North Carson Area
Drainage Plan

Final | June 2020

Prepared By:

Kimley»Horn

In Association With:

CARSON WATER SUBCONSERVANCY DISTRICT

FEMA

06/04/2020

Executive Summary

The North Carson Area Drainage Plan began as two floodplain re-delineation projects in the northern part of Carson City funded by FEMA through the Cooperating Technical Partner (CTP) grant program and administered through the Carson Water Subconservancy District (CWSD). The Eagle Valley Golf Courses A and B Floodplain Restudy was initiated in 2014, and the Goni Canyon Creek Floodplain Restudy was initiated in 2016. Both have been approved by FEMA and are either effective data or will be effective data after a 90-day appeal period. Both FEMA floodplain remapping studies generated flood depth and velocity data on a 15' grid spacing for their entire study areas. This allowed Carson City Public Works staff the ability to identify and quantify flood hazard areas outside FEMA designated floodplains.

The North Carson Area Drainage Plan (NCADP) was originally identified as part of the Carson River Watershed Floodplain Management Plan and remains consistent with the Carson City Hazard Mitigation Plan. The NCADP was initiated in 2018 as part of a CTP grant from FEMA administered by CWSD. The NCADP builds on the flood hazard data compiled for the two previous floodplain re-delineation studies. The project also expands the hydrologic and hydraulic modeling completed for the floodplain studies to include the entire area north of I-580 and Highway 50. The goal of the NCADP was to use existing and new flood hazard data to identify improvement projects to mitigate flooding, and once identified further develop the projects that FEMA would consider as part of future grant applications to fund construction. Nine projects were identified throughout the area of study.

Initially, nine projects were reduced to four projects by soliciting public input at a public meeting on November 14, 2019, and by additional factors. The cost of each project was compared with the measurable benefits to quantify an initial Benefit Cost Ratio (BCR). FEMA only considers projects for grant award with BCRs of one (1) or greater. Of the original nine, only four selected projects had initial BCRs of one or greater. These four projects were then further refined to develop conceptual design (~15%) and engineer's opinion of probable cost for each. Each potential project was also coded into the hydraulic models to create proposed conditions results. These results quantify the effect on flood depths and velocities of the proposed projects for various storm events. It is anticipated that the results of the NCADP will be combined with additional Benefit Cost Analysis to formulate FEMA grant applications for submission to the State of Nevada and FEMA in the future.

Figure 1: North Carson City

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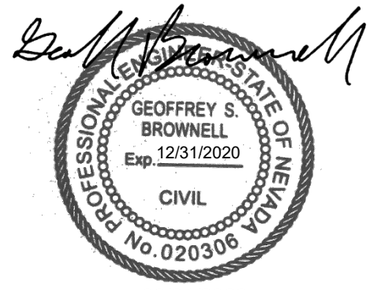

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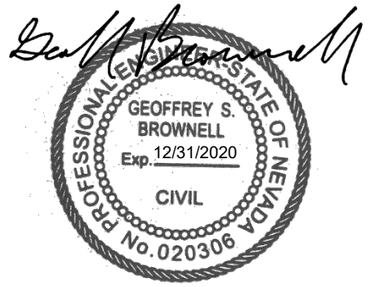


06/04/2020

1. Purpose

The purpose of the North Carson Area Drainage Plan (NCADP) is to identify flood prone areas in the northern portion of Carson City, develop conceptual mitigation projects for these areas, select the strongest candidates for further development, and refine these candidates for future consideration as part of grant applications to FEMA. The strongest candidates are identified as those with the most reasonable chance of achieving a Benefit Cost Ratio greater than one as required by the State of Nevada and FEMA for all grant application submissions. The NCADP was first identified as part of the Carson River Watershed Floodplain Management Plan developed by the Carson Water Subconservancy District. The NCADP is also consistent with the Carson City Hazard Mitigation Plan, with the goal to reduce the possibility of damage and loss due to flooding.

2. Project History

The North Carson Area Drainage Plan began as two FEMA floodplain remapping projects in the northern part of Carson City to account for changes in flood flows due to the construction of the Carson City Freeway (I-580). The Eagle Valley Golf Course A and B Floodplain Remapping project was initiated in 2014, and the Goni Canyon Creek Floodplain Remapping project was imitated in 2016. The respective study boundaries are shown in Figure 2. Both remapping projects have been approved by FEMA with the Eagle Valley Letter of Map Revision (LOMR), FEMA Case # 16-09-1091P, effective 12/26/17, and the Goni Canyon Creek LOMR, FEMA Case # 19-09-1428P, to be effective in April 2020.

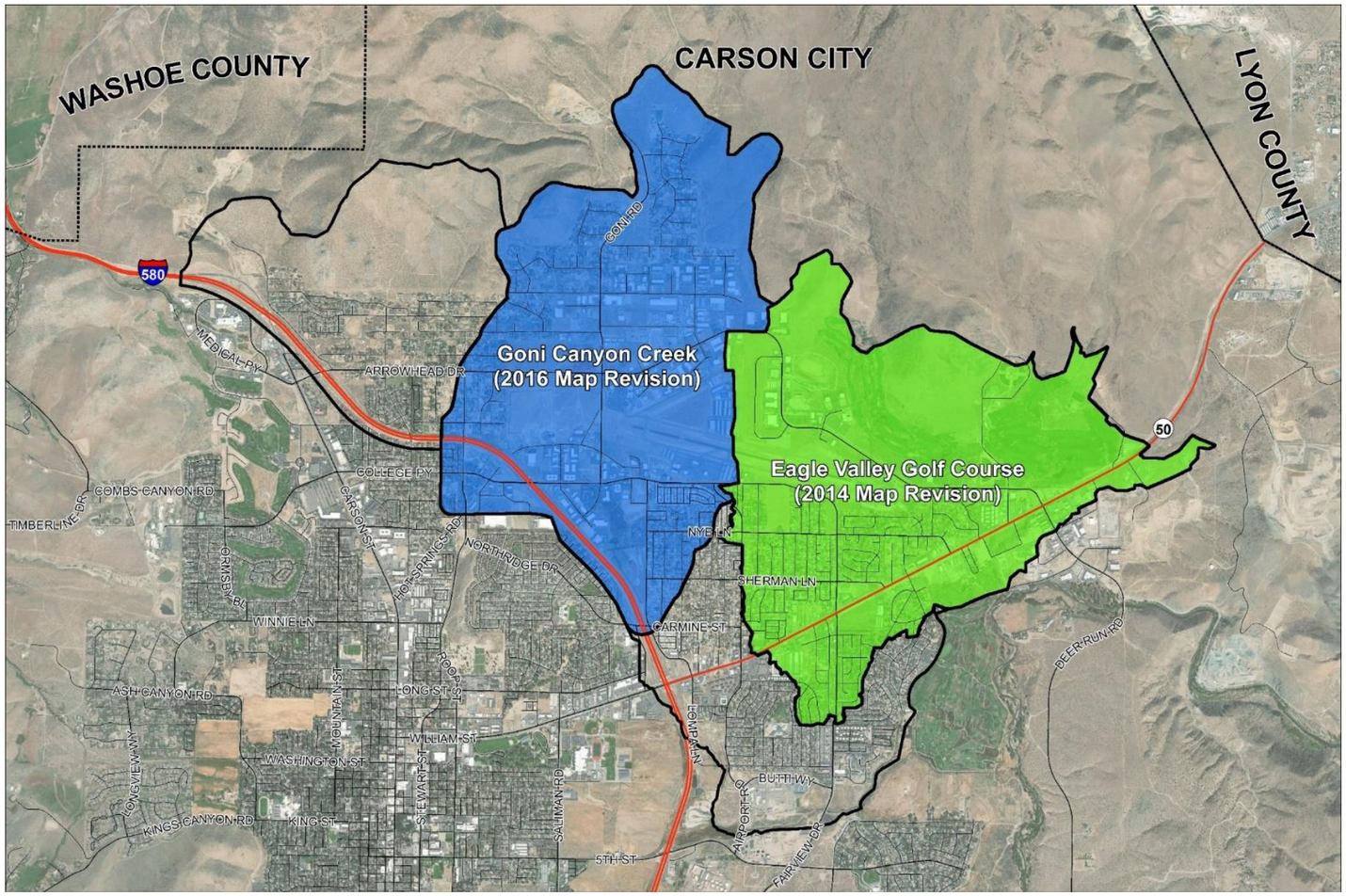


Figure 2: Goni Canyon Creek & Eagle Valley

Figure 3: FEMA Flood Hazards illustrates the revised floodplain delineations for both watersheds.

