

# ENGINEERING REPORT

## Blair Lane to Blairmont Drive Drainage Improvements

### PREPARED FOR:

City of Lebanon Engineering Department

### PREPARED BY:

Neel-Schaffer, Inc.



**October 1, 2011**

## **Introduction**

It has been reported that several properties in the vicinity of Blairmont Drive and Cook Drive experience frequent structural flooding. These properties include 1710 Cook Drive and 1709 Blairmont Drive.

The City of Lebanon commissioned Neel-Schaffer, Inc. to perform a comprehensive drainage analysis of this area in order to identify conceptual drainage improvements that will help reduce the frequency of flooding. The following report describes methodology utilized and results obtained in the drainage analysis. In addition, drainage improvement recommendations and preliminary estimated project costs are included.

## **Limited Topographic Survey**

A limited topographic survey of the drainage channel from Blairmont Drive to 50 feet downstream of Cook Drive was performed to supplement the Ragan-Smith survey performed in 2006. In addition to channel cross sections and culvert crossing data, finished floor elevations of key residential buildings were obtained.

## **Watershed Description**

The watershed covers an area of approximately 498 acres (0.78 square miles), and extends from Blair Lane southwest to Foxglove Circle. Two primary areas of interest were identified:

- The cross drain on Cook Drive; and
- The drainage channel from Blairmont Drive to Blair Lane.

The study area was previously analyzed as a part of the Bartons Creek Tributary 3 Drainage Improvements study conducted by Neel-Schaffer, Inc. in March 2011. Sub-basins, land use and time of concentration data from that study were used as a basis for the hydrologic analysis of the study area.

The hydrologic model used in this analysis was HEC-HMS, developed by the U.S. Army Corps of Engineers. The Soil Conservation Service (SCS) method was used to compute storm water runoff for various frequency recurrence intervals. The SCS procedure is based on land use, soil data, and other topographic features which together are used to estimate the runoff potential (known as the Runoff Curve Number) at each area of interest. A summary of the hydrologic parameters and runoff is presented on Figure 1.

## **Analysis of Existing Storm Water Runoff**

Storm water runoff from the upper reaches of the watershed is collected by a drainage ditch that outfalls into the Blair Lane bridge. Roadway crossings are located at Blairmont Drive (15'-wide by 5.5'- high concrete bridge) and Cook Drive (8'-wide by 5.7'-high corrugated metal pipe arch).

During the technical analysis, it was determined that the channel from Blairmont Drive to Blair Lane, as well as the Cook Drive culvert, are undersized in relation to the amount of storm water runoff collected. Table 1, shown on page 3, and Table 2, shown on page 4, summarizes the existing conditions flood depths at the two aforementioned residences and road crossings for various storm events.

### **Analysis of Drainage Improvement Alternatives**

As shown on Figure 2, two types of drainage improvements were considered for the mitigation of the flooding issues in the study area. The first type of improvement considered is widening of the channel from Blairmont Drive north to Blair Lane. The channel widening would be done in two segments as shown on Figure 2. Both segments will use the same bottom width and channel side slopes. The segment of channel improvement from Blairmont Drive to Cook drive will have a slightly shallower slope than the northern segment from Cook Drive to Blair Lane.

The second improvement considered is the replacement of the culvert at Cook Drive. The existing culvert is an 8'-wide by 5.7'-high corrugated metal pipe arch. Hydraulic analysis shows that this crossing has a 2-year level of service. This means that Cook Drive is submerged by the 5-year flood runoff event. Replacing the existing culvert with a 14'-wide by 7'-high concrete box culvert, in conjunction with the channel improvements, will result in a 25-year level of service. No improvements were considered for the bridge at Blairmont Drive, since it was determined to be functioning properly.

Table 1 summarizes the potential flood reduction at the residential properties that would result from the recommended improvements. Table 2 summarizes the potential flood reduction at the two roadway crossings.



Address	Return Period (years)	Dis-charge (cfs)	Finished Floor Elev. (ft.)	Existing Water Surface Elev. (ft.)	Existing Structural Flooding Depth (ft.)	Future Water Surface Elev. (ft.)	Future Structural Flooding Depth (ft.)
1707 Cook Dr	2	321	552.31 (Garage)	550.71	0	549.57	0
	5	453		551.13	0	550.22	0
	10	567		551.44	0	550.63	0
	25	728		551.84	0	551.08	0
	50	860		552.14	0	551.41	0
	100	999		552.43	0.12	551.72	0
1703 Cook Dr	2	321	554.31	550.89	0	549.71	0
	5	453		551.29	0	550.35	0
	10	567		551.6	0	550.75	0
	25	728		551.97	0	551.2	0
	50	860		552.24	0	551.53	0
	100	999		552.5	0	551.83	0
1710 Cook Dr	2	321	552.87 (Garage/ Basement)	553.42	0.55	550.96	0
	5	453		554.95	2.08	551.98	0
	10	567		555.53	2.66	552.79	0
	25	728		556.17	3.30	553.89	1.02
	50	860		556.64	3.77	554.65	1.78
	100	999		557.08	4.21	555.14	2.27
1709 Blairmont Dr.	2	321	553.5 (Garage)	553.67	0.17	551.59	0
	5	453		555.22	1.72	552.55	0
	10	567		555.88	2.38	553.36	0
	25	728		556.65	3.15	554.48	0.98
	50	860		557.23	3.73	555.28	1.78
	100	999		557.78	4.28	555.85	2.35

**Table 1. Flood Elevation Reductions at Residential Properties**



Location	Return Period (years)	Dis-charge (cfs)	Over- topping Elevation (ft.)	Existing Water Surface Elev. (ft.)	Existing Flooding Depth (ft.)	Future Water Surface Elev. (ft.)	Future Flooding Depth (ft.)
Cook Dr.	2	321	554.26	553.38	0.00	550.77	0.00
	5	453		554.96	0.70	551.82	0.00
	10	567		555.55	1.29	552.65	0.00
	25	728		556.21	1.95	553.77	0.00
	50	860		556.7	2.44	554.59	0.33
	100	999		557.15	2.89	555.07	0.81
Blairmont Dr.	2	321	555	554.05	0.00	553.84	0.00
	5	453		555.71	0.71	554.92	0.00
	10	567		556.32	1.32	555.54	0.54
	25	728		556.99	1.99	555.96	0.96
	50	860		557.48	2.48	556.42	1.42
	100	999		557.96	2.96	556.93	1.93

**Table 2. Flood Elevation Reductions at Roadway Crossings**

A description of the proposed structural alternatives and preliminary estimated project costs are shown below. The following costs include engineering/design fees, and provision for 20% contingency:

Structural Alternatives (See Figure 2)	Preliminary Estimated Project Cost
Channel Improvement – Cook Dr. to Blairmont Drive: 1,220 LF (Tie into existing channel immediately upstream of Blair Lane bridge and immediately downstream of Blairmont Dr. bridge.) 12 ft. bottom width, 3:1 side slopes (see Figure 2)	\$ 20,000.00
Cook Dr. Culvert Replacement - Replace existing 36 LF 8' x 5' CMP Arch with 36 LF 14' x 7' Concrete Box Culvert @ 0.8% slope.	\$ 200,000.00

The above costs do not include property acquisition, which may be necessary to widen the existing drainage channel. It is recommended to realign the centerline of channel to run coincident with property lines where possible. This should be done particularly for the portion of channel north of Cook Drive adjacent to the residence at 1703 Cook Drive. This may reduce the amount of easement for the City to purchase or be donated from residents, and the land gained



from the realignment may help offset the land lost to the additional footprint of the improved channel.

**Future Design Considerations and Additional Analysis**

Many steps will have to be taken prior to implementing the recommended drainage improvements. A full hydraulic and civil design will need to be completed prior to implementing the recommended improvements. The design process will determine the exact extent of the required easement acquisitions, and will enable more exact cost estimates for the proposed work.

