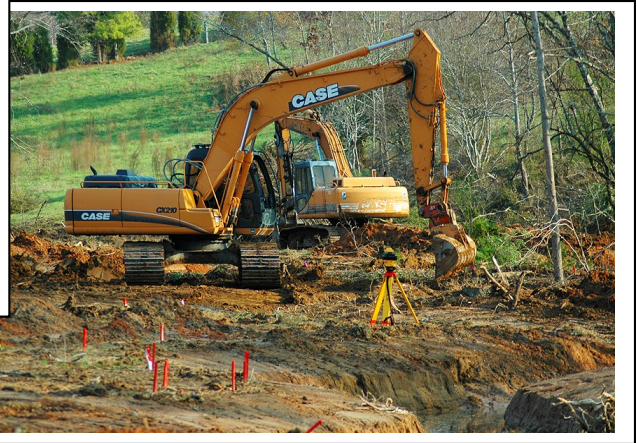


STONEBRIDGE STREAM MITIGATION PROJECT

AS-BUILT REPORT



Prepared for
Environmental Banc & Exchange, LLC
10055 Red Run Boulevard, Suite 130
Owings Mills, Maryland 21117-4860

Prepared by
WK Dickson & Company, Inc.
3101 John Humphries Wynd
Raleigh, North Carolina 27612
(919) 782-0495

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STONEBRIDGE STREAM MITIGATION PROJECT AS-BUILT REPORT

PROJECT DESCRIPTION

The Stonebridge Stream Mitigation Project is located on an 1,196 acre site in Moore County, North Carolina. Restoration work was completed on two unnamed tributaries to Crawley Creek referred to as UT-1 and UT-2. The streams exhibited diminished habitat value prior to construction as a result of past and on-going agricultural activities. The site was identified by EBX-Neuse I, LLC as having potential to help meet the compensatory mitigation requirements of the NC Department of Transportation (DOT) as solicited through the DOT's Full Delivery Project S-1. The objective of this project is to provide 6,240 stream mitigation units (SMU) to the DOT through the full delivery process in the Cape Fear 03030003 hydrologic unit. The mitigation units are to be accomplished through the restoration of stream and riparian habitats as defined in the inter-agency Stream Mitigation Guidelines (USACE, 2003).

Prior to implementation of the mitigation plan, the streams were in a disturbed condition due to the impacts of unrestricted cattle access, dredging and other anthropic channel manipulations. UT-1 is the biggest degraded resource and was the focus of restoration efforts. A total of 5,556 SMU's were achieved by restoring planform, section and profile features on UT-1. This number is derived from the as-built survey of 5,676 linear feet of restored stream length minus 70 feet for a crossing reservation near the middle of the project and minus another 50 feet adjacent to the culvert at the downstream end of the project. UT-2 was similarly degraded and flows east-southeast from a small dam, entering UT-1 near the center of the project area. The design for this small tributary yielded an additional 564 linear feet of restored stream. The total SMU's generated from stream restoration on UT-1 and UT-2 are 6,120.

This report is intended to document the stream restoration activities at the Stonebridge site. The report includes elevations, photographs and sampling plot locations, and a description of initial species composition by community type. The report also includes a list of the species planted and the associated densities.

PROJECT SITE

The Stonebridge Stream Mitigation Project is located in Moore County, North Carolina, north of Carthage within hydrologic unit 03030003 in the Cape Fear River Basin. The project site is accessed from the west via Glendon-Carthage Road. The 1,196 acre parcel has been used for agricultural purposes as a cow/calf operation. The surrounding area is rural, and covered with a mix of farms, woods and modest homesites. Figure 1 shows typical pre-restoration conditions along UT-1.



Figure 1. Typical pre-restoration conditions at the Stonebridge Stream Mitigation Project.

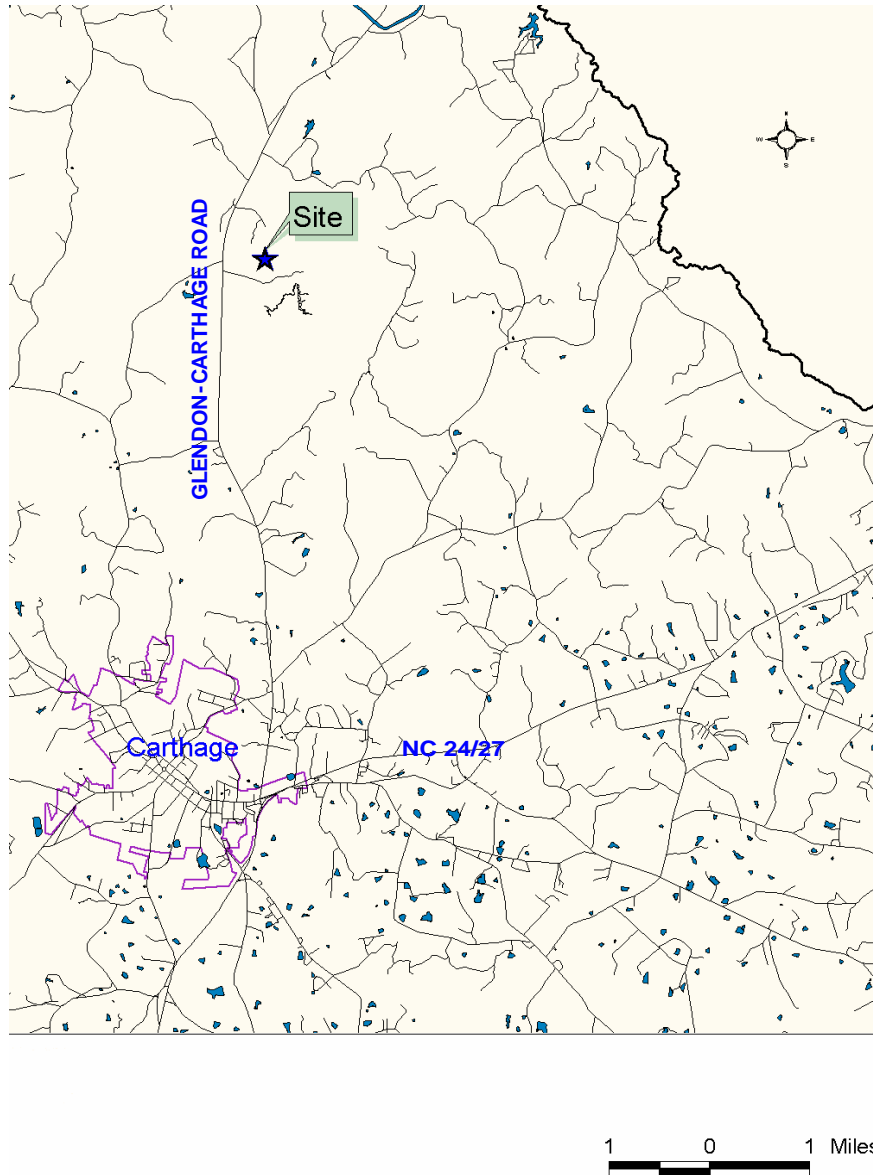


Figure 2. Stonebridge site general location map.

RESTORATION SUMMARY

CONSTRUCTION

A natural channel design approach has been applied to develop stable hydraulic geometry parameters along UT-1 and UT-2. Construction began October 18, 2005 and was completed on February 28, 2006. The rebuilding of the channel established stable cross-sectional geometry, restored planform sinuosity, and increased in-stream pools and other streambed diversity to improve benthic habitat. Approximately 6,120 linear feet of stream were constructed. These modifications included the installation of bank or channel bed revetments, log habitat structures, and altering the channel area and shape to the appropriate size.