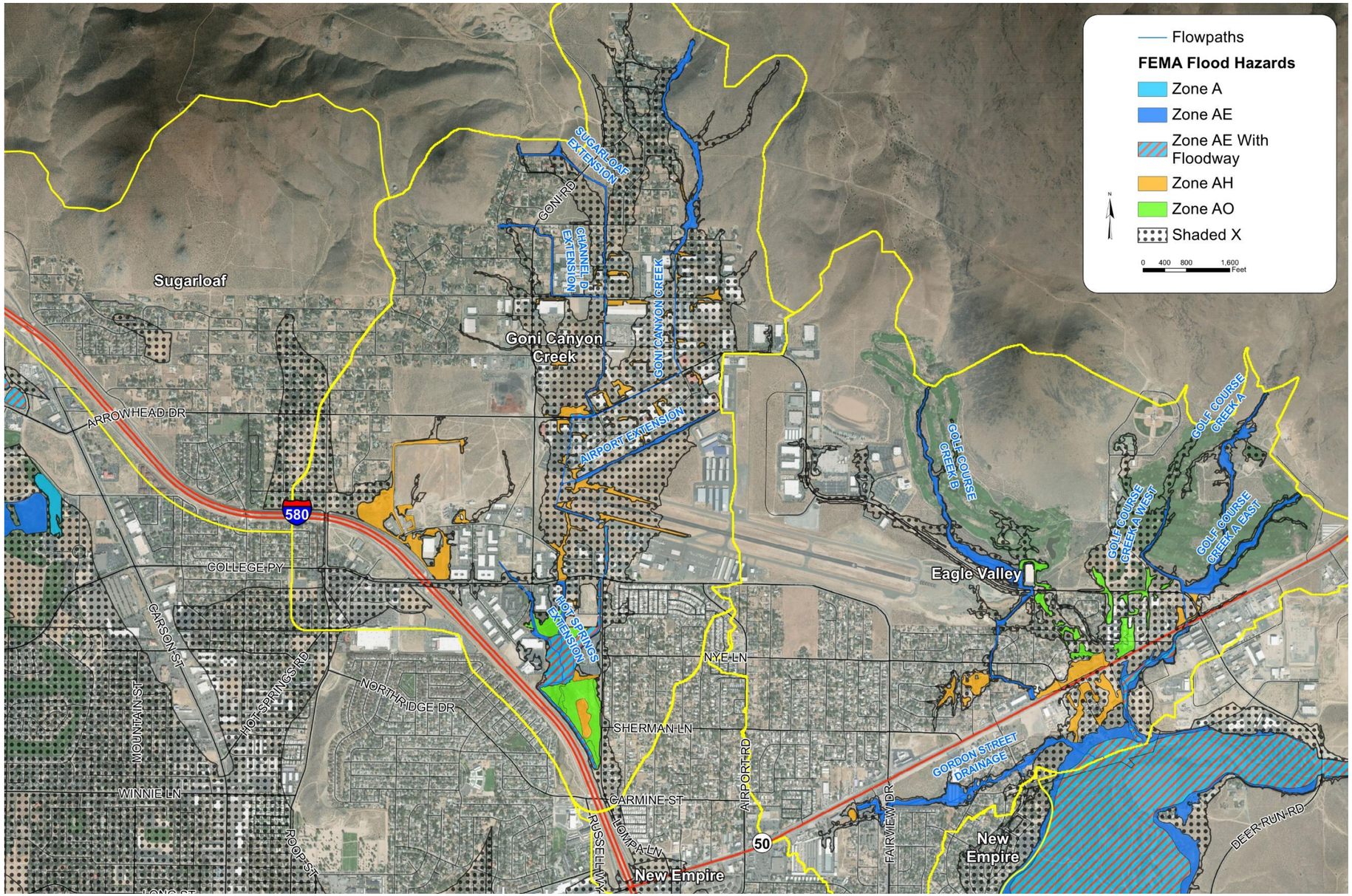


Figure 3: FEMA Flood Hazards

2.1. Eagle Valley

Figure 4: Eagle Valley (CSLF) shows the changes in floodplain due to the Eagle Valley Golf Courses A and B Floodplain Restudy. The following areas were added, removed, and unchanged. Areas in orange were added, green were removed, and blue remained unchanged.

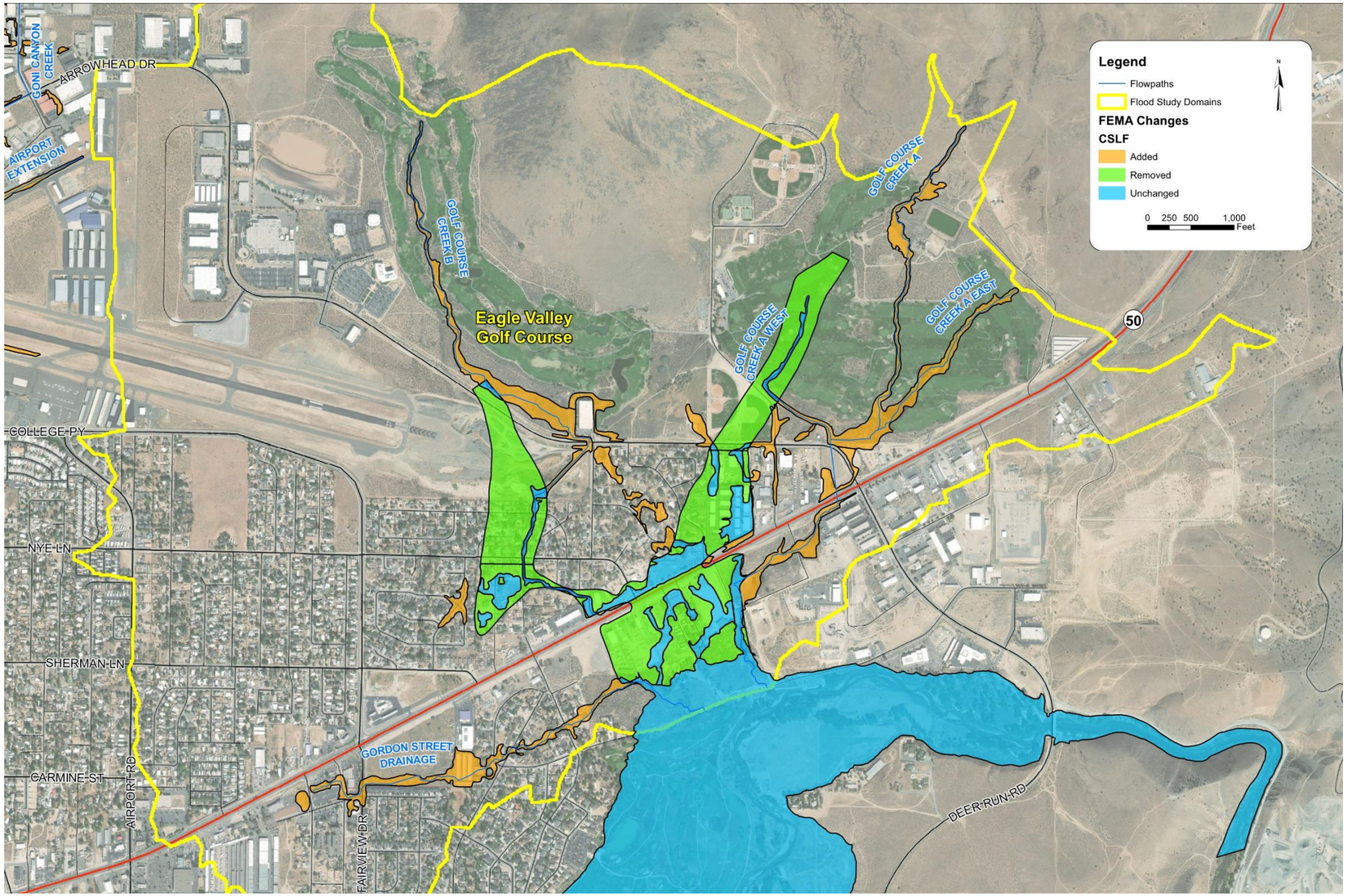


Figure 4: Eagle Valley (CSLF)

2.2. Goni Canyon Creek

Figure 5 demonstrates the changes in floodplain due to the Goni Canyon Creek Floodplain Restudy. Areas in orange were added, green were removed, and blue remained unchanged.