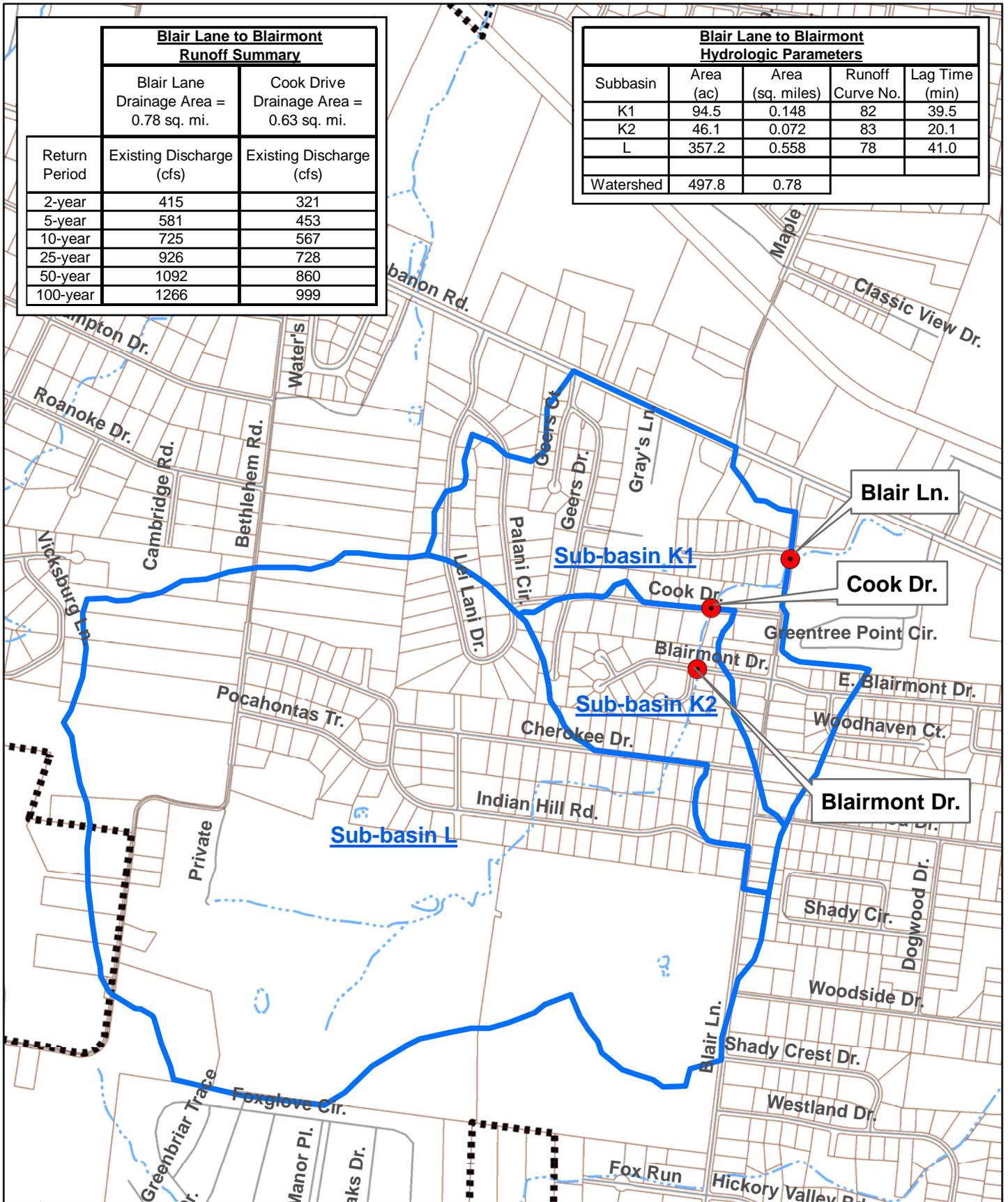


**Blair Lane to Blairmont  
Runoff Summary**

Return Period	Blair Lane Drainage Area = 0.78 sq. mi.	Cook Drive Drainage Area = 0.63 sq. mi.
	Existing Discharge (cfs)	Existing Discharge (cfs)
2-year	415	321
5-year	581	453
10-year	725	567
25-year	926	728
50-year	1092	860
100-year	1266	999

**Blair Lane to Blairmont  
Hydrologic Parameters**

Subbasin	Area (ac)	Area (sq. miles)	Runoff Curve No.	Lag Time (min)
K1	94.5	0.148	82	39.5
K2	46.1	0.072	83	20.1
L	357.2	0.558	78	41.0
Watershed	497.8	0.78		