To begin construction a survey crew staked out the new channel alignments for UT-1 and UT-2. A construction access route was designated to access the work area from established farm roads.

A pump-around system was used so that the new channels could be constructed in the dry. Material for root wads, log veins, and log toes were obtained on site and stockpiled. An excavator with a hydraulic thumb was used to construct the new channel and install the structures. Channel construction, floodplain grading, and structure installation were completed sequentially in sections. The existing stream was typically filled with material excavated from the new channel and floodplain areas; however, in some locations the old channel was left unfilled to protect existing trees and/or to diversify aquatic habitat. Native material revetments were installed as needed to reduce bank stress, provide grade control, and increase habitat diversity. Fences were installed to keep cattle out of the stream and buffer restoration areas.

VEGETATION PLANTING

All vegetation was planted at the site in late March 2006 after construction was complete. Bare root native tree and shrub species were planted to establish forested riparian buffers of approximately fifty feet on both sides of the restored stream. The plants were selected to establish vertical habitat structure and a diverse mix of species. The planted area consists of two zones. The first is a wetter zone predominantly consisting of moist soil species such as green ash (*Fraxinus pennsylvanica*), ironwood (*Carpinus caroliniana*) and elderberry (*Sambucus canadensis*). The second is a drier zone predominantly consisting of more mesic species such as yellow poplar (*Liriodendron tulipifera*) and Northern red oak (*Quercus rubra*). Black locust (*Robinia pseudo-acacia*) was planted as a nurse tree in the upland zone. The initial stocking of riparian plantings across the site was approximately 798 stems per acre. A list of all species planted and their percent composition is included in Table 1. In addition to the riparian plantings, black willow (*Salix nigra*) cuttings bundles were installed on the outside of bends.

Table 1. Baseline planted tree and shrub composition.

COMMON NAME	SCIENTIFIC NAME	TOTAL PLANTED	TREES/ACRE	PERCENT COMPOSITION
green ash	<i>Fraxinus pennsylvanica</i>	1800	115	14.4
elderberry	<i>Sambucus canadensis</i>	1000	64	8.0
sweet bay magnolia	<i>Magnolia virginiana</i>	500	32	4.0
river birch	<i>Betula nigra</i>	1900	121	15.2
Sycamore	<i>Platanus occidentalis</i>	1500	96	12.0
Yellow poplar	<i>Liriodendron tulipifera</i>	500	32	4.0
black locust	<i>Robinia pseudo-acacia</i>	1000	64	8.0
ironwood	<i>Carpinus caroliniana</i>	1500	96	12.0
silky dogwood	<i>Cornus amomum</i>	2000	128	16.0
redbud	<i>Cercis canadensis</i>	400	25	3.2
No. red oak	<i>Quercus rubra</i>	400	25	3.2
Totals:		12500	798	100

COMMENTS AND OBSERVATIONS

Construction progressed steadily throughout the fall and winter and was completed on time. The vast majority of the project was built according to the design plans, with the major change being related to crossing reservations. As the restoration began to take shape, the landowner realized that the crossing locations he had approved in the design were not all situated to his liking. Working with the landowner after the stream construction was mostly completed, two crossings were relocated and one of the agricultural crossings was completely eliminated from the

restoration area. Unfortunately, the relocation of the major crossing cut off a newly constructed meander bend and shortened two others. This change resulted in the loss of approximately 24 potential SMU's.

The final design plans described 6,249 linear feet of stream restoration. The as-built survey documented construction of 6,120. As described above, over twenty linear feet were lost in the re-construction of the major crossing. Comparison of final design plans with the as-built survey shows several locations where the constructed channel deviates slightly from the design. Individually, the deviations are very slight and impossible to identify on the ground, such as shortening a meander length or meander amplitude by a few feet. Such modifications are made in the field to accommodate unforeseen bedrock or to preserve valuable trees.

Minor deviations from the design plans included the substitution of coir fiber matting for local sod mats to stabilize newly constructed stream banks. The nature of the soils at the site precluded the harvesting of good quality sod mats. This is a common problem in stream restoration and the construction documents therefore included a specification for the coir material. Other minor differences between design and installation were usually related to bedrock occurrences, which occasionally obviated the need for planned revetments in the channel bed or banks.

Three out-of-bank flows occurred during the approximately four month construction period. Two other flows approached the design bankfull stage. These flows happened when portions of the new channel had been excavated but had not yet had protective revetments installed. Slight downcutting resulted in a few places that was remedied when grade control structures were installed.

MONITORING SET-UP

The five-year monitoring plan for the Stonebridge Stream Mitigation Project includes monitoring criteria for stream channel stability, vegetation success, and benthic macro-invertebrate abundance. Shortly after completion of construction and planting, an as-built survey was conducted. Following completion of the as-built survey, the monitoring program set-up was completed. This task included establishment of permanent cross sections, installation of three crest gages and establishment of vegetation monitoring plots. Specific locations of vegetation plots, permanent cross sections, and crest gages are shown on the as-built drawings (Appendix C). Photos were taken to document as-built appearance of permanent cross sections and vegetation plots throughout the project (Appendix A). The baseline benthic macro-invertebrate survey will be completed later in the year.

STREAM STABILITY

Cross Sections

The mitigation plan for the Stonebridge project requires twelve (12) semi-permanent cross sections to be monitored on the restored tributaries UT-1 and UT-2. The cross sections were established during monitoring set-up in evenly distributed pairs of one riffle and one pool per 1,000 linear feet of restored stream. Locations of cross sections are specified on as-built drawings in Appendix C and photos of the cross sections are included in Appendix A. The cross sections were surveyed during the monitoring set-up. The cross section surveys are shown in Appendix B. Each cross section will be resurveyed annually including measurements of floodplain, top of bank, bankfull, edges of water, and thalweg. In addition, any fluvial features present will be documented.

Longitudinal Profile

Longitudinal profiles will be surveyed in years one, three, and five of the monitoring period. UT-2 will be surveyed for its entire length. Profiles along UT-1 will be measured at three representative sections, each comprising approximately 900 linear feet. The cumulative length of the measured profiles will be at least 3,000 linear feet. Features measured will include thalweg, inverts of in-stream structures, water surface, bankfull and top of low bank. The longitudinal profiles presented in Appendix C were derived from the as-built survey data.

Hydrology

Three crest gages were installed at the site: one on UT-1 near the downstream end of the project and one each on UT-2 and UT-1 immediately above the confluence (see locations on as-built drawings in Appendix C). Crest gages will be checked monthly to document high flows. During the gage inspections any high water marks will or debris lines observed will be documented and photographed.

VEGETATION

Fourteen 100 square meter vegetation sampling plots were established at the restoration site to monitor the success of riparian buffer vegetation. The locations of these plots were random but distributed across the planted portions of the site (see locations on as-built drawings in Appendix C). The plots cover approximately 2% of the site. The center of each plot is located with a ten-foot section of metal fence post with a white PVC cover. Each planted woody stem was located with a three-foot section of white PVC and identified with a permanent aluminum tag. Total planted trees are summarized in Table 2.