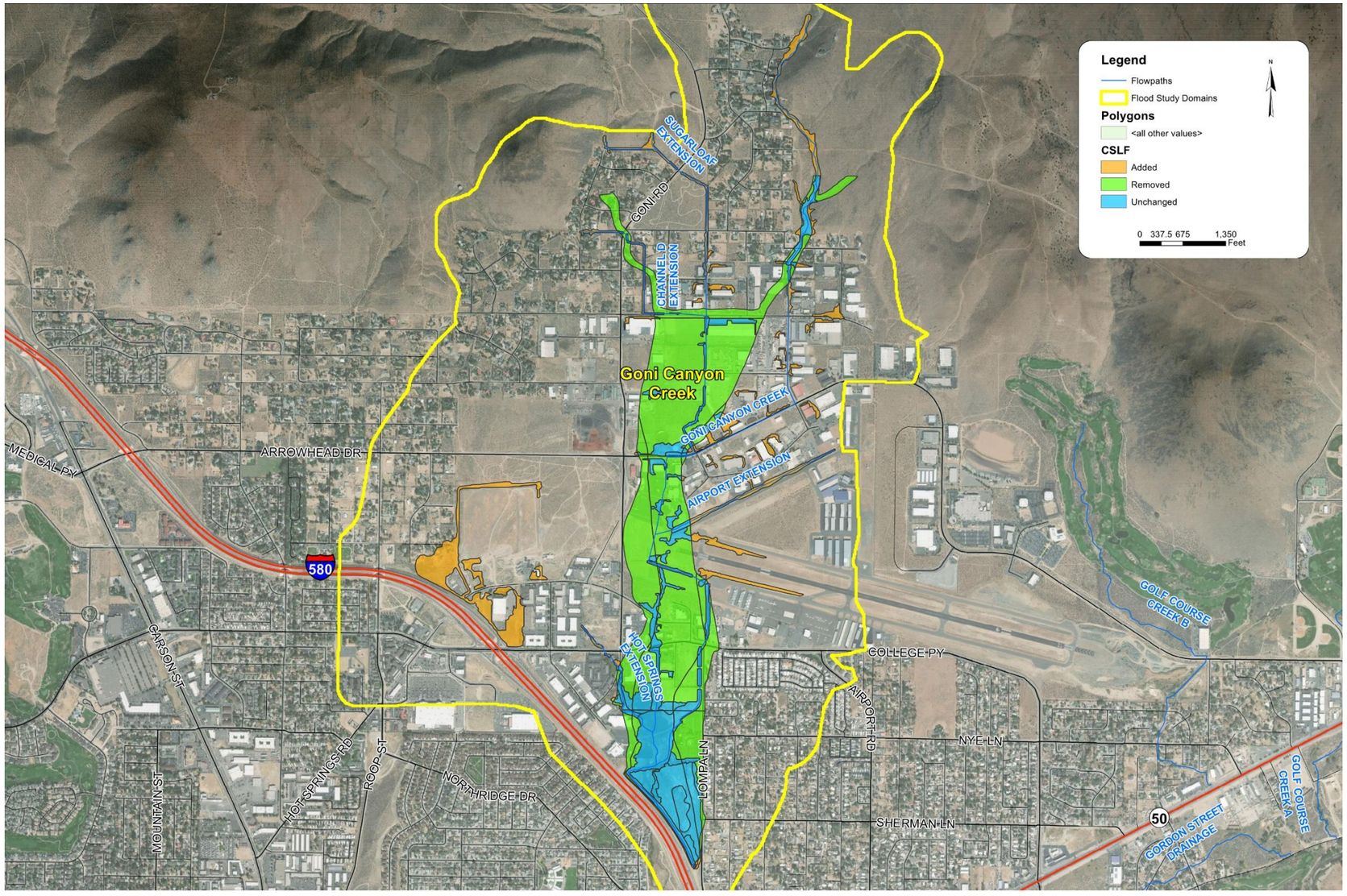


Figure 5: Goni Canyon Creek (CSLF)

3. North Carson Area Drainage Plan

With the completion of the remapping projects, flood hazard data was generated for the entire watersheds including areas outside of the FEMA Special Flood Hazard Areas (SFHAs). The remapping projects were completed using two-dimensional hydraulics yielding depth and velocity data on 15' grids for the entire study areas. This allowed for the identification of flood prone areas, and to formulate potential improvement projects to mitigate the flood hazard. In addition to the modeling domains for Goni Canyon Creek and Eagle Valley Golf Courses, two additional areas were added to the NCADP as shown in Figure 6: Flood Study Overview Map on the right. The areas labeled as Sugarloaf and New Empire were added at the discretion of Carson City to further analyze known flooding issues, and to expand the project area. FLO-2D Pro hydrology and hydraulic modeling software was used to define the flood hazards Pertain to these additional areas, the same methodologies were incorporated as the remapping studies (refer to FEMA cases 16-09-1091P and 19-09-1428P for detailed explanations of modeling approach and parameters).

3.1. Goals for the Project

The overarching goal for the NCADP are as follows:

1. Utilized the FEMA Risk MAP datasets (depth and velocity grids) generated as part of the floodplain remapping studies to identify potential flood prone areas in the watersheds.
2. Expand the NCADP study area to include additional areas to the West and South.
3. Based on the flood hazard analysis effort, identify Areas of Mitigation Interest (AOMI's). AOMI's are flood prone areas where a potential solution has also been identified.
4. Based on a collaborative decision matrix, prioritize the AOMI's.
5. For the top 3-4 AOMI's after prioritization, develop conceptual design and cost associated with the construction of the mitigation improvements for each area and to reduce the possibility of damage and loss due to floods.
6. Formulate conceptual design and costs such that they can be easily utilized for future FEMA grant application submissions.

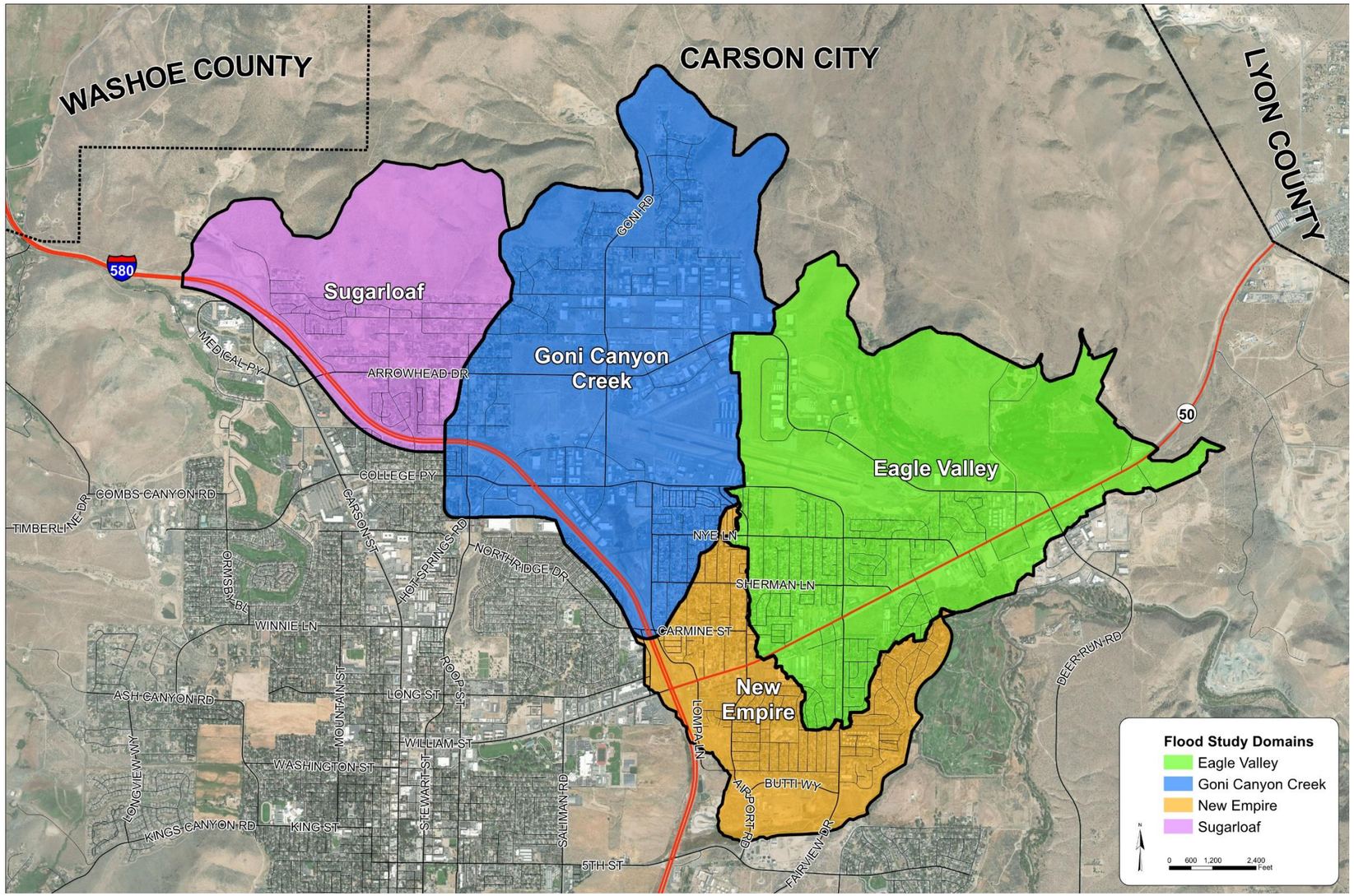
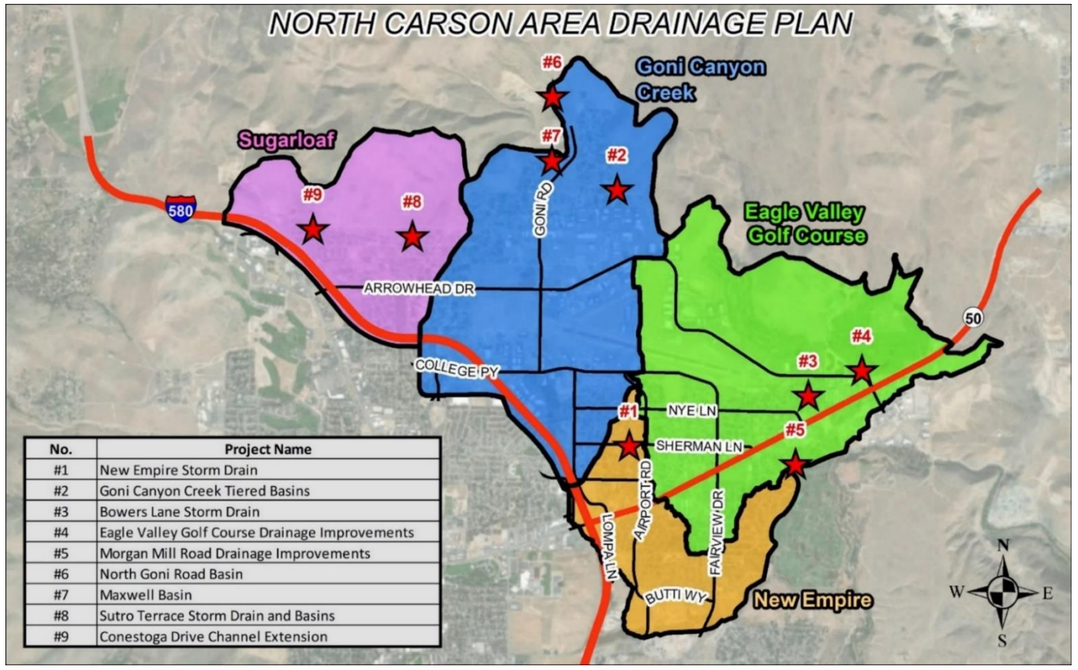