**Legend**

-  Sub-Basins
-  Parcels
-  City Limits



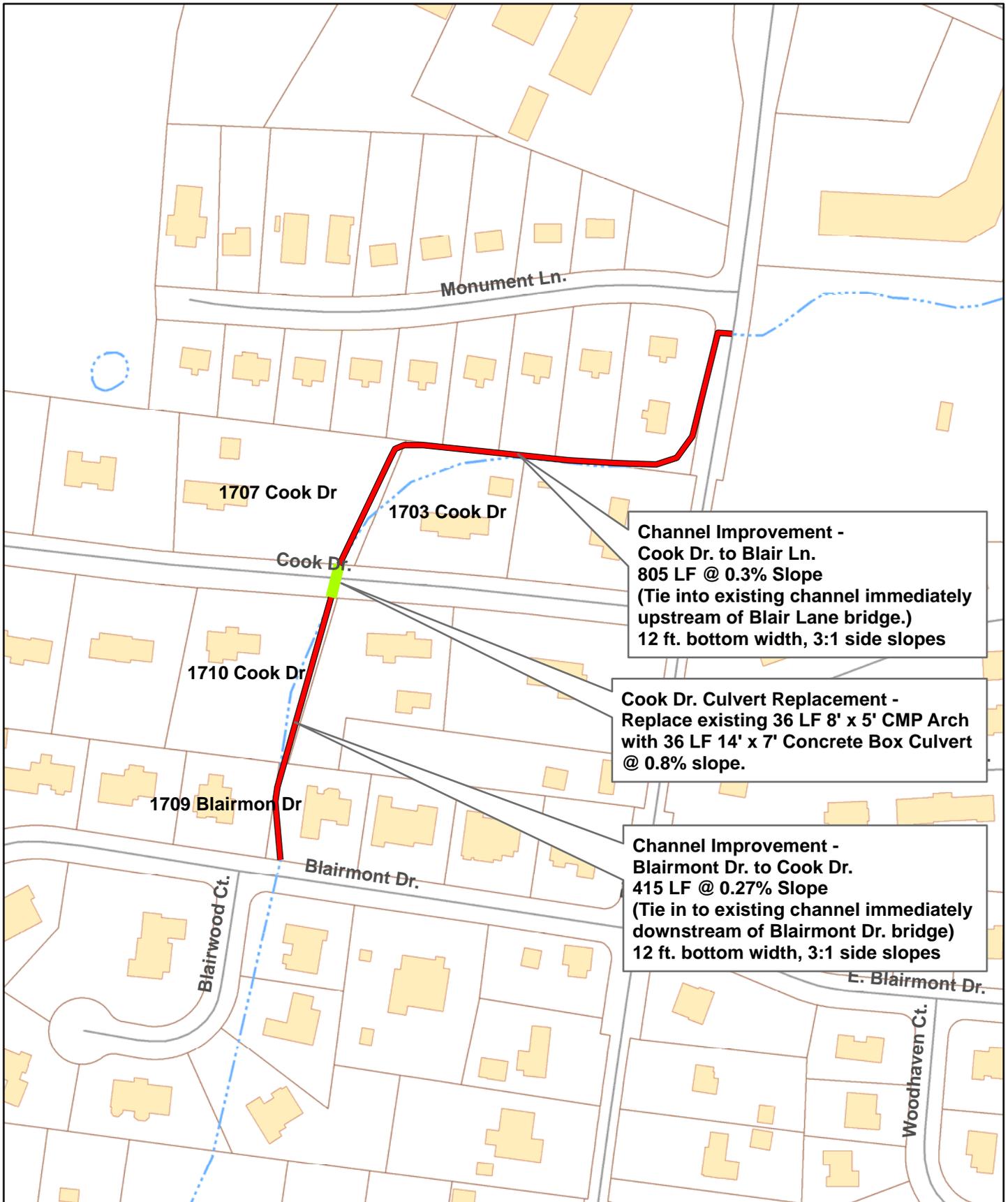
1 inch = 1,000 feet

**City of Lebanon Drainage Analysis  
Blair Lane to Blairmont**



**Hydrologic  
Data**

**FIGURE 1**



**Legend**

- Channel Improvement
- Culvert Replacement
- Buildings
- Parcels



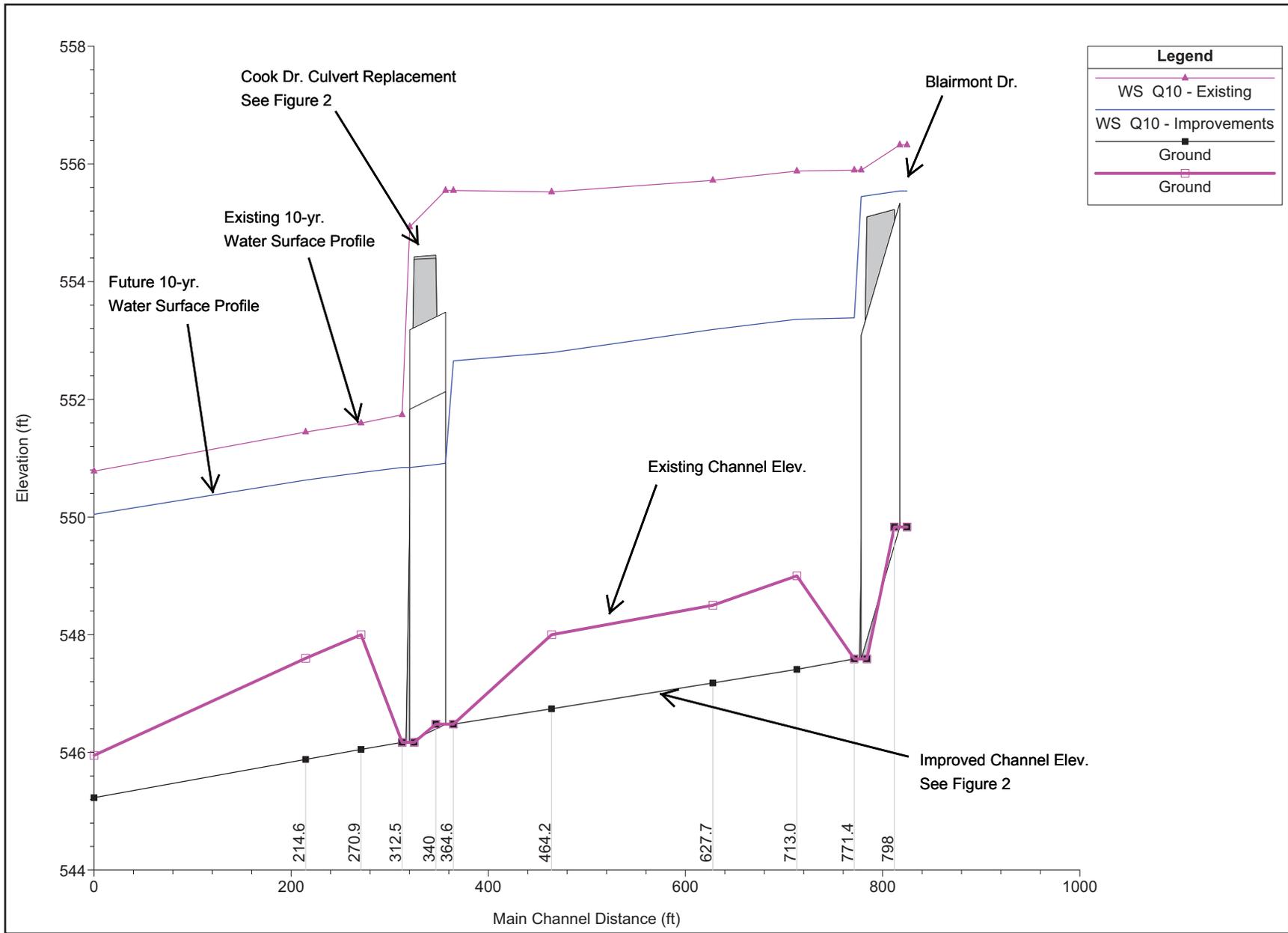
1 inch = 200 feet

**City of Lebanon Drainage Analysis  
Blair Lane to Blairmont**