Table 2. Planted trees per plot and corresponding stocking levels

	TREES OBSERVED	STOCKING LEVEL (PER ACRE)
Plot 1	16	663
Plot 2	20	829
Plot 3	21	871
Plot 4	16	663
Plot 5	24	995
Plot 6	29	1203
Plot 7	14	580
Plot 8	16	663
Plot 9	17	705
Plot 10	19	788
Plot 11	20	829
Plot 12	17	705
Plot 13	14	580
Plot 14	19	788
Average	18.7	775.8

Planted woody species will be monitored twice per year each year for the first three years. Herbaceous plant cover will be monitored annually using one square meter quadrats.

BENTHIC MACROINVERTEBRATES

Benthic macro-invertebrates will be surveyed at three locations along the restoration reach and one reference reach location in Fall 2006 utilizing the NCDWQ Qual-4 methodology. In addition to benthic sampling, NCDWQ habitat assessment forms will be completed at each monitoring station. All collected samples will be preserved in alcohol and analyzed by an aquatic ecologist for taxonomic identification. Metrics that will be calculated include: taxa abundance; EPT abundance, EPT richness; EPT biotic index; and total biotic index.

Stonebridge Stream Mitigation Project
As-Built Survey



1-Cross Section 1 Upstream



3-Cross Section 1 Left Bank



2-Cross Section 1 Downstream



4-Cross Section 1 Right Bank

Stonebridge Stream Mitigation Project
As-Built Survey



5-Cross Section 2 Upstream



6- Cross Section 2 Downstream



7- Cross Section 2 Left Bank

Stonebridge Stream Mitigation Project
As-Built Survey



8-Cross Section 3 Upstream



10-Cross Section 3 Left Bank



9- Cross Section 3 Downstream



11- Cross Section 3 Right Bank

Stonebridge Stream Mitigation Project
As-Built Survey



12- Cross Section 4 Upstream



14-Cross Section 4 Left Bank



13- Cross Section 4 Downstream



15-Cross Section 4 Right Bank

Stonebridge Stream Mitigation Project
As-Built Survey



16-Cross Section 6 Upstream



18-Cross Section 6 Left Bank



17-Cross Section 6 Downstream



19-Cross Section 6 Right Bank

Stonebridge Stream Mitigation Project
As-Built Survey



20-Cross Section 10 Upstream



22-Cross Section 12 Upstream

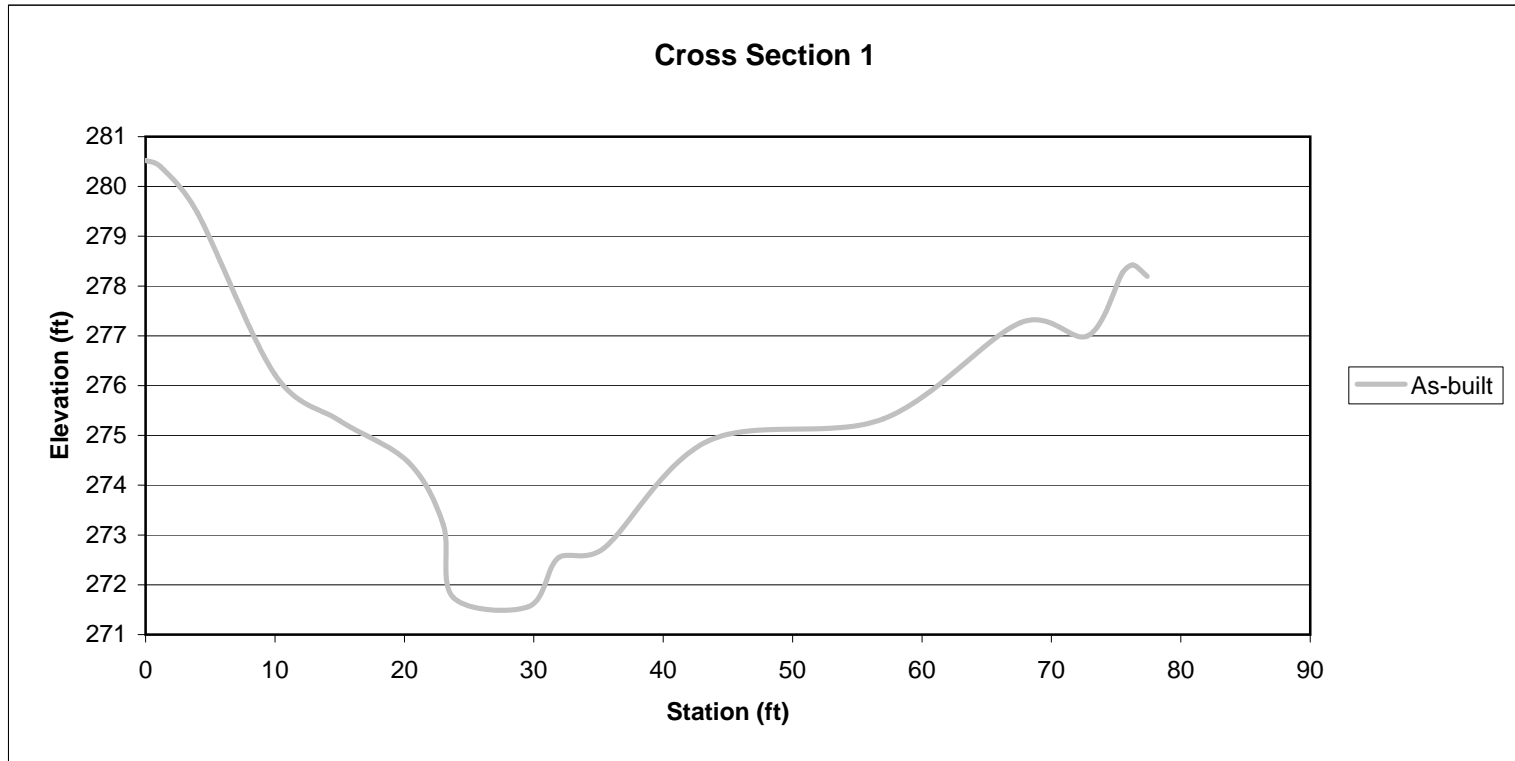


21-Cross Section 10 Left Bank

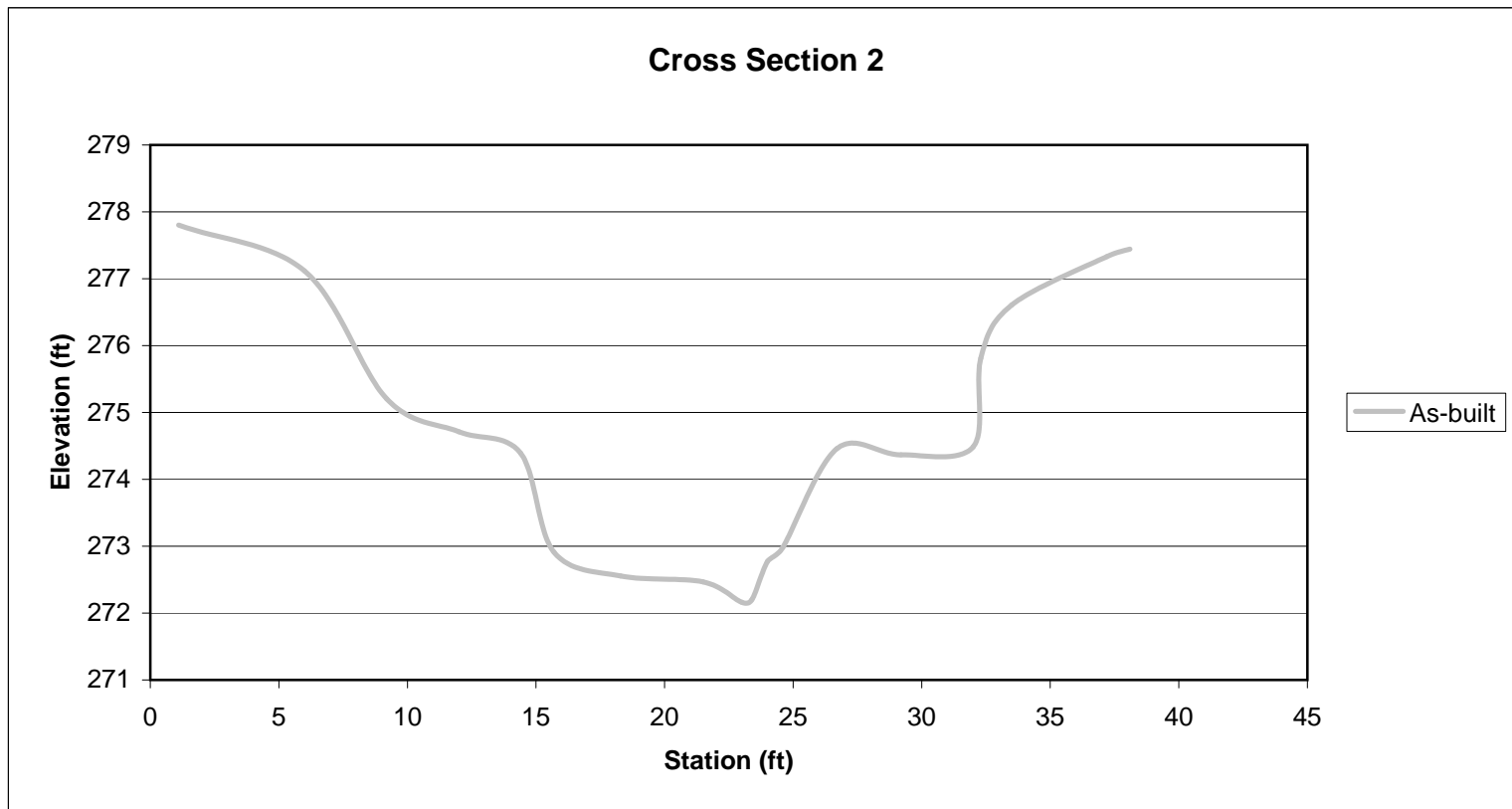


23-Cross Section 12 Downstream

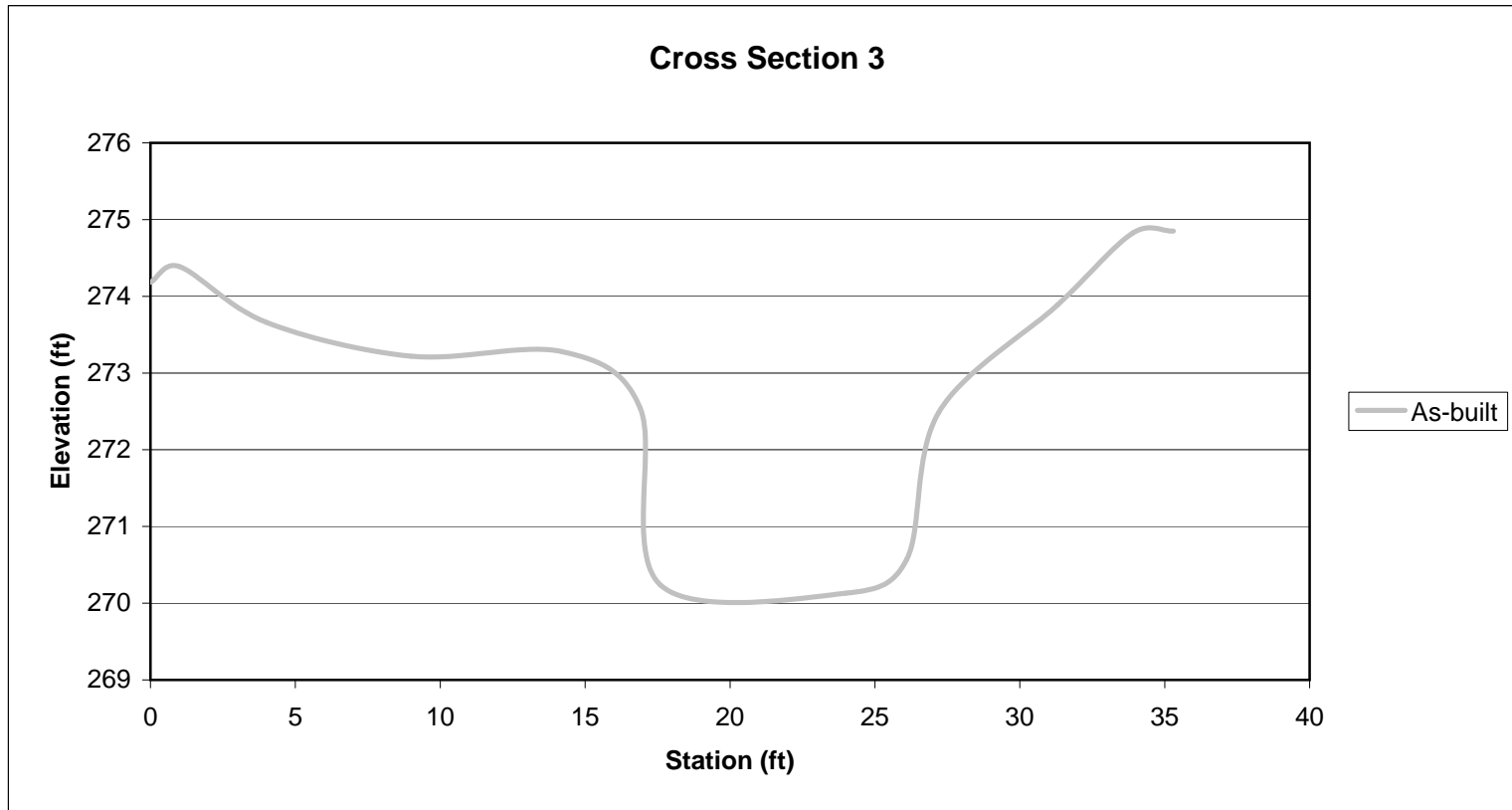
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As-Built Survey