Figure 6: Flood Study Overview Map

4. Areas of Mitigation Interest

Initially, nine areas of Mitigation Interest were identified. With the help of City Public Works staff, the AOMI's were identified as known problem areas or areas with as known flood hazard. The flood hazard data generated from the hydraulic modeling supported these determinations. For each AOMI, conceptual mitigation projects were discussed with the project team and a preferred alternative selected. Figure 8: Drainage Plan shows the location of each AOMI in the study area and within each model domain. Figure 7: Flood Mitigation Locations shows the locations of each AOMI relative to 100-year flood depths and demonstrates the exhibit layout for the following sections where each AOMI is discussed in detail.



No.	Project Name
#1	New Empire Storm Drain
#2	Goni Canyon Creek Tiered Basins
#3	Bowers Lane Storm Drain
#4	Eagle Valley Golf Course Drainage Improvements
#5	Morgan Mill Road Drainage Improvements
#6	North Goni Road Basin
#7	Maxwell Basin
#8	Sutro Terrace Storm Drain and Basins
#9	Conestoga Drive Channel Extension

Figure 8: Drainage Plan

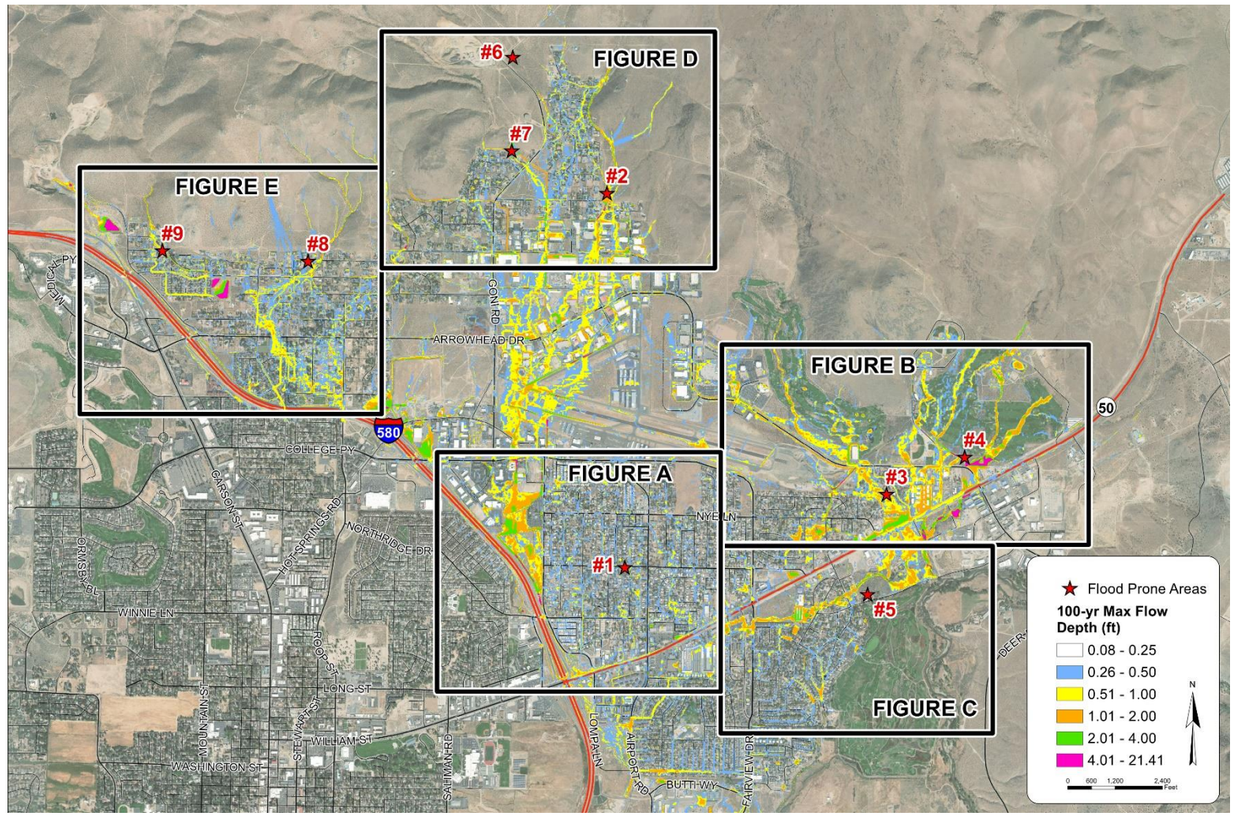


Figure 7: Flood Mitigation Locations

4.1. New Empire Storm Drain

AOMI #1 was titled New Empire Storm Drain. This area, Figure 7 A, is subject to flooding for the reason of absence of infrastructure and conveyance. Many of the north/south streets lack curb and gutter on one or both sides of the road where minimum flow depth can impact the residential lots. The storm water sits on the lots and does not drain. The improvements considered for this study were to construct new curb and gutter and/or valley gutters on some of the north/south streets to better convey runoff south. Runoff at Sherman Lane and Carmine Drive would be intercepted by catch basins and storm drain and conveyed to existing infrastructure. West of Airport Road, runoff would be conveyed to open space and the I-580 drainage system. East of Airport Road, runoff would be conveyed to existing storm drain near College Parkway. Because of cost, these systems would be designed to convey 10-year runoff. It was estimated for the total cost to be approximately $9.9 million and it may benefit to some degree up to 770 structures.

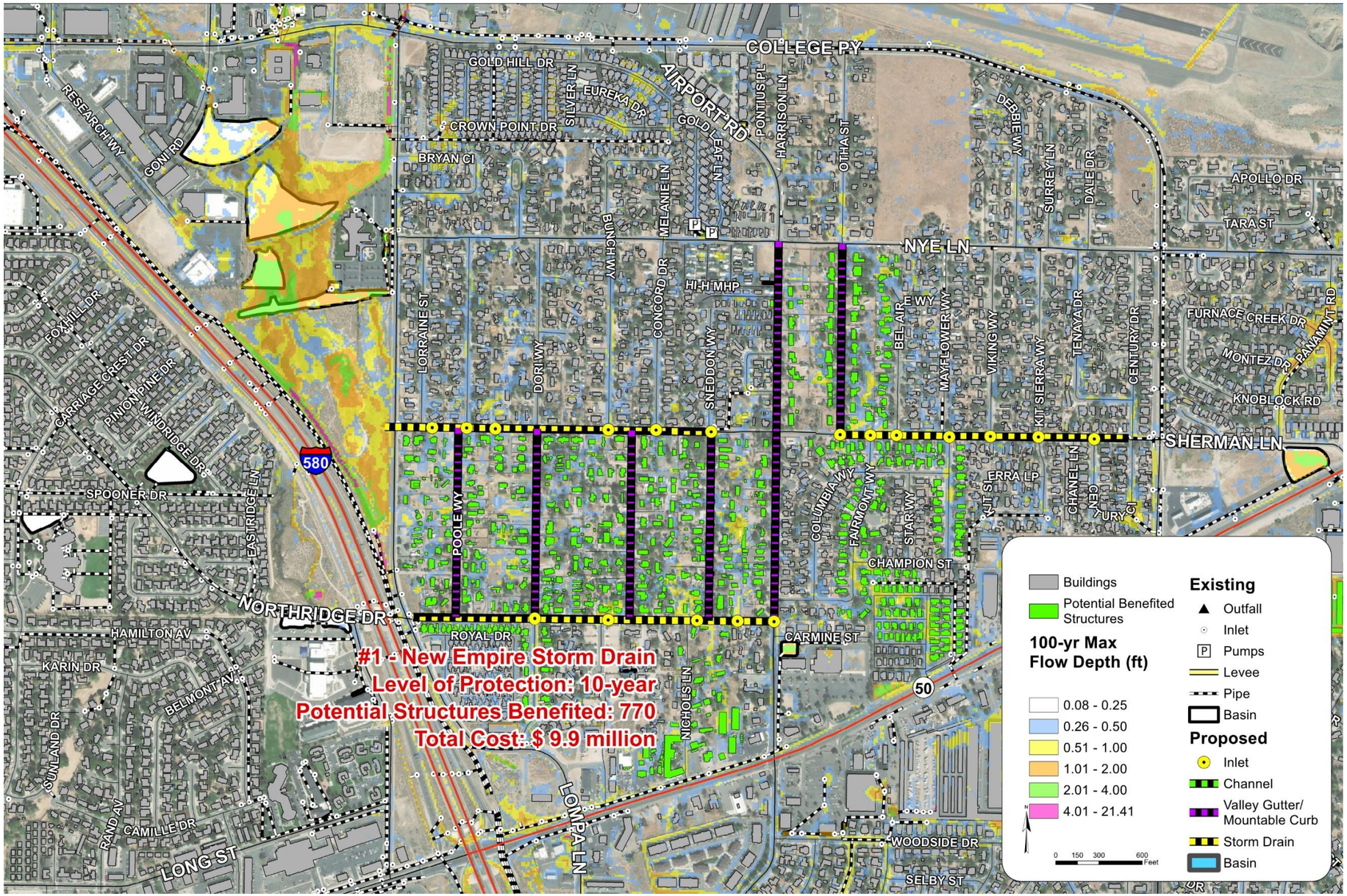


Figure 7 A: Flood Prone Areas (New Empire)