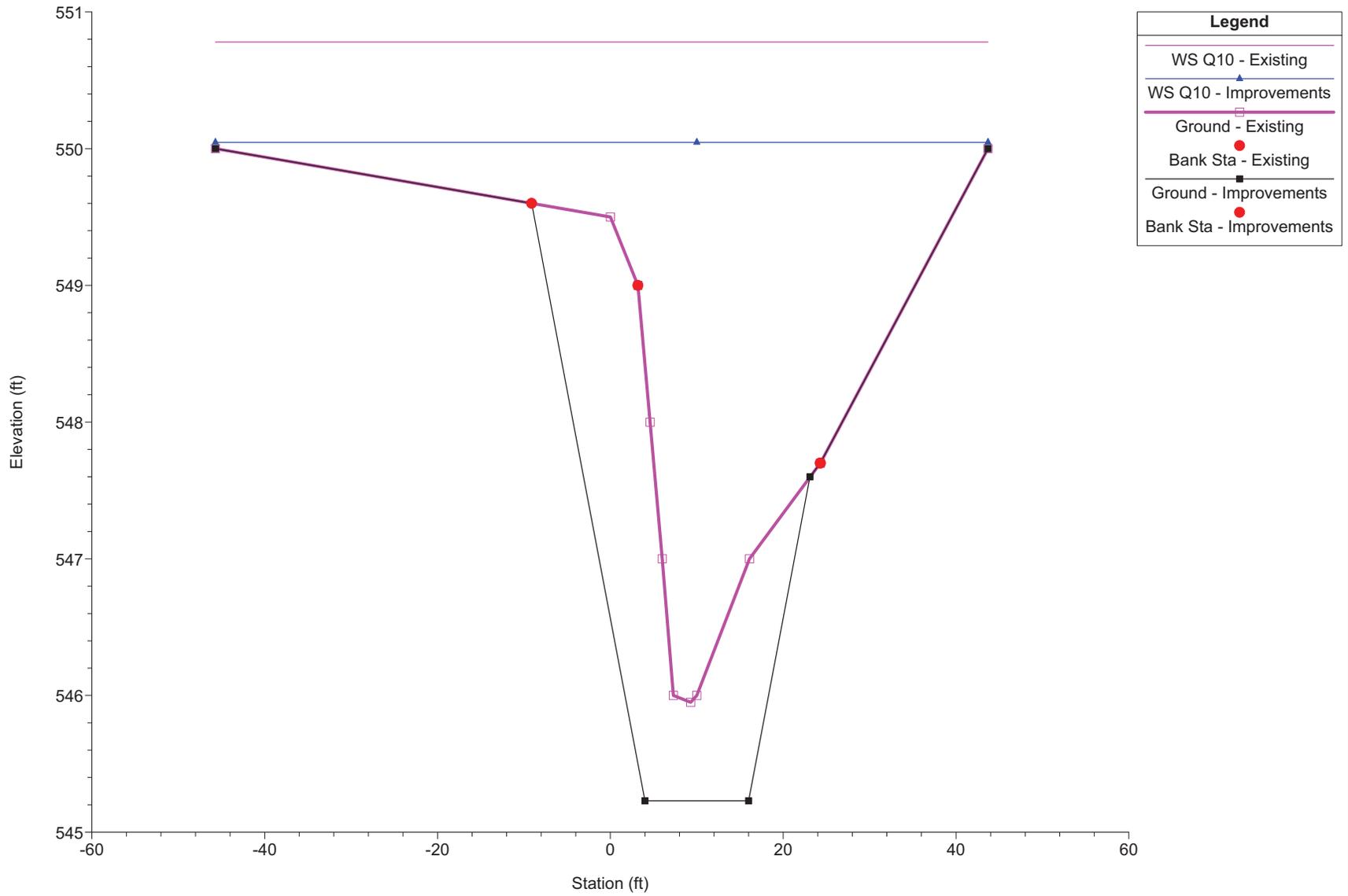


**Recommended  
Improvements**

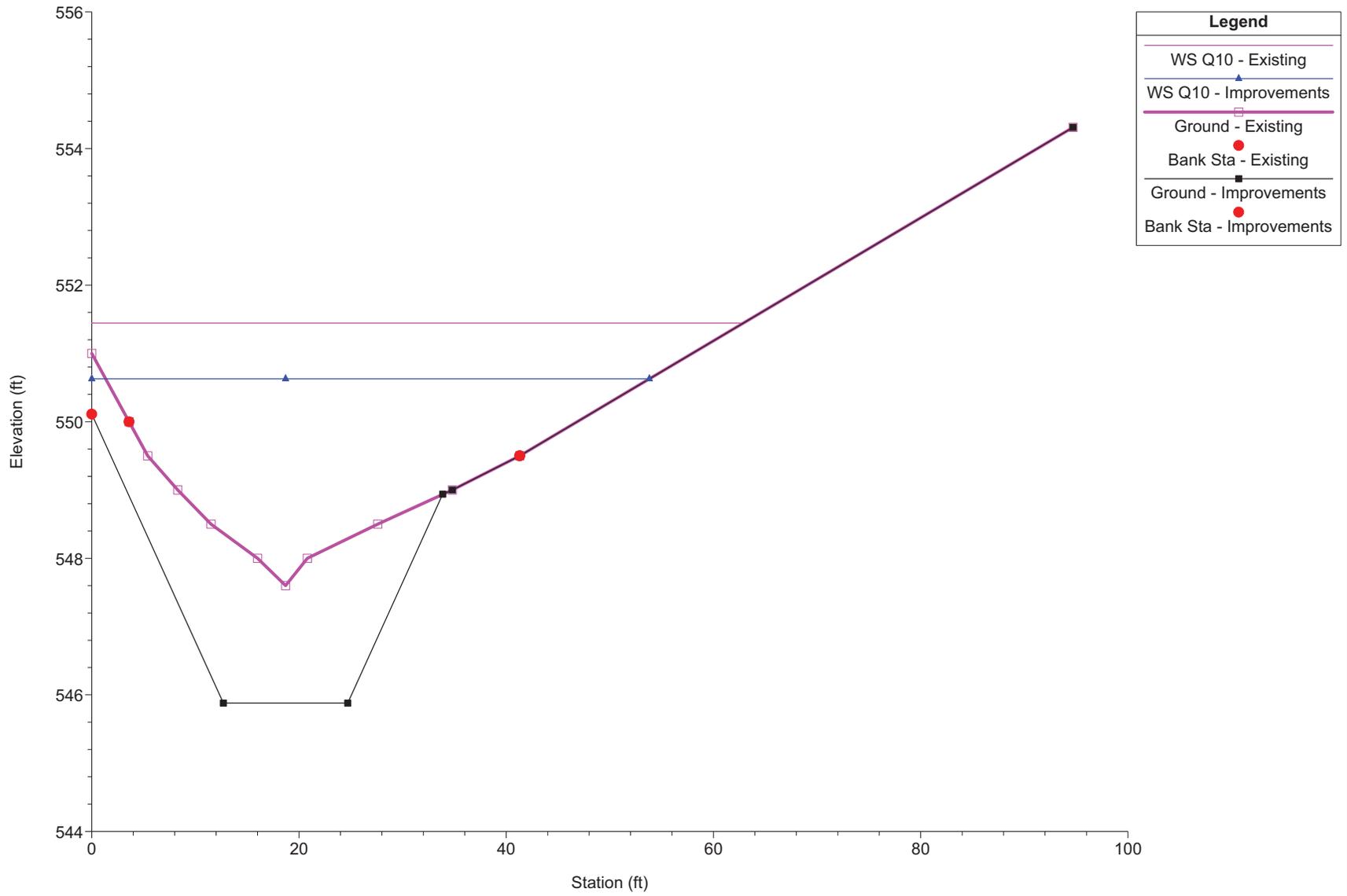
**FIGURE 2**



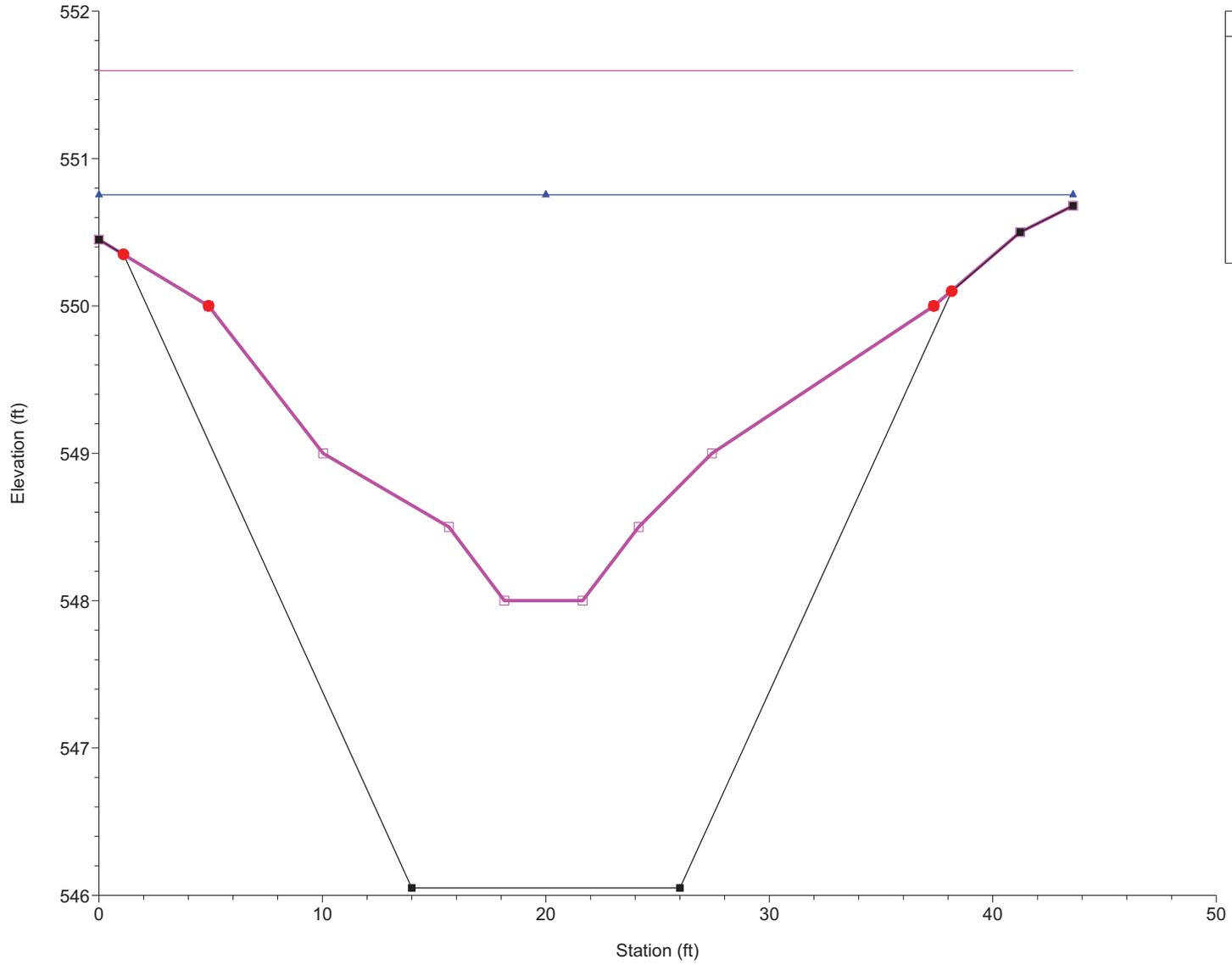
RS = 0.1



RS = 214.6 Garage FFE LT = 552.31

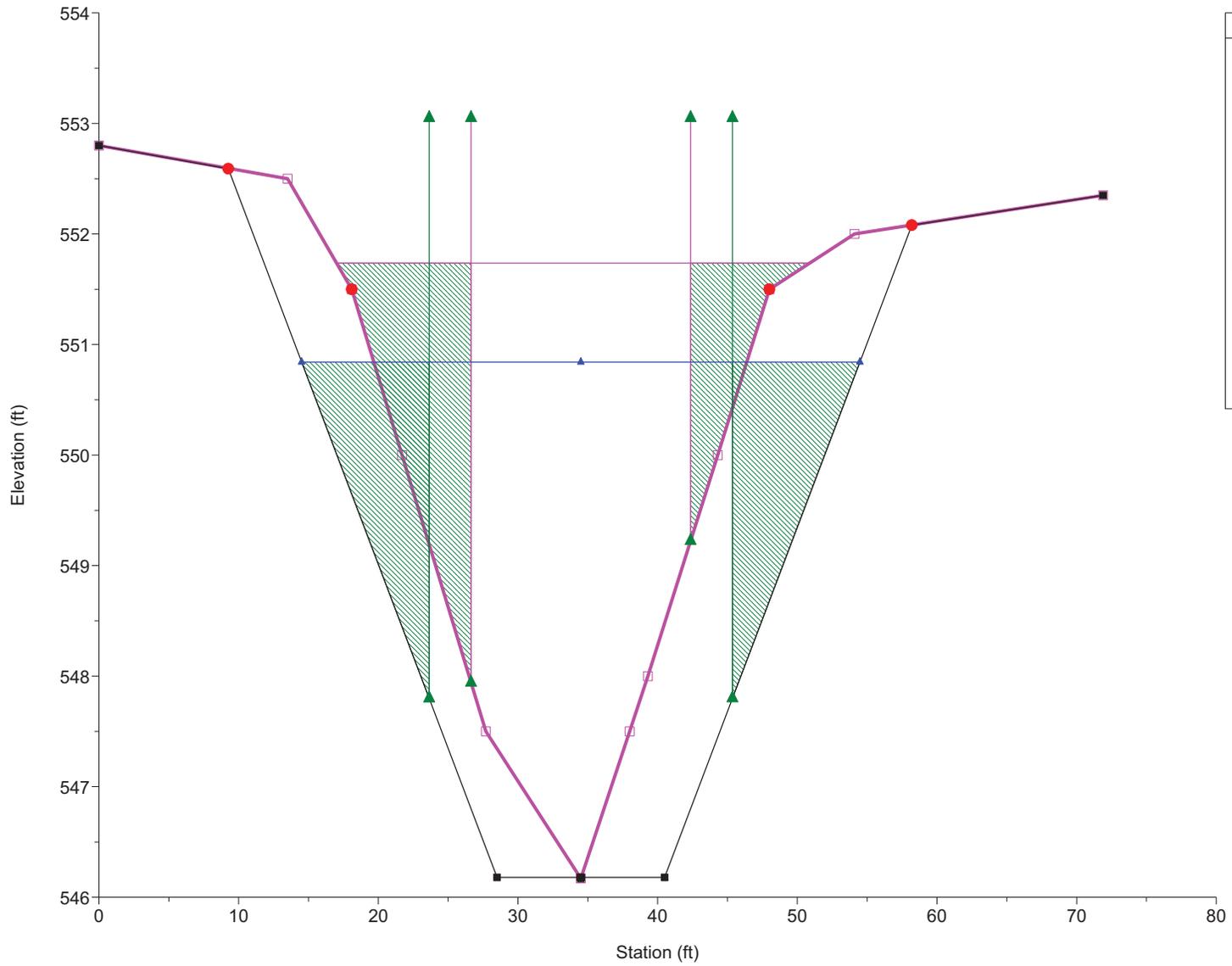


RS = 270.9 RES FFE RT 554.31



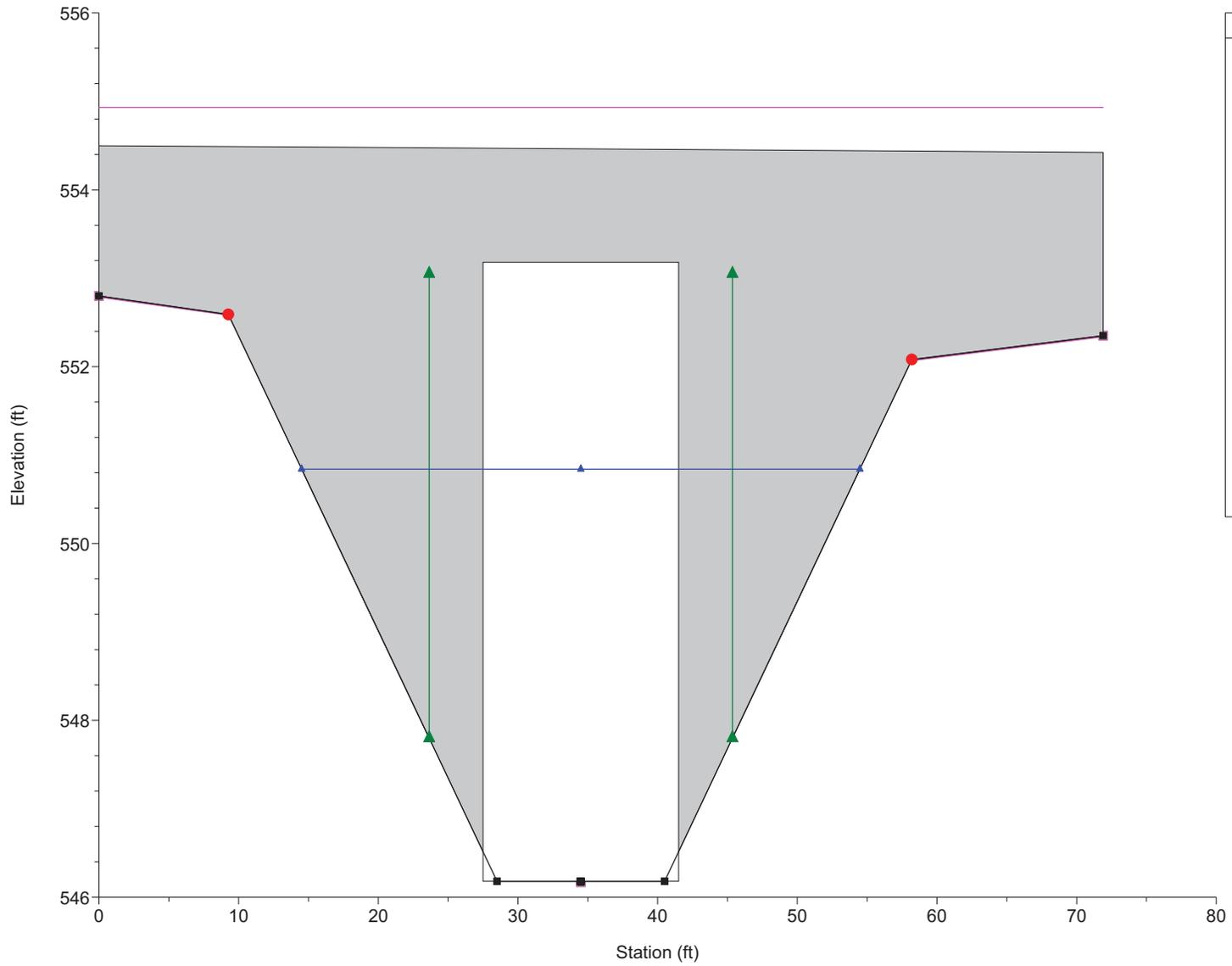
Legend	
WS Q10 - Existing	—