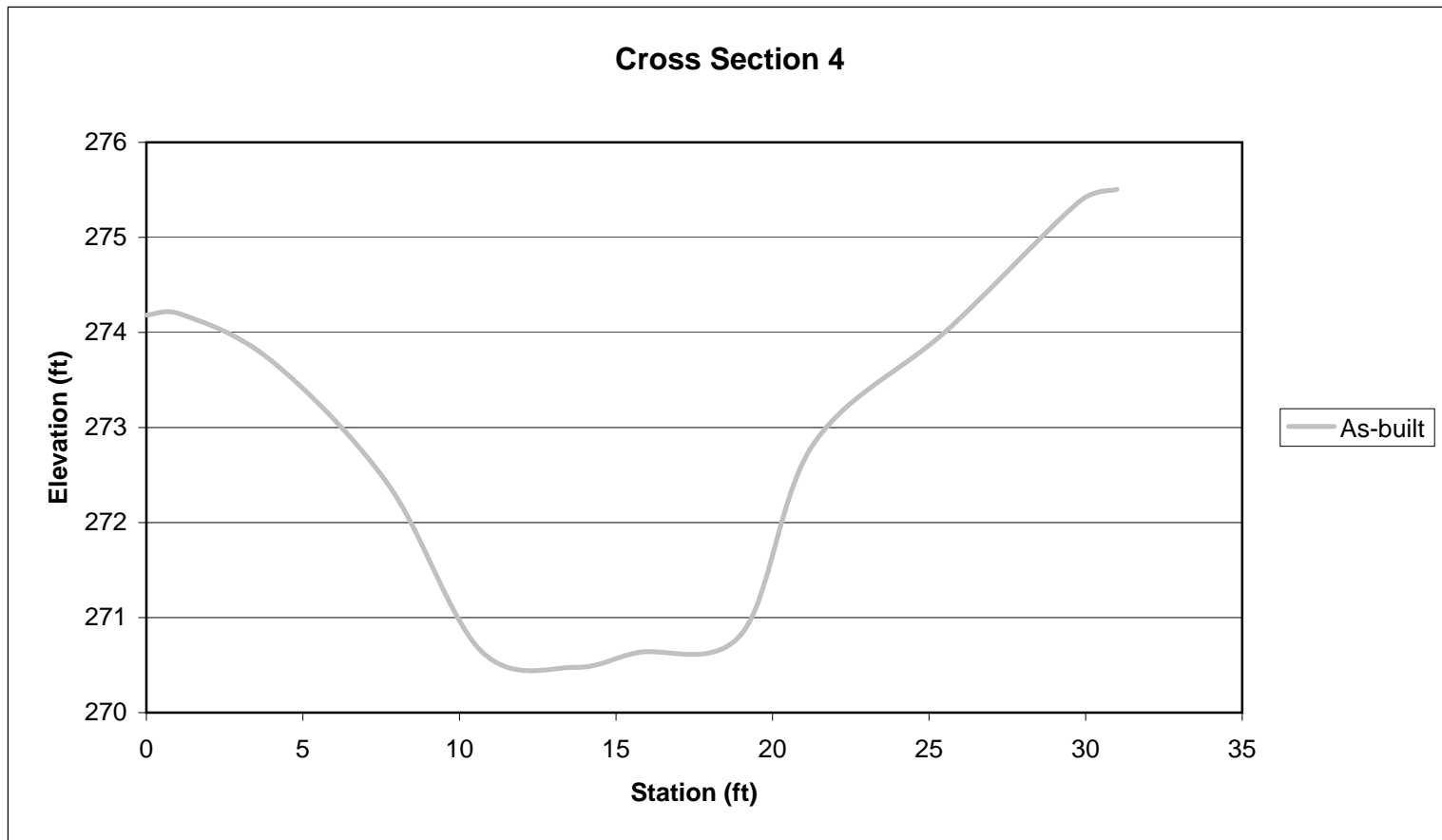
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As-Built Survey