4.2. Bowers Lane Storm Drain

AOMI #3 was titled Bowers Lane Storm Drain. In this area (Figure 7 B), runoff crosses Arrowhead Drive from the golf course and inundates the downstream neighborhood ultimately ponding upstream of Highway 50. This area also has FEMA SFHA's associated with the flood hazard. The design solution formulated was to intercept 10-year flows at Arrowhead Drive and Bowers Lane and convey to the Carson River via storm drain and open channel. The total estimated cost of these improvements is approximately $4.9 million with up to 80 structures benefitted in some capacity. It is likely that the SFHA would also be reduced.

4.3. Eagle Valley Golf Course Drainage Improvements

AOMI #4 was titled the Eagle Valley Golf Course Drainage Improvements and would also intercept runoff impacting Arrowhead Drive downstream to Highway 50 as it is demonstrated in Figure 7 B. The improvements would increase the capacity of the open channel along Centennial Park Drive to intercept runoff from the golf course and the upstream highlands. Runoff would be conveyed to an online detention basin as shown, where flows would be metered through the existing culverts under Arrowhead Drive. The system would convey 10-year runoff at a total approximate cost of $5.1 million. Up to 50 structures could benefit in some capacity.

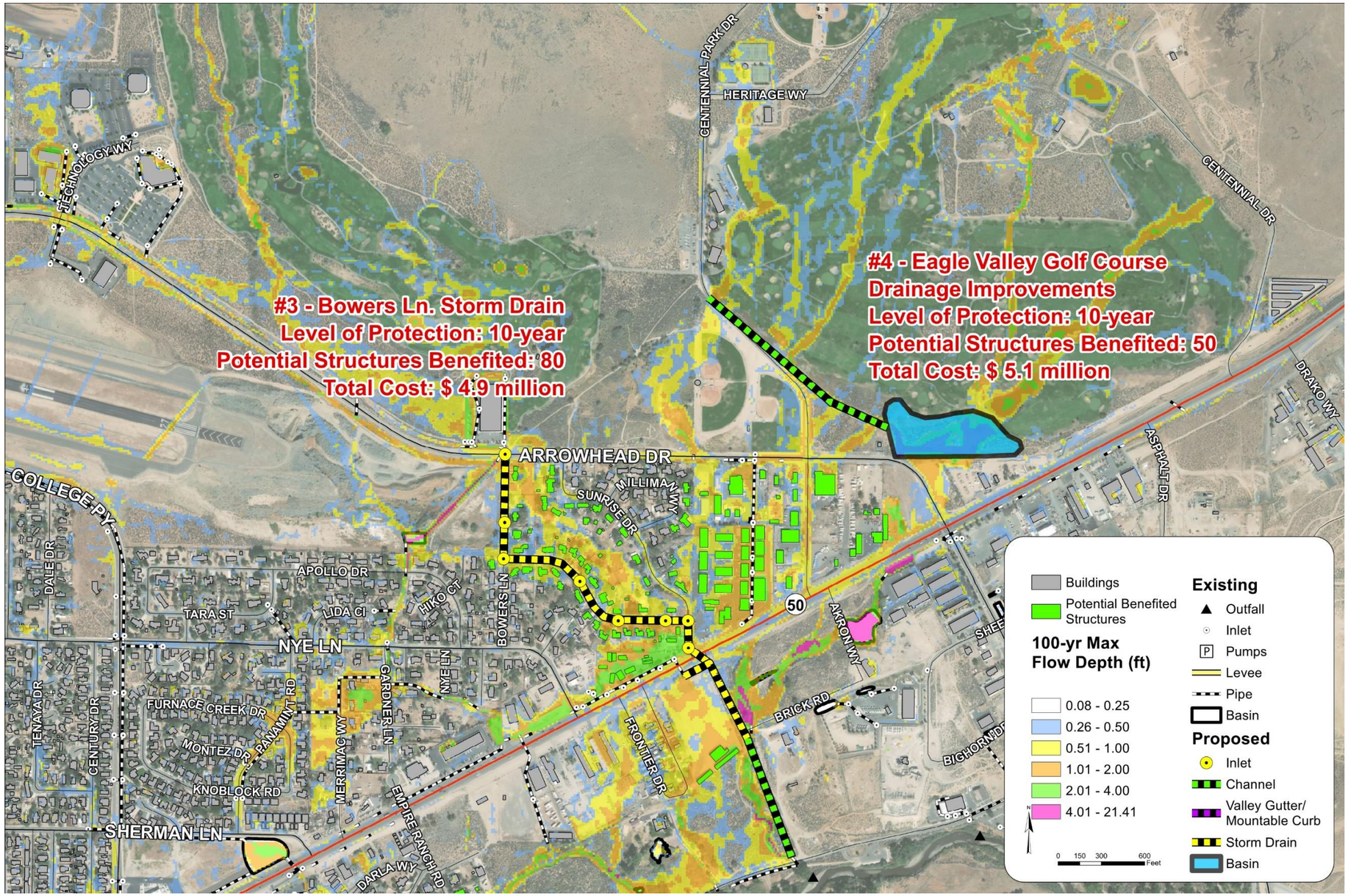


Figure 7 B: Bowers Lane Storm Drain & Eagle Valley Golf Course

4.4. Morgan Mill Road Drainage Improvements

AOMI #5 was titled Morgan Mills Road Drainage Improvements, Figure 7 C. The intent of these improvements is to mitigate flooding from Gordon Street downstream to Empire Ranch Road and beyond to the Carson River. This system would be designed to convey 100-year runoff as well to remove the FEMA SFHA. The improvements include storm drain additions and modifications near Gordon Street, a detention basin in open space between Gordon Street and Highway 50, and a storm drain outlet along Morgan Mill Road to the Carson River. The estimated cost of construction would be $5.8 million and could benefit up to 50 structures.