WS Q10 - Improvements	▲
Ground - Existing	□
Bank Sta - Existing	●
Ground - Improvements	■
Bank Sta - Improvements	●

RS = 312.5

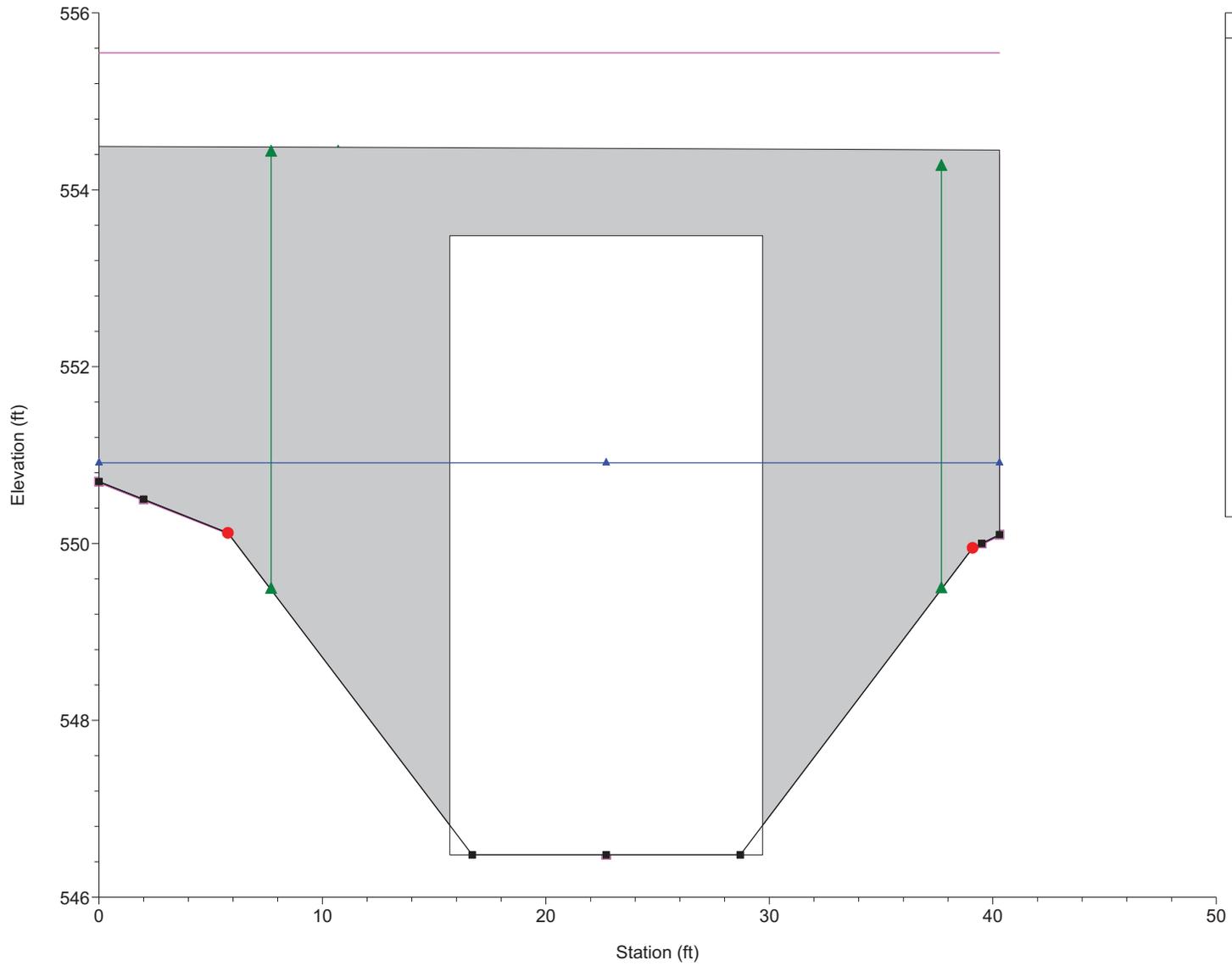


Legend	
WS Q10 - Existing	▲
WS Q10 - Improvements	▲
- Existing	▨
Ground - Existing	■
Ineff - Existing	▲
Bank Sta - Existing	●
- Improvements	▨
Ground - Improvements	■
Ineff - Improvements	▲
Bank Sta - Improvements	●

RS = 340 Culv Cook Dr.