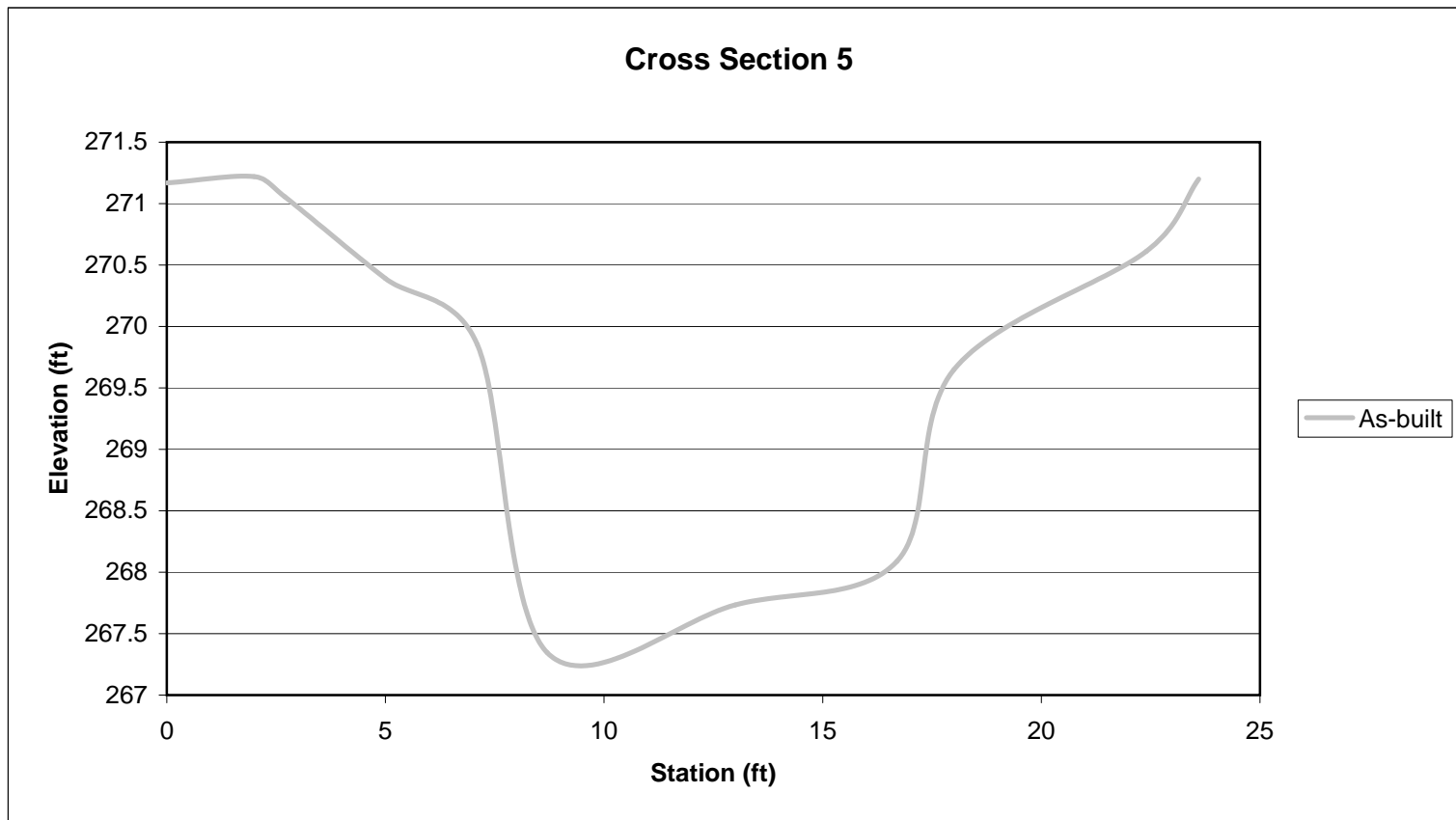
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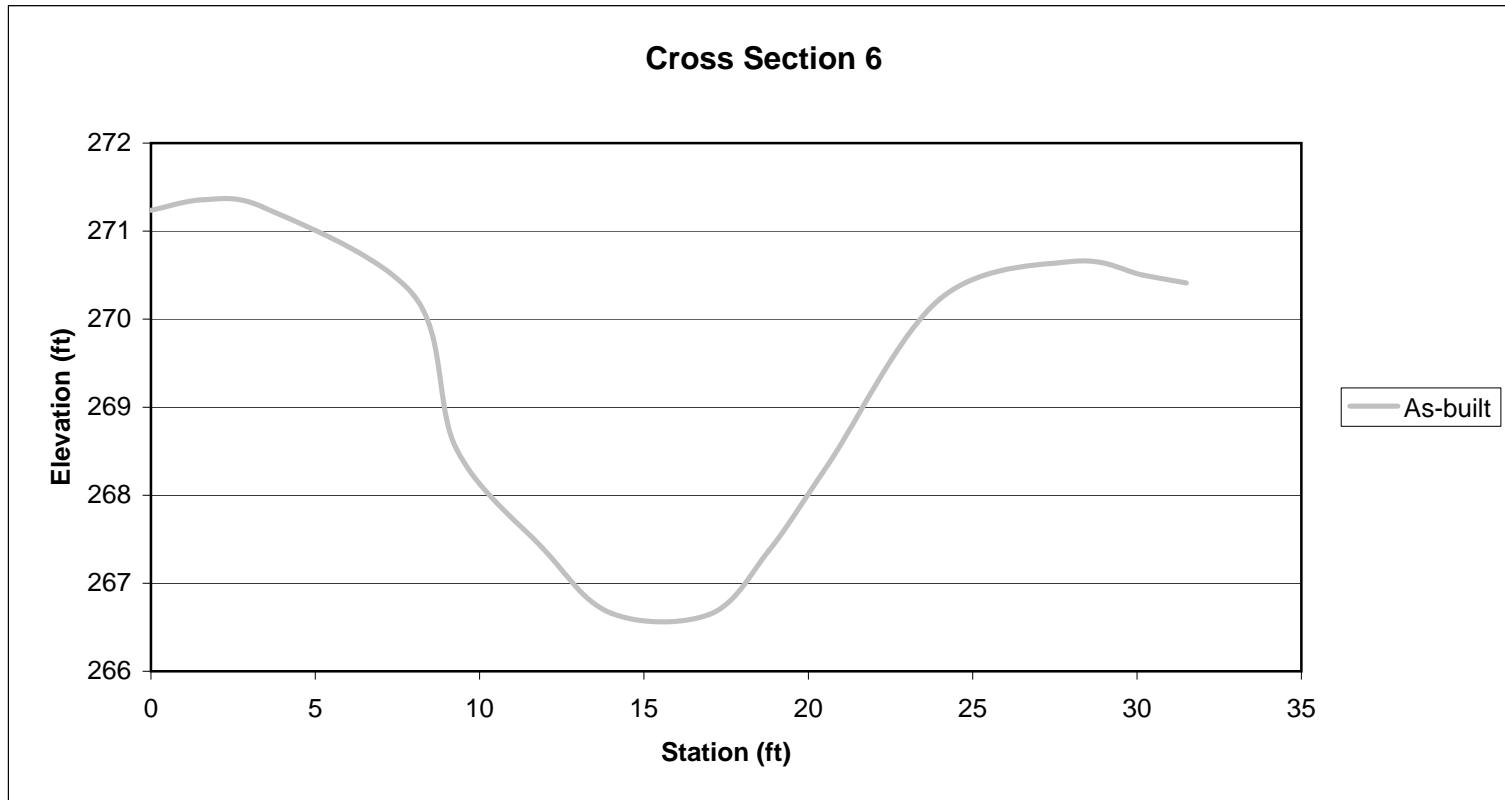
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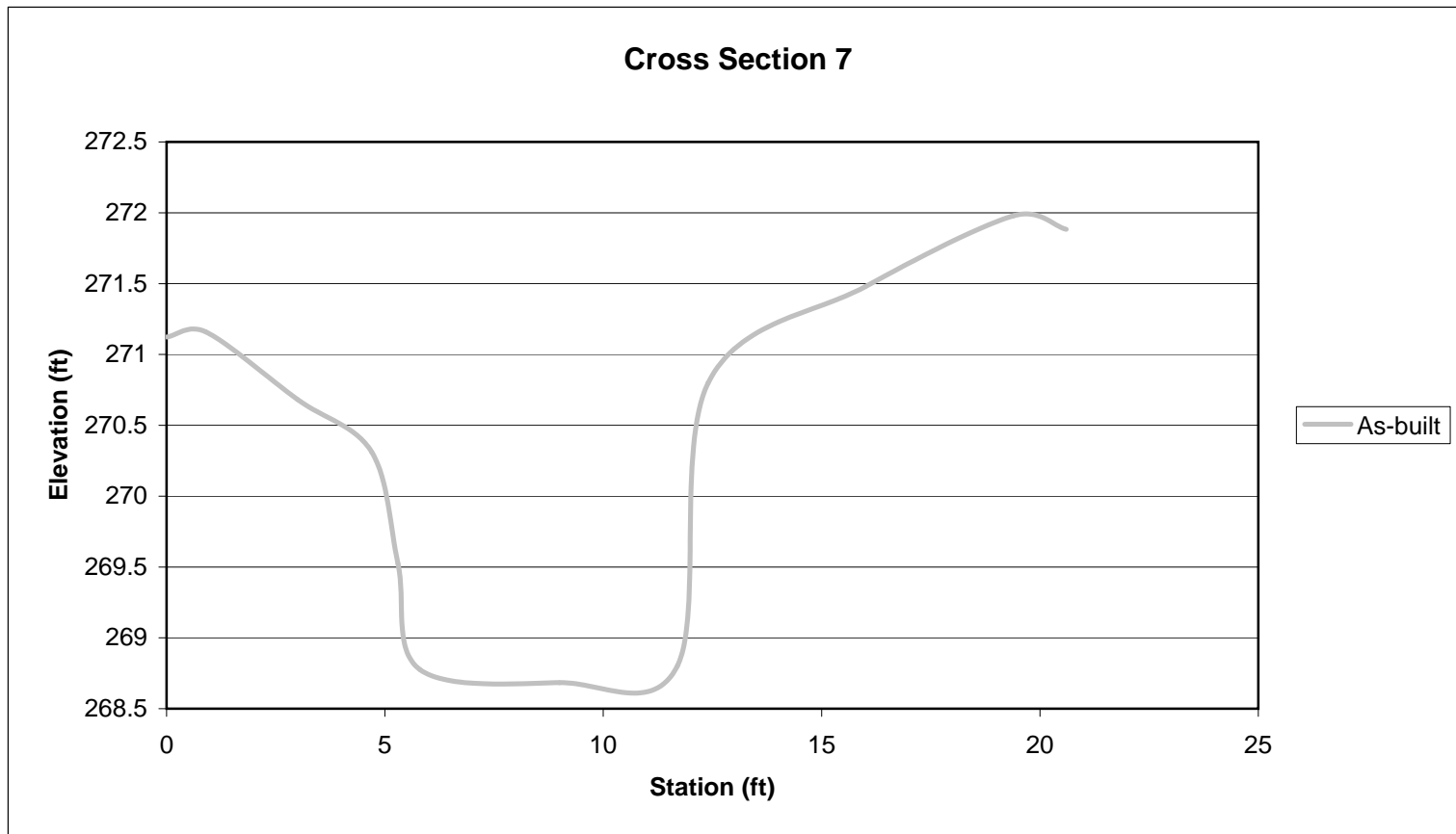