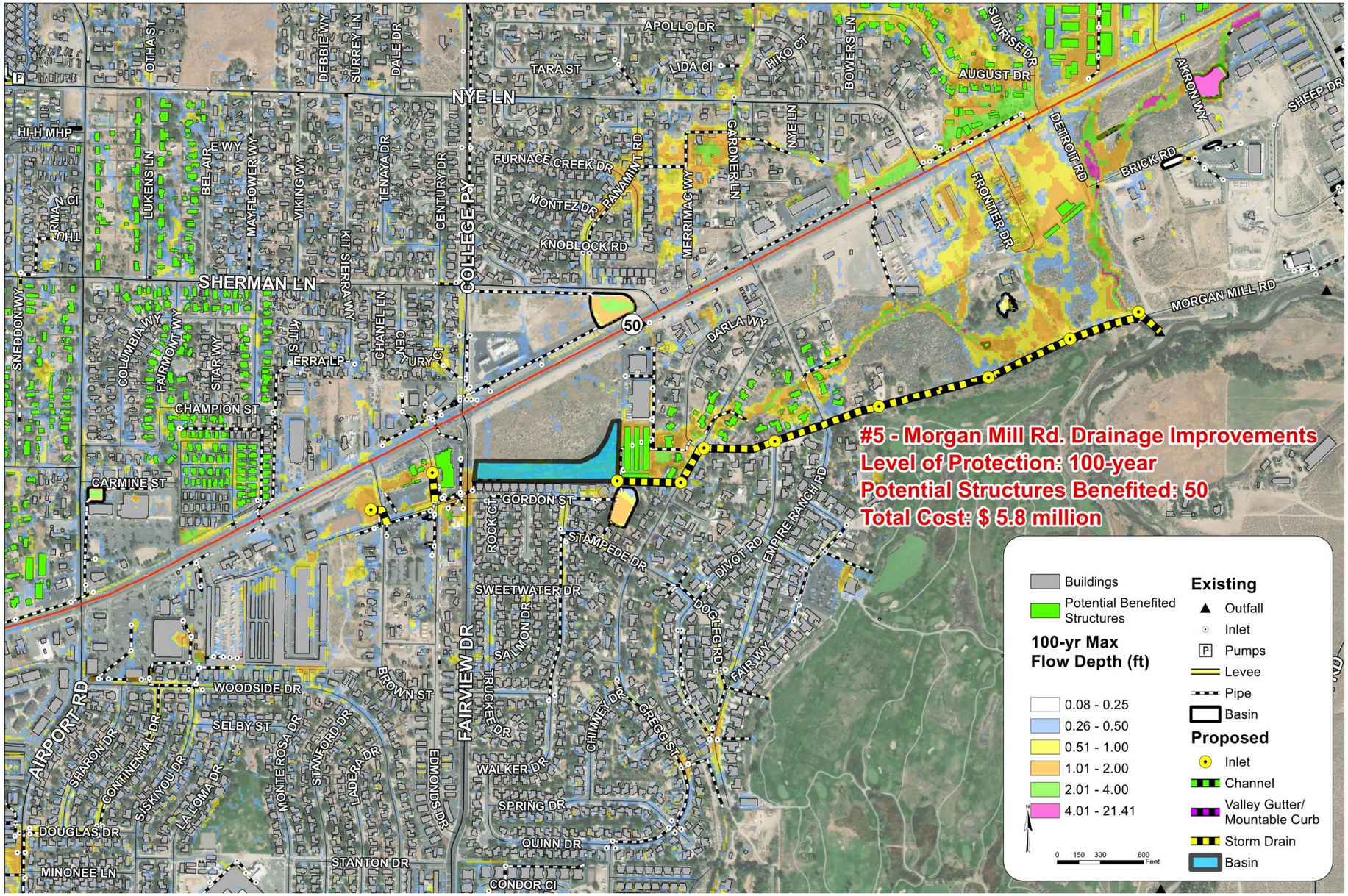


Figure 7 *C: Morgan Mill*

4.5. Goni Canyon Creek Tiered Basins

Each of the AOMI's shown on Figure 7 D are similar and related. Each is comprised of a basin or basins to intercept runoff from the surrounding upland areas that contribute to Goni Canyon Creek and meter through existing downstream drainage infrastructure. Also, each is designed to intercept 100-year runoff and to take advantage of City owned open space. AOMI #2, titled Goni Canyon Creek Tiered Basins, is the most extensive of the basin systems. The tiered basins are in line with Goni Canyon Creek receiving the most runoff volume. The total cost of these basins was estimated to be approximately $10.9 million benefitting up to 70 structures. The combination of these basins and the others shown on Figure 7 D would also serve to substantially remove the downstream FEMA SFHA's associated with Goni Canyon Creek and tributaries.

4.6. North Goni Road Basin

AOMI #6 is titled North Goni Road Basin and would cost approximately $1.8 million to construct. Up to 30 structures may benefit in some capacity.

4.7. Maxwell Basin

AOMI #7 is titled Maxwell Basin and would cost approximately $1.9 million to construct. Up to 30 structures may benefit in some capacity.

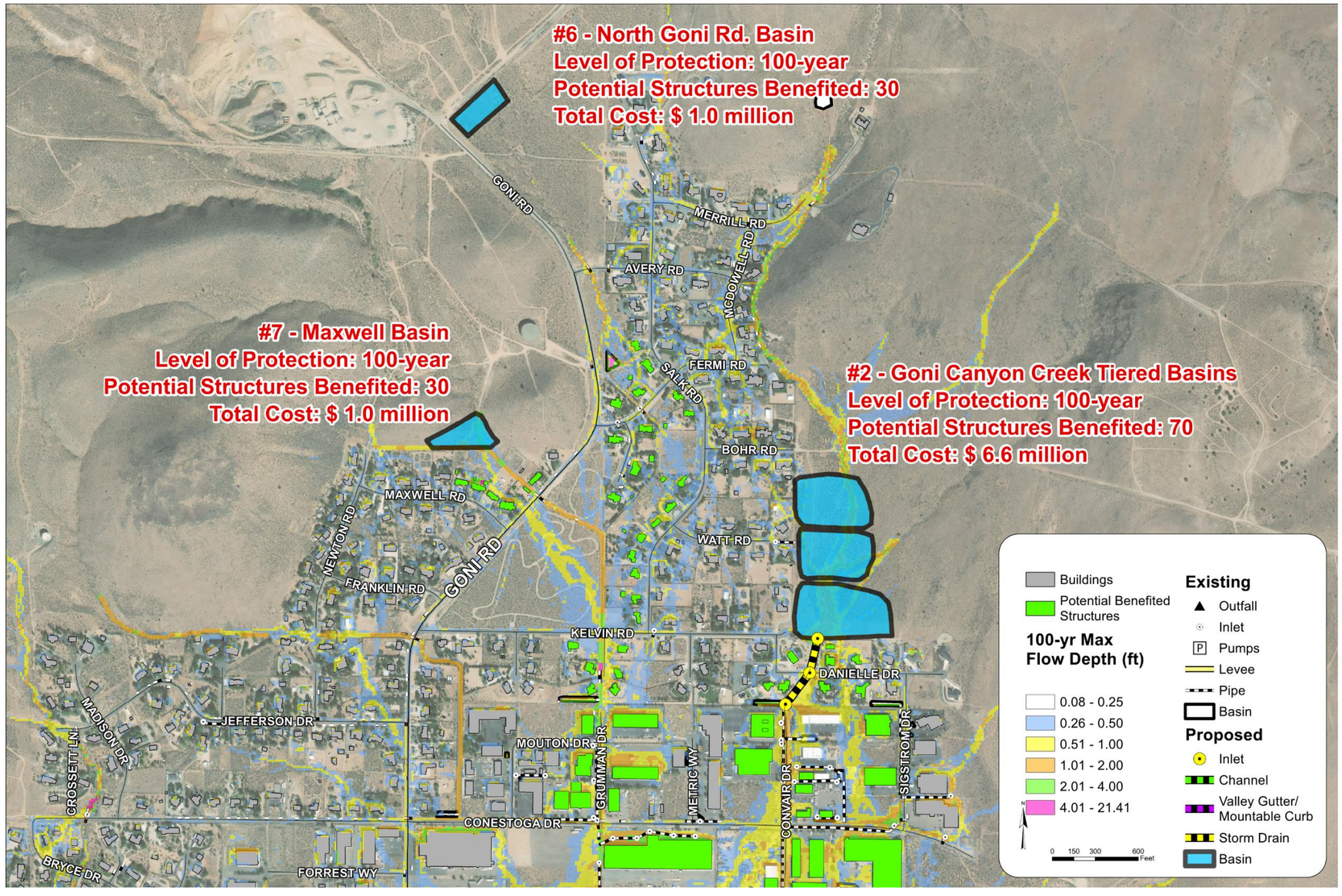


Figure 7 D: Goni Canyon Creek, N Goni Rd, & Maxwell Basins

4.8. Sutro Terrace Storm Drain and Basins

AOMI #8 was titled Sutro Terrace Storm Drain and Basin, Figure 7 E. This system was designed to intercept 100-year runoff from the upstream hillslopes via on-line basin and storm drain. The basin would intercept only the upper part of the 10-year runoff hydrograph such that the downstream storm drain could intercept the remaining runoff. The storm drain would tie into the existing storm drain system that outlets into the Shenandoah Basin. The total cost was estimated as $3.3 million and up to 240 structures could benefit.

4.9. Conestoga Drive Channel Extension

AOMI was titled Conestoga Drive Channel Extension. The system extends and improves the existing channel that starts near Heaven Hill Way to convey 100-year runoff. The system would outfall at the existing channel at the east end of Conestoga Drive. The total cost was estimated to be $2.1 million and up to 30 structures downstream could benefit.