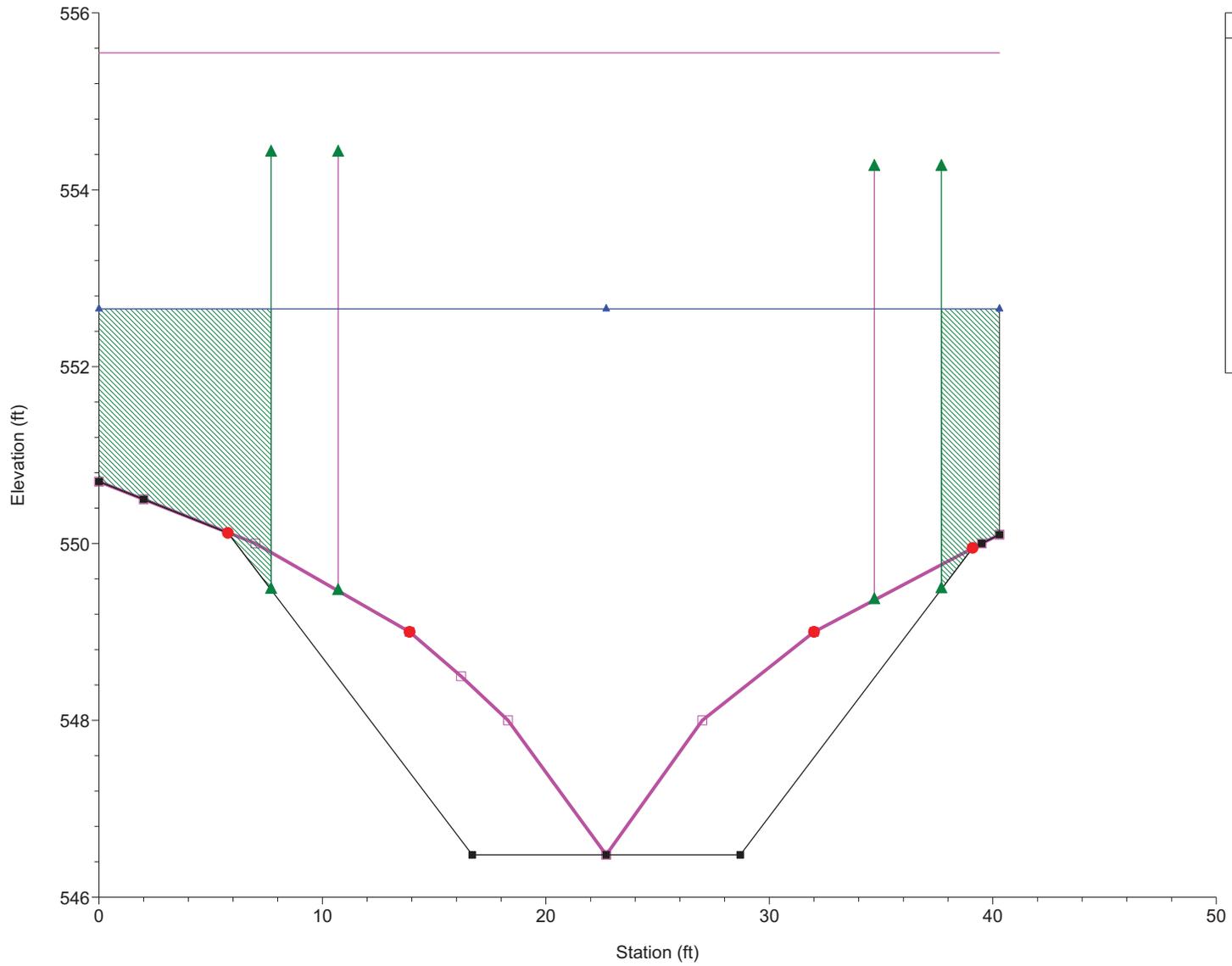


RS = 340 Culv Cook Dr.



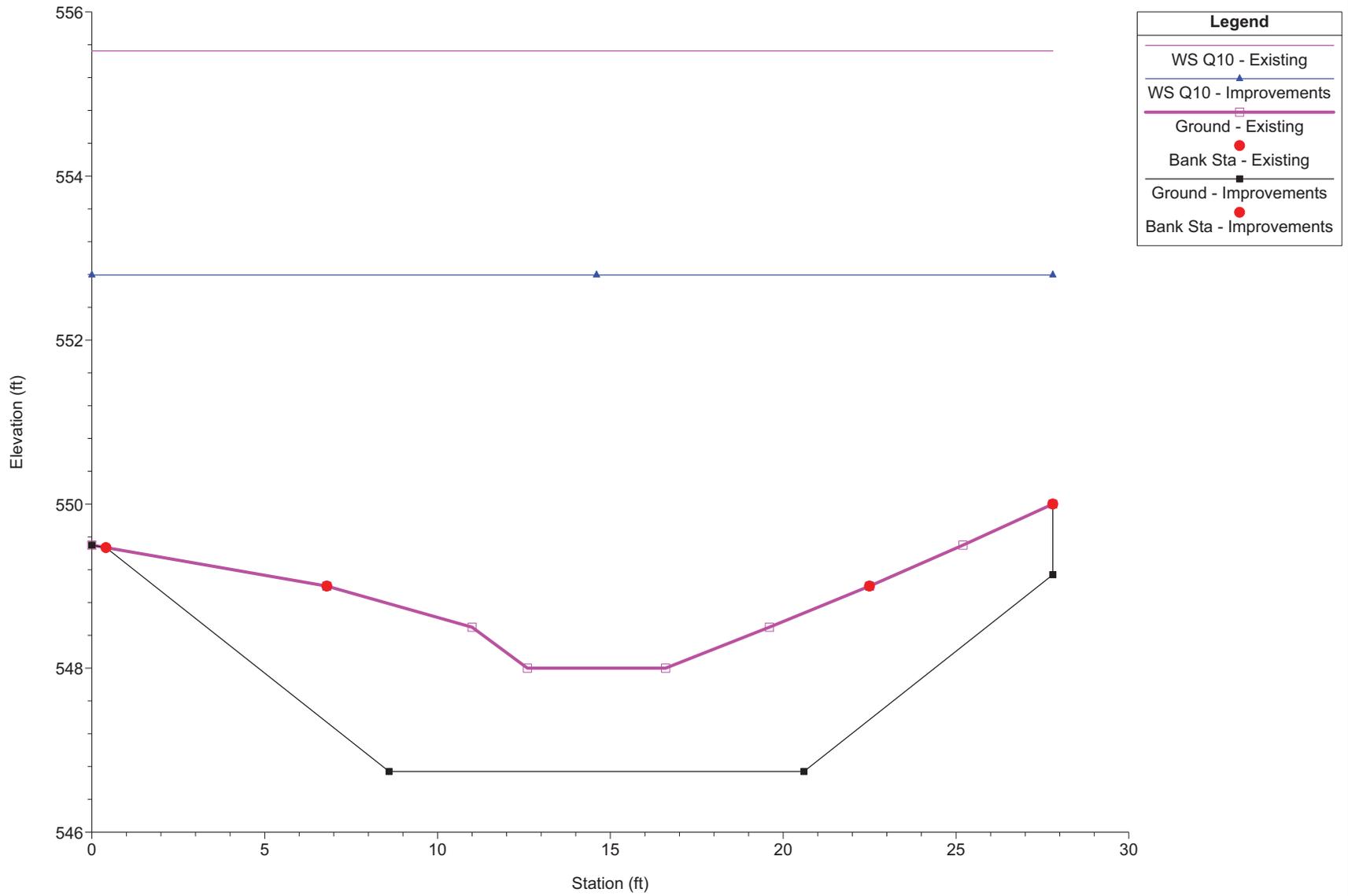
Legend	
WS Q10 - Existing	▲
WS Q10 - Improvements	▲
- Existing	■
- Existing	□
Ground - Existing	—
Ineff - Existing	▲
Bank Sta - Existing	●
- Improvements	▨
- Improvements	■
- Improvements	□
Ground - Improvements	—
Ineff - Improvements	▲
Bank Sta - Improvements	●