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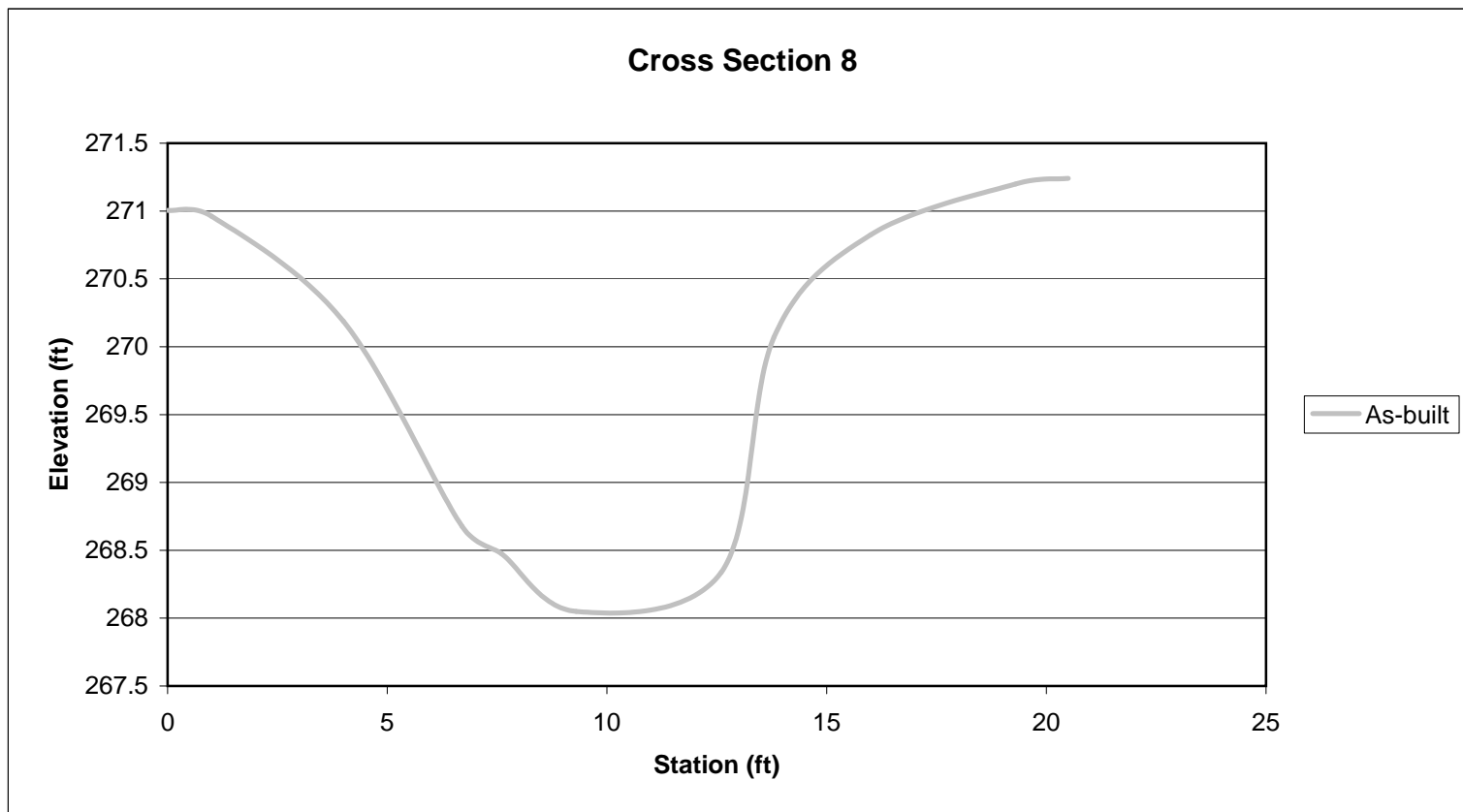
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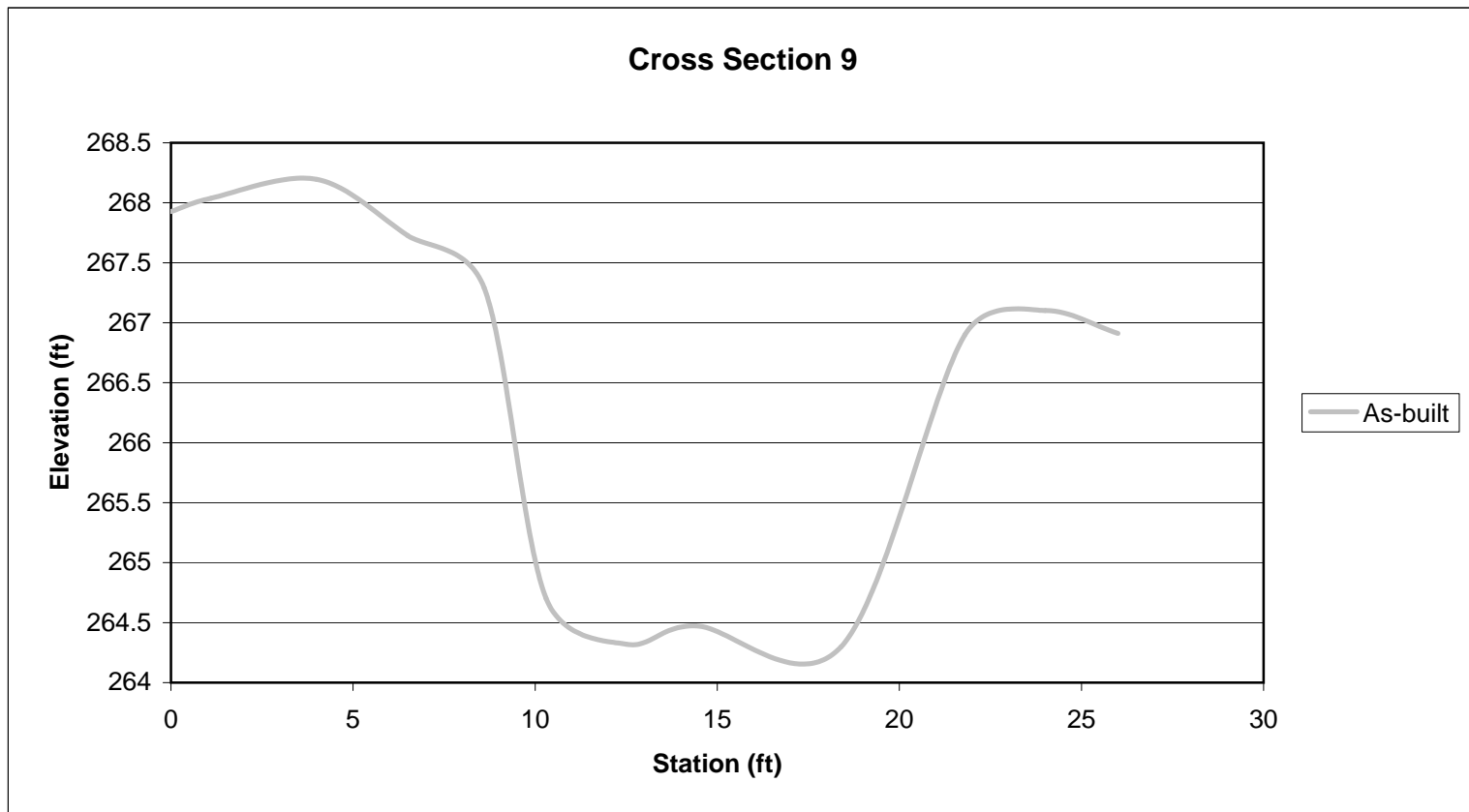