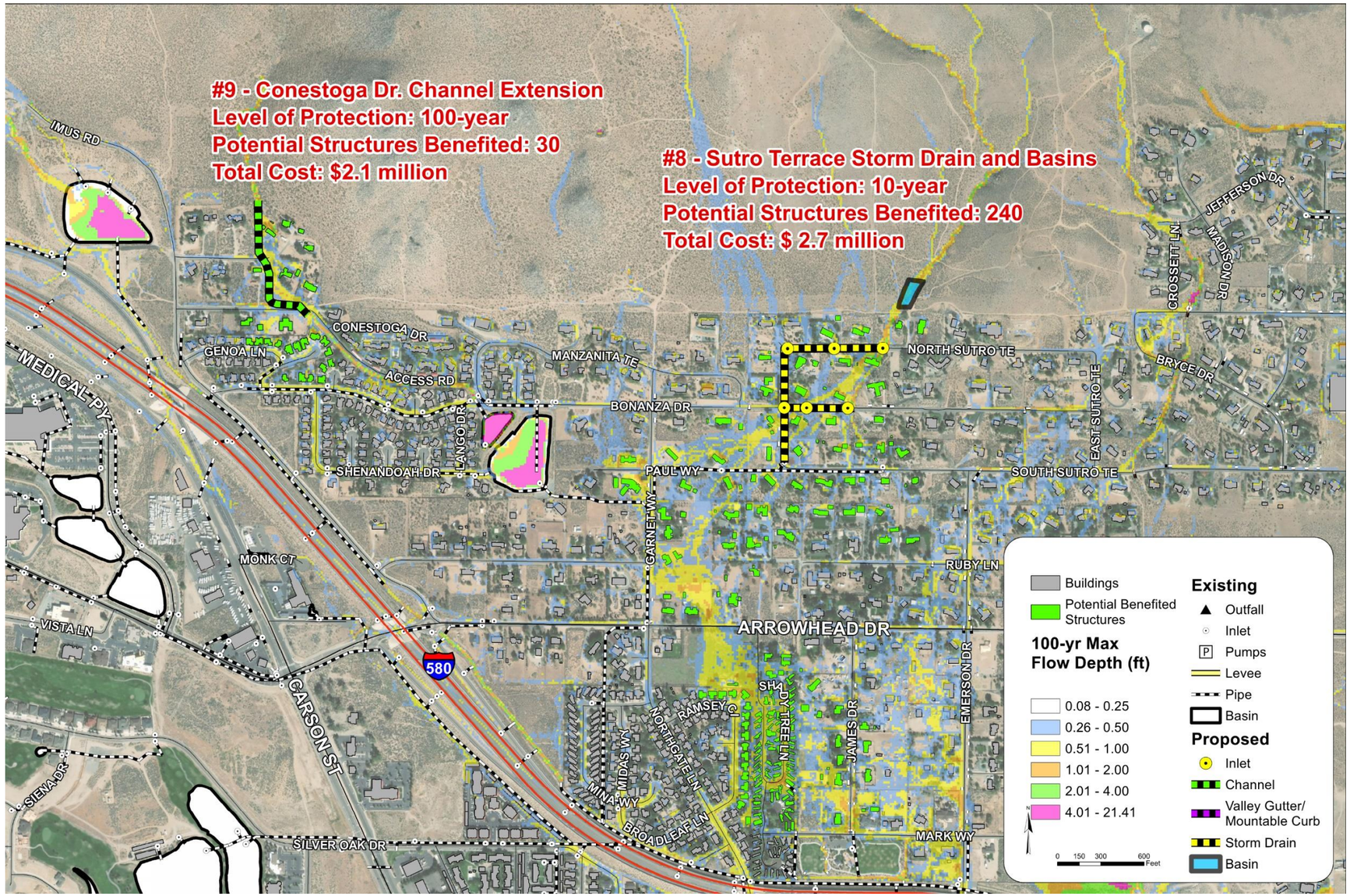


Figure 7 E: Sutro Terrace & Conestoga Drive Channel

5. Selection of Preferred Alternatives

With the formulation of the nine AOMI's, the next step was to narrow the list down to 3-4 preferred alternative to further develop conceptual design and cost for future inclusion in FEMA grant applications. Determining the preferred alternatives was a multi-step process that involved the public, input from Carson City Public Works staff, and both quantitative and qualitative analyses.

5.1. Public Meeting

A public meeting was conducted on November 14, 2019 at the Carson City Community Center. After a brief presentation, attendees were asked to place dots on their preferred projects displayed at the exhibit boards. All nine AOMI's were displayed as shown in this report. Each attendee was given three dot stickers to affix to projects without ranking. The results are presented in the next section and in the Appendices.

5.2. Decision Matrix

Following the public meeting, a decision matrix was created to house the results of the public input along with other decision factors that were deemed important to consider. Most of the decision factors would influence whether a positive benefit cost ratio (BCR) would be achievable. FEMA requires a BCR of one (1) or greater to indicate a viable project. The BCR is a measure of the project benefit in dollars divided by the project cost. Other more intangible factors can influence the ratio as well. ***Table 1*** on the following page shows the completed decision matrix. The following is a list of the project factors considered in ranking the AOMI's:

- **Level of Protection** – 10-year vs. 100-year Storm Protection (10-year was the minimum criteria for this project)
- **Initial Project Cost ($)** – The initial rough estimate of construction cost for each AOMI
- **Number of Potential Structures Benefitted -** How many downstream structures may see a reduction in flood depths
- **Number of Structures with > 0.5' and 1.0' of Flow Depth During the 100-year Storm** – A rough measure of the severity of the flood risk
- **Number of Structures in the FEMA SFHA** – How might the project reduce flood hazards, but also flood insurance premium relief
- **10-, 25-, 50-, 100-, and 500-year Potential Damage ($) -** Estimates of potential damages that could be incurred for each storm event based on published depth-damage curves for structure and contents
- **Annualized Loss ($) -** The total losses for each storm event annualized
- **Present Day Benefit Value ($)** – Total benefit over the project lifecycle (assumed 75 years) normalized to today's dollars
- **Maximum Probable Benefit Cost Ratio** – The maximum probable BCR achievable based on the estimated project cost and benefit
- **Public Input in Number of Dots -** How many dots were affixed to each AOMI at the public meeting
- **Removes SFHA?** – Yes or no on whether AOMI would remove all or part of the existing floodplain
- **Impacts Regional Traffic Flow?** – Does the flood hazard affect regional transportation corridors
- **Impacts Businesses?** – Does the flood hazard affect businesses
- **Impacts Critical Facilities? -** Does the flood hazard affect critical facilities

Each of these factors was considered when ranking the AOMI's. Ultimately, four AOMI's were selected as preferred alternatives to further develop design and cost in anticipation of future inclusion in FEMA grant applications. The four selected were:

1. Maxwell Basin
2. North Goni Road Basin
3. Goni Canyon Creek Tiered Basins
4. Sutro Terrace Storm Drain and Basins

Table 1: Decision Matrix

Ranking	AOI ID	Name	Level of Protection	Project's Initial Cost ($)	No. of Potential Structures Benefited	No. Structures > 0.5 ft in the 100-year storm	No. Structures > 1 ft in the 100-year storm	No. of Structures in ex FEMA Floodplain	10-yr Potential Damage ($)	25-yr Potential Damage ($)	50-yr Potential Damage ($)	100-yr Potential Damage ($)	500-yr Potential Damage ($)	Annualized Loss ($)	Present Day Benefit Value (75 year service life)	Maximum Probable BCR*	Public Input No. of Dots	Removes SFHA?	Impacts Regional Traffic Flow?	Impacts Businesses ?	Impacts Critical Facilities?
1	7	Maxwell Basin	100-year	$ 1,000,000	19	4	2	7	$ 1,700,000	$2,400,000	$3,200,000	$ 5,000,000	$ 13,500,000	$ 321,000	$ 4,557,031	4.56	3	y	y	y	n
2	6	North Goni Road Basin	100-year	$ 1,000,000	22	4	2	0	$ 600,000	$ 700,000	$ 900,000	$ 1,300,000	$ 2,100,000	$ 83,800	$ 1,189,655	1.19	8	y	y	y	n
3	2	Goni Canyon Creek Tiered Basins	100-year	$ 6,600,000	59	11	3	20	$ 3,600,000	$4,500,000	$6,100,000	$ 8,100,000	$ 16,200,000	$ 549,600	$ 7,802,319	1.18	4	y	y	y	n
4	8	Sutro Terrace Storm Drain and Basins	10-year	$ 2,700,000	166	16	6	0	$ 2,300,000	$3,000,000	$3,600,000	$ 4,200,000	$ 5,700,000	$ 315,000	$ 4,471,853	1.66	9	n	n	n	n
5	1	New Empire Storm Drain	10-year	$ 9,900,000	547	1	0	0	$ 1,900,000	$2,100,000	$2,300,000	$ 2,400,000	$ 2,900,000	$ 214,500	$ 3,045,119	0.31	7	n	y	n	n
6	3	Bowers Lane Storm Drain	10-year	$ 4,900,000	62	15	8	29	$ 1,500,000	$1,800,000	$2,200,000	$ 2,900,000	$ 4,100,000	$ 200,700	$ 2,849,209	0.58	0	y	y	y	n
7	4	Eagle Valley Golf Course Drainage Improvements	10-year	$ 5,100,000	45	15	8	19	$ 1,900,000	$2,700,000	$3,400,000	$ 4,000,000	$ 5,600,000	$ 285,600	$ 4,054,480	0.79	3	y	y	y	n
8	5	Morgan Mill Road Drainage Improvements	100-year	$ 5,800,000	37	7	1	16	$ 700,000	$1,200,000	$1,600,000	$ 2,100,000	$ 3,200,000	$ 131,100	$ 1,861,143	0.32	4	y	y	y	n
9	9	Conestoga Drive Channel Extension	100-year	$ 2,100,000	30	2	0	0	$ 200,000	$ 300,000	$ 400,000	$ 600,000	$ 1,800,000	$ 40,200	$ 570,694	0.27	3	n	n	n	n

Max Probable BCR >1

0.5 < Max Probable BCR < 1

Max Probable BCR < 0.5

*Max Probable BCR is where the expected damages after the mitigation solution is zero. Typically, the mitigation solution does not remove all the expected damage. The BCR formula is: (Expected damage before the mitigation - the expected damage after the mitigation)/Cost.

6. Preliminary Design Concepts

In this section, it details the conceptual design in plan and profile view of each preferred alternative. In addition, opinions of probable cost for design and construction are also provided. It should be noted that costs increased significantly from initial AOMI development to conceptual design. This was mostly due to increased excavation costs for the reason of cut required on fairly steep slopes to daylight the basins. For the initial cost estimates, only the required storage volume was used to calculate excavation costs.