RS = 364.6

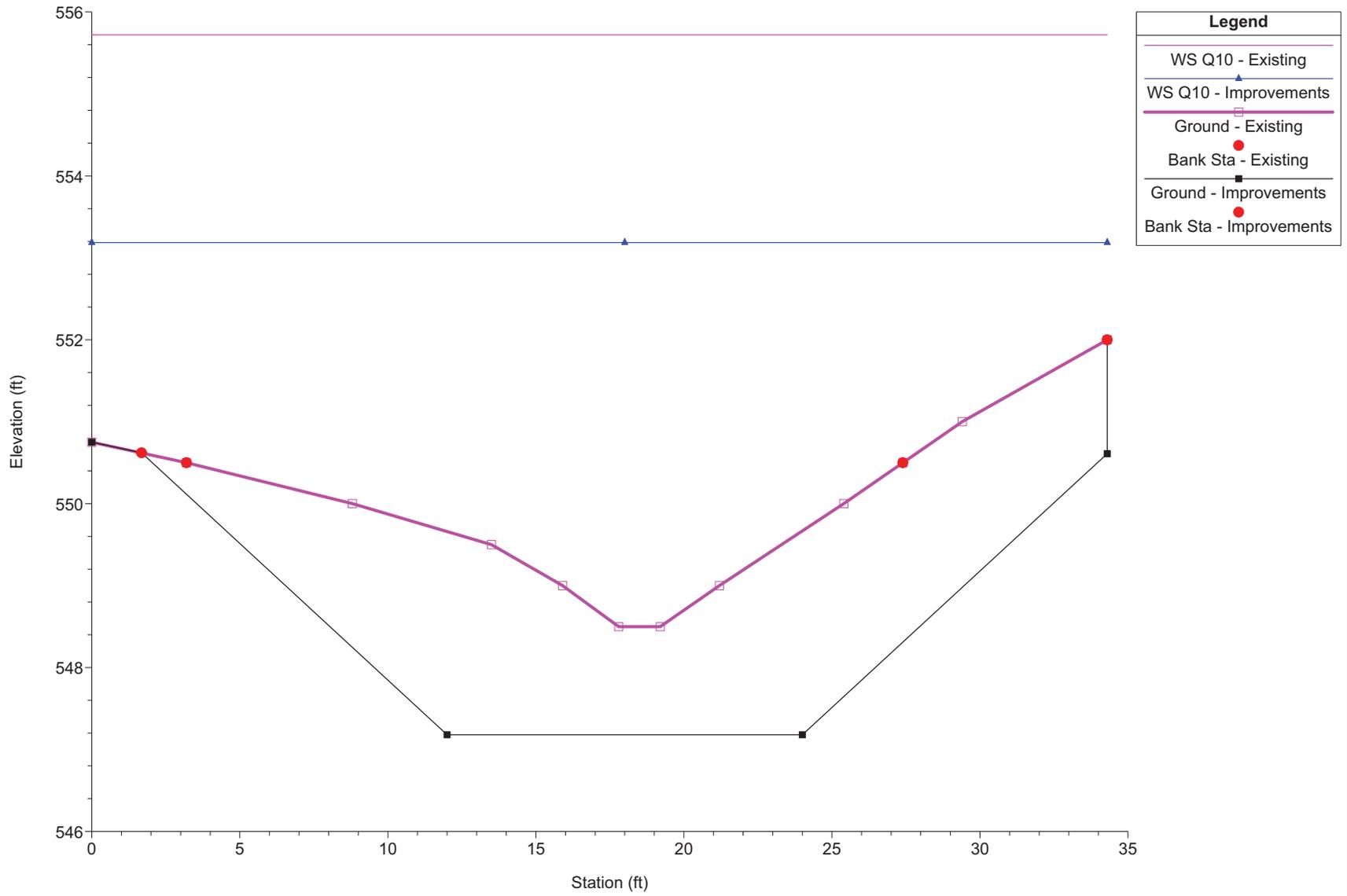


Legend	
WS Q10 - Existing	▲
WS Q10 - Improvements	▲
Ground - Existing	□
Ineff - Existing	▲
Bank Sta - Existing	●
- Improvements	▨
Ground - Improvements	■
Ineff - Improvements	▲
Bank Sta - Improvements	●

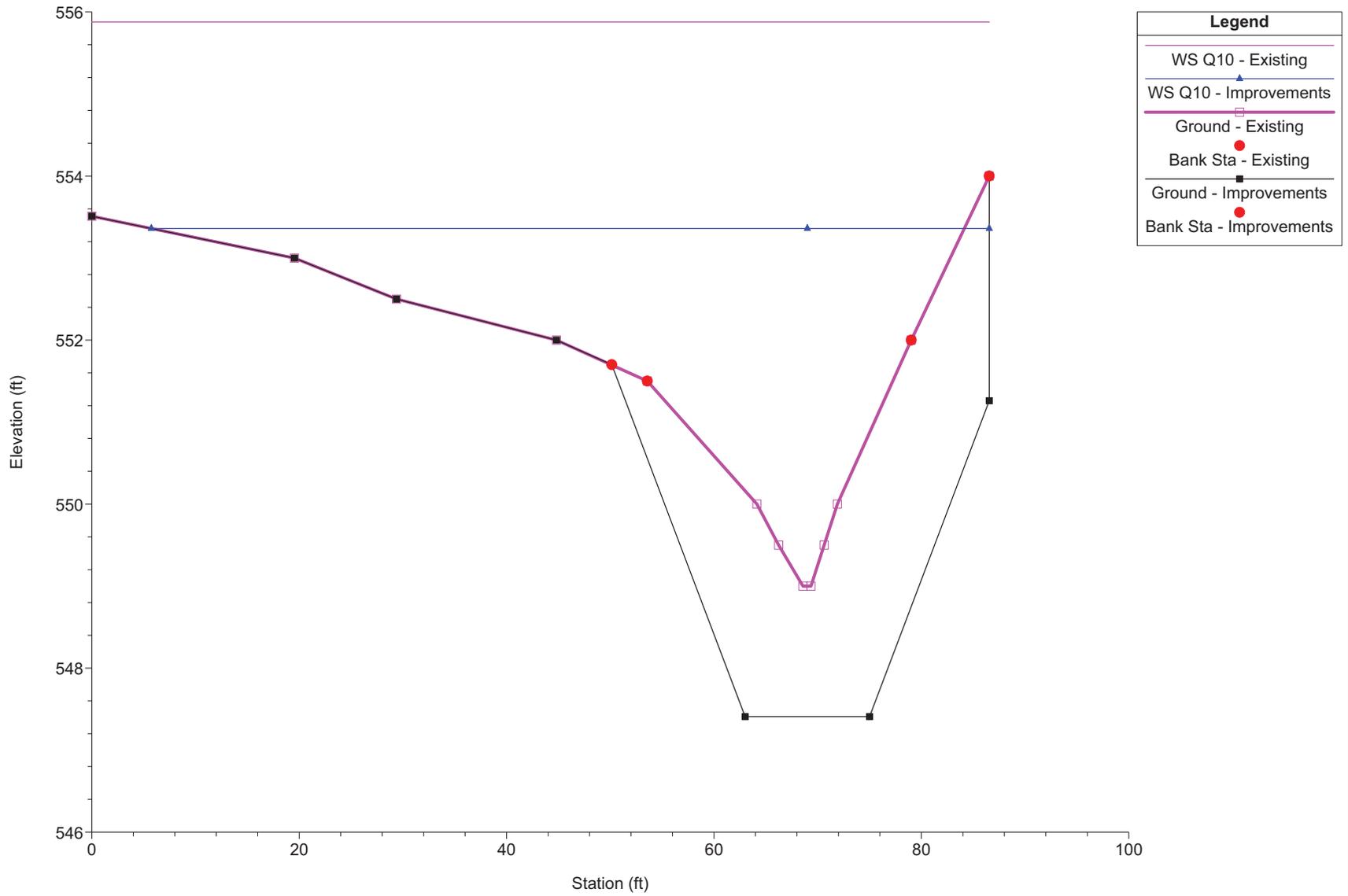
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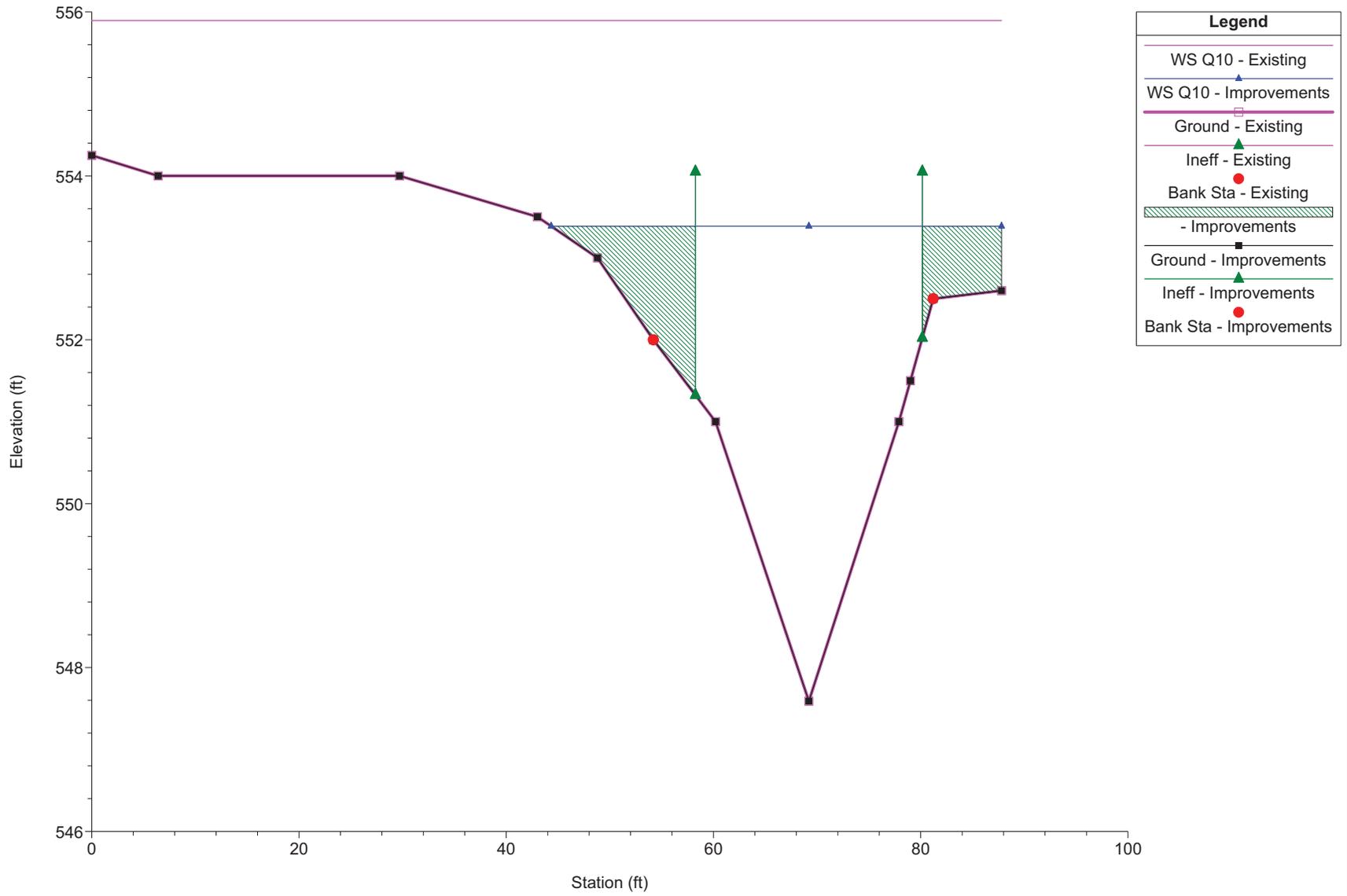
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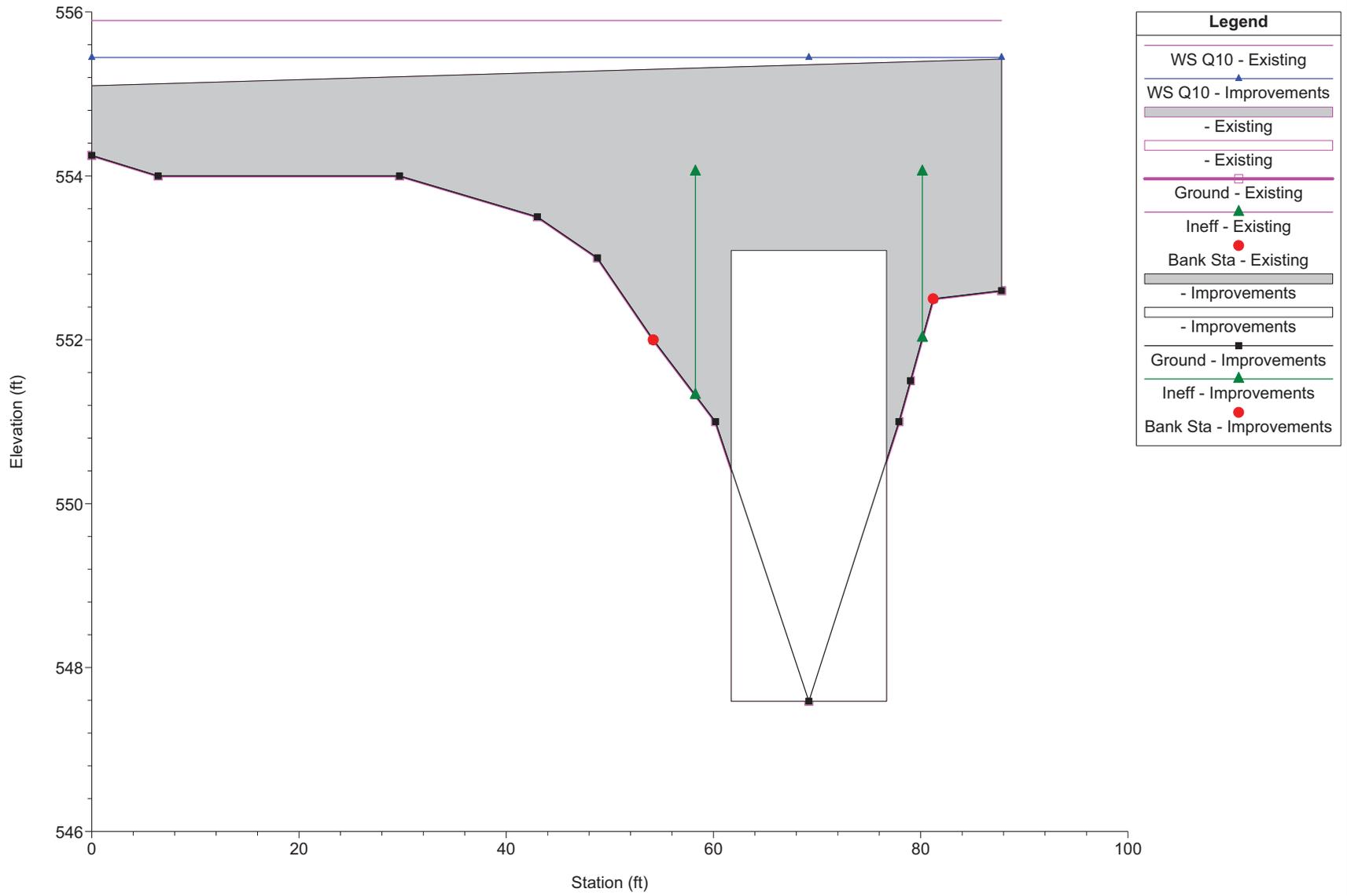
RS = 713.0 GARAGE FFE LT 553.5



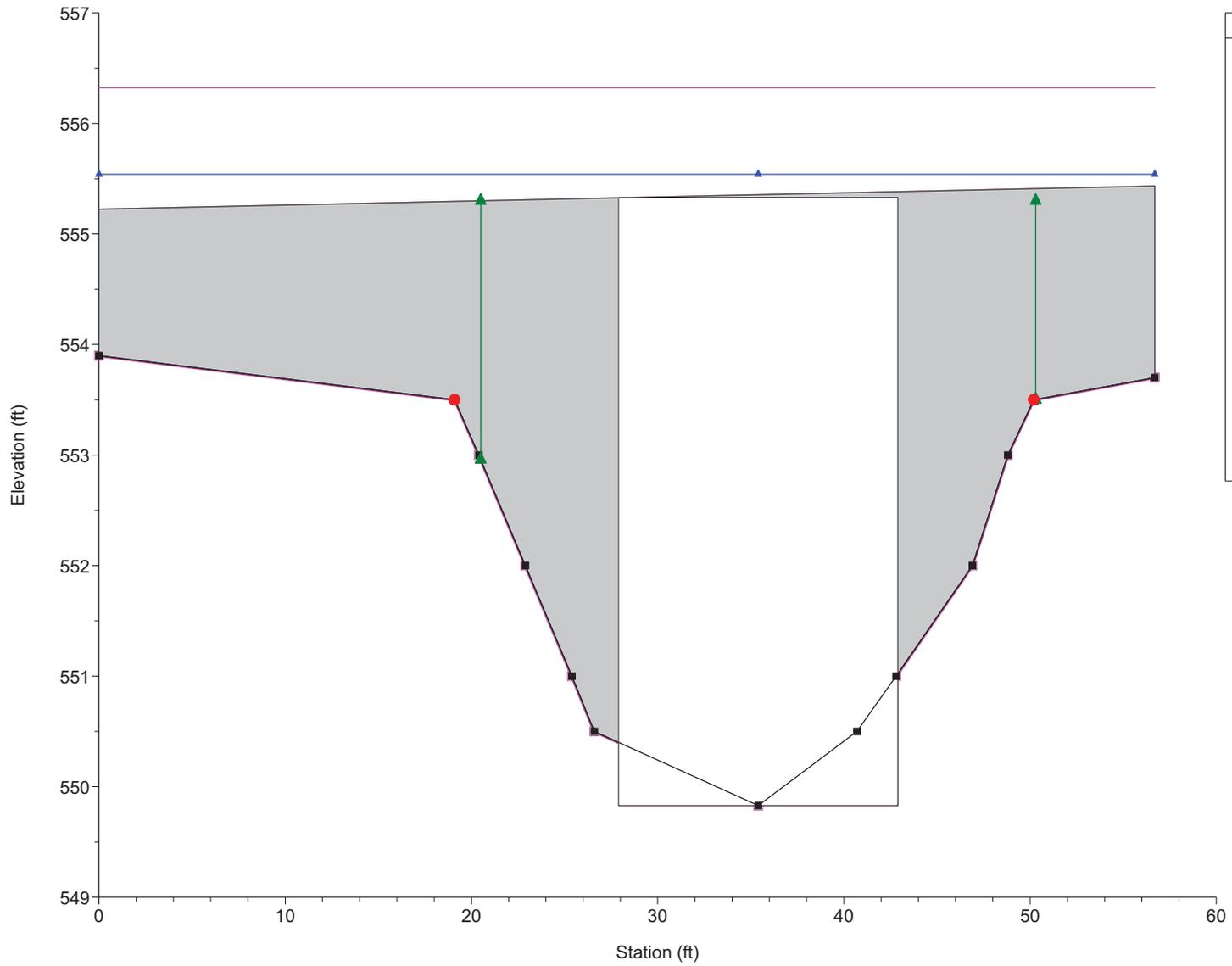
RS = 771.4



RS = 798 Culv Blarimont Dr.



RS = 798 Culv Blarimont Dr.



Legend	
WS Q10 - Existing	▲
WS Q10 - Improvements	▲
- Existing	■
- Existing	□
- Existing	■
Ground - Existing	▲
Ineff - Existing	▲
Bank Sta - Existing	●
- Improvements	■
- Improvements	□
Ground - Improvements	■
Ineff - Improvements	▲
Bank Sta - Improvements	●

RS = 824.8