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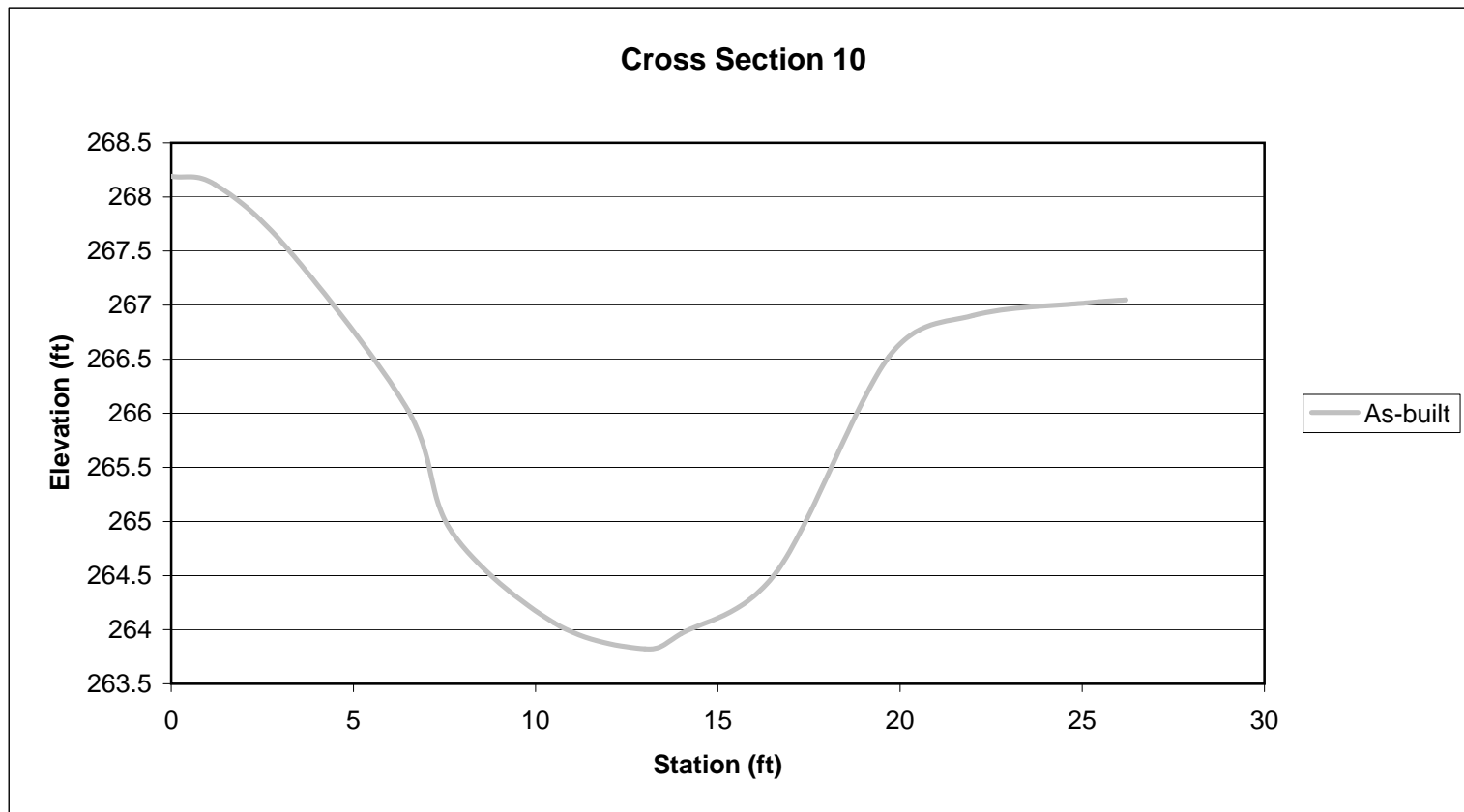
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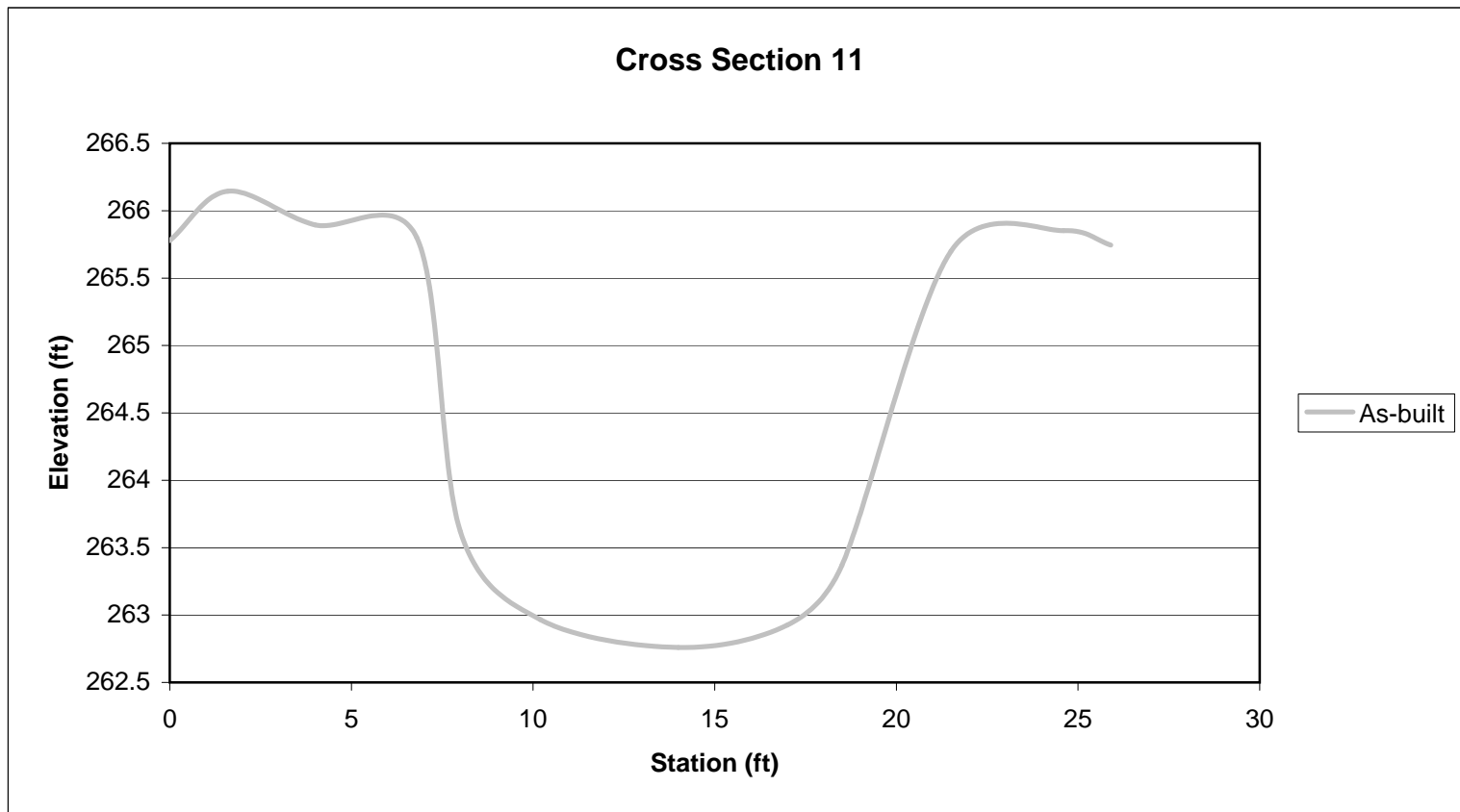
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