Figure 9: Maxwell Basin View

6.1. Maxwell Basin

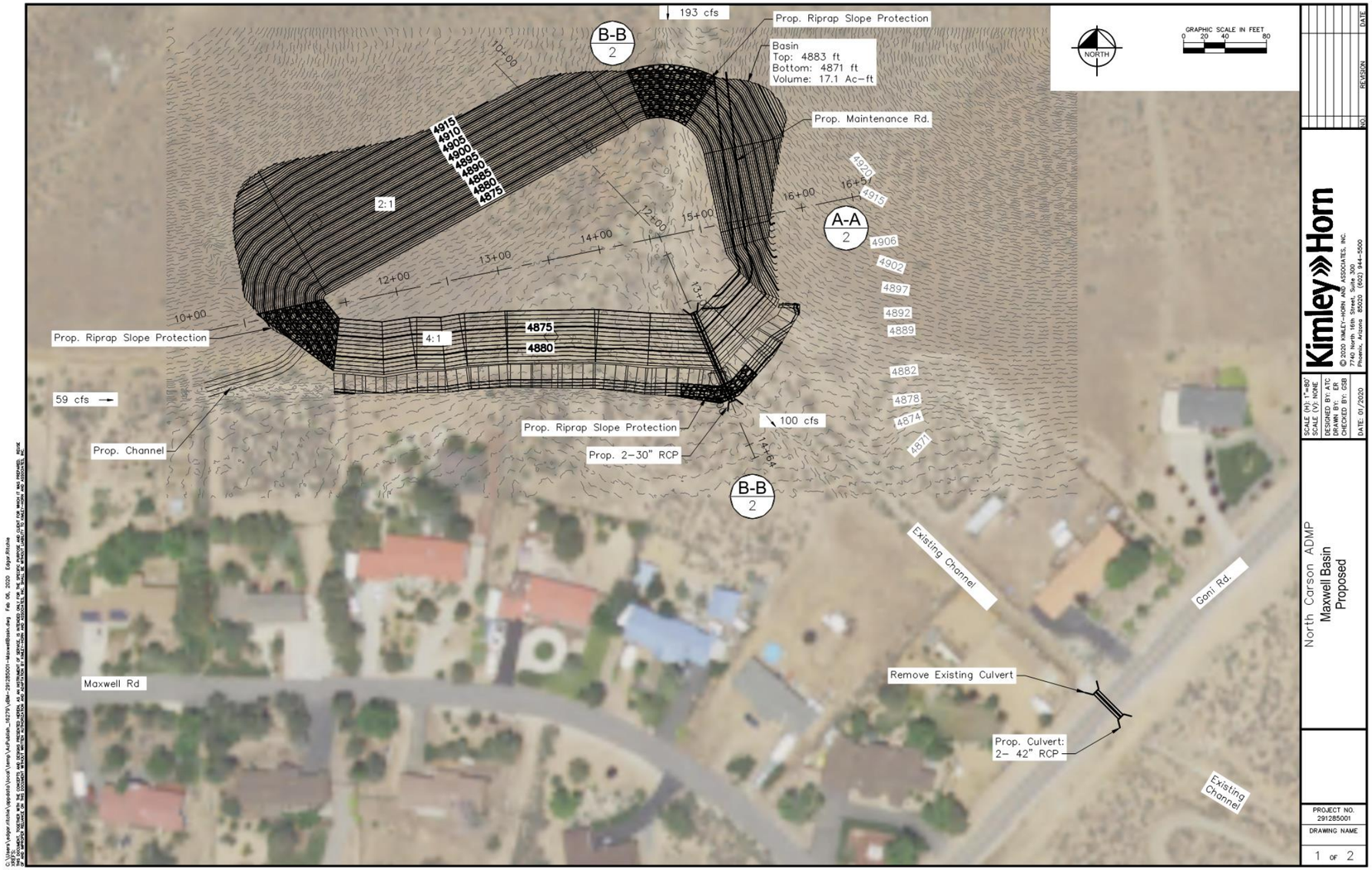


Figure 10: Maxwell Basin

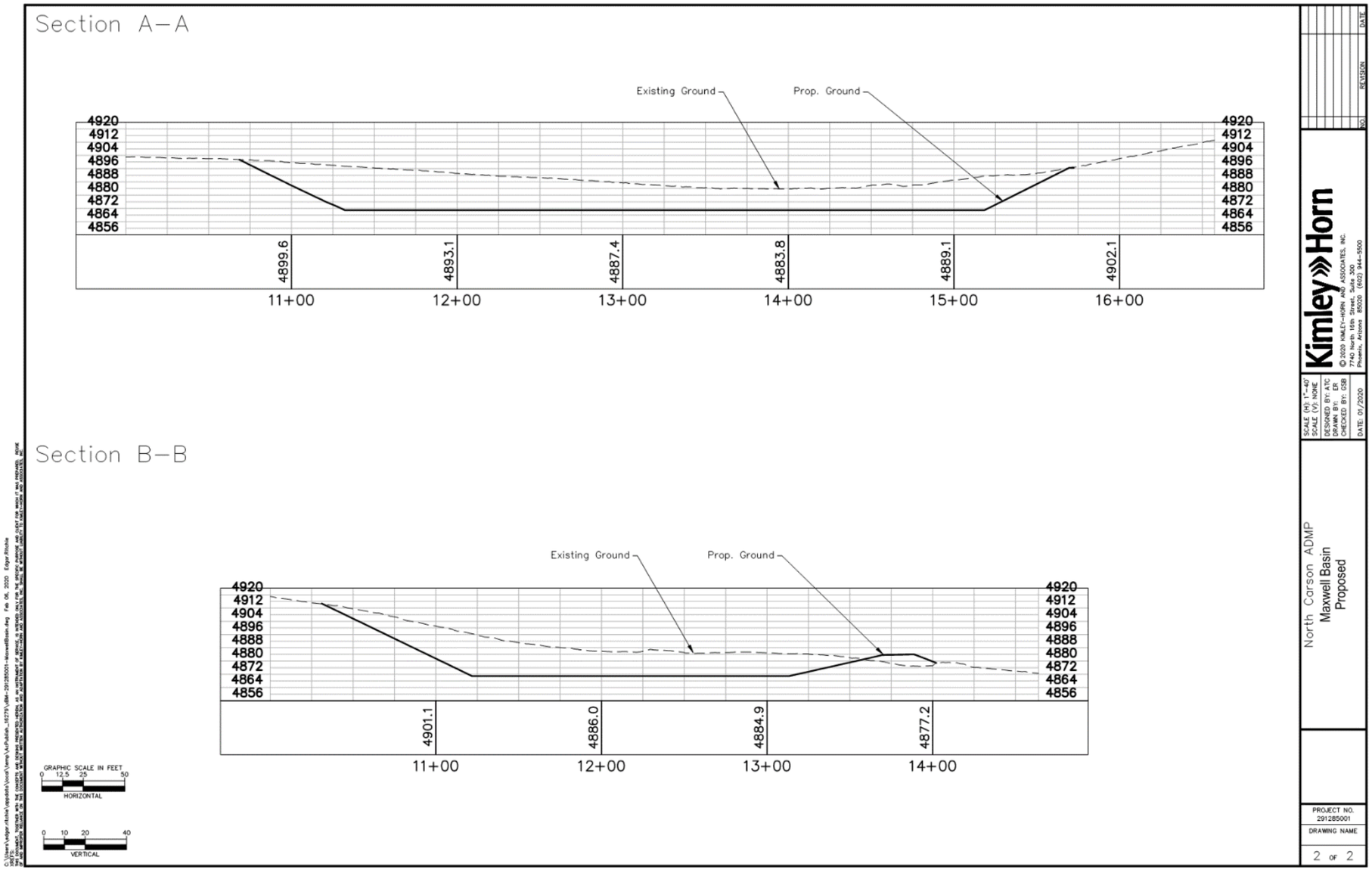


Figure 11: Maxwell Basin Profile View

Table 2: Maxwell Basin

Kimley»Horn

Project: ***North Carson Area Drainage Plan***
Location **#7 - Maxwell Basin**
Level of Protection **100-year**
Designed by: **ATC** Date: 2/5/2020
Checked by: **GSB** Date: 2/5/2020

Item Description	Unit	Unit Price	Qty	Cost
Basin Earthwork (Export)	CY	$ 10	56,600	$ 566,000
Riprap	SY	$ 75	800	$ 60,000
Storm Drain (30'' RCP)	LF	$ 190	375	$ 71,250
Storm Drain (42" RCP)	LF	$ 250	100	$ 25,000
Utility Conflict	EA	$ 30,000	2	$ 60,000
Maintenance Roadway	SY	$ 15	330	$ 4,950
Earthen Channel	CY	$ 14	3,820	$ 53,098
Basin Landscaping (Passive)	SF	$ 2	139,300	$ 278,600
Roadway Pavement	SF	$ 5	360	$ 1,800
Construction Subtotal				$ 1,121,000
Removals (5%)				$ 56,050
Miscellaneