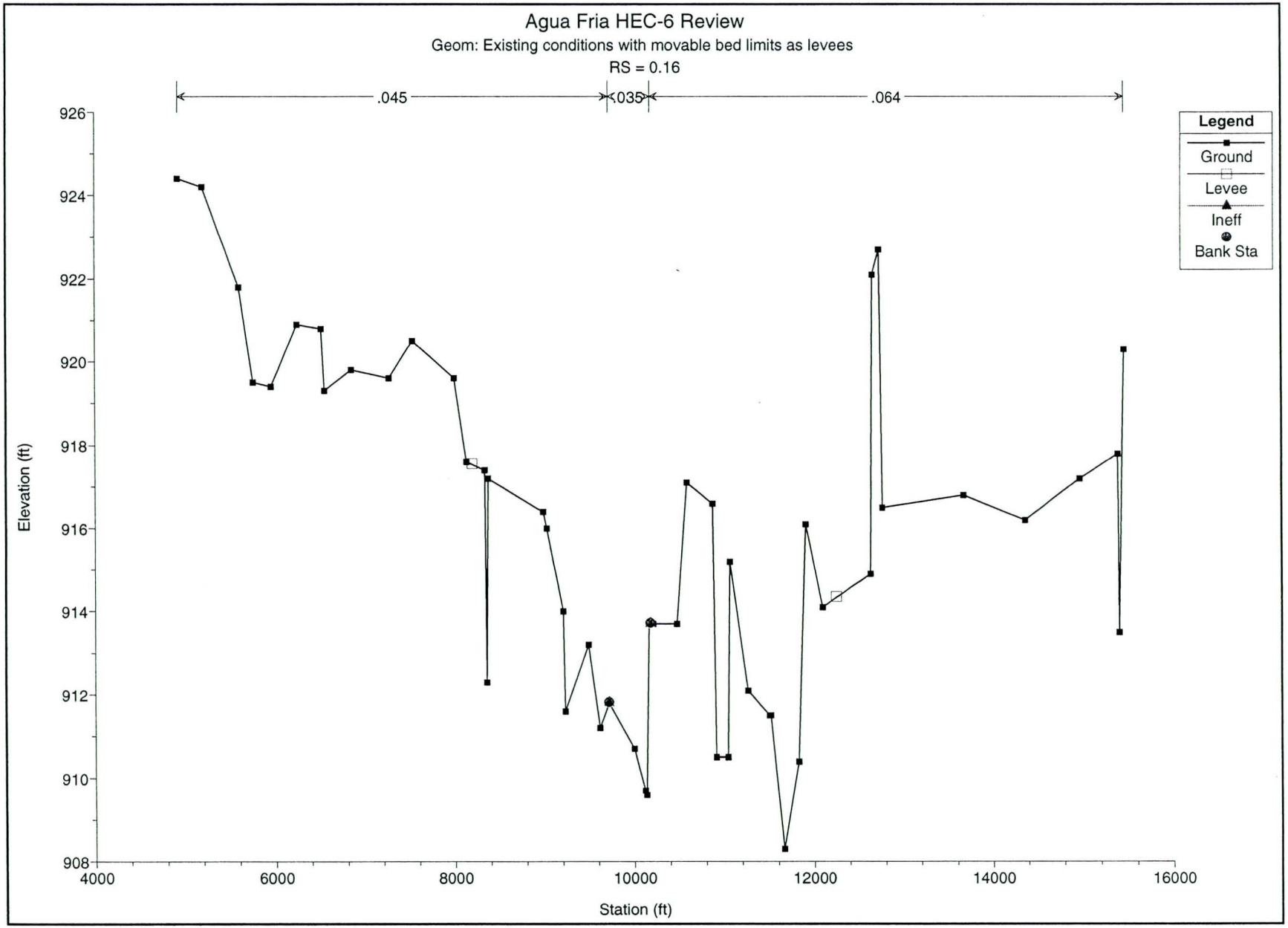

Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 1.71
.045
.035
.05
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
955
950
945
940
935
930
925
5000
6000
7000
8000
9000
10000
11000
12000
Station (ft)


Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 1.33
.045
.035
.05
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
942
940
938
936
934
932
930
928
926
924
6000
7000
8000
9000
10000
11000
12000
13000
Station (ft)


Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 0.73
.05
.035
.066
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
928
926
924
922
920
918
916
2000
4000
6000
8000
10000
12000
14000
16000
Station (ft)


Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 0.63
.048
.035
.074
Legend
Encr
Ground
Levee
Bank Sta
Elevation (ft)
930
928
926
924
922
920
918
916
914
2000
4000
6000
8000
10000
12000
14000
16000
18000
Station (ft)


Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 0.44
.045
.035
.1
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
928
926
924
922
920
918
916
914
912
2000
4000
6000
8000
10000
12000
14000
16000
18000
Station (ft)


Agua Fria HEC-6 Review
Geom: Existing conditions with movable bed limits as levees
RS = 0.16
.045
.035
.064
Legend
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
926
924
922
920
918
916
914
912
910
908
4000
6000
8000
10000
12000
14000
16000
Station (ft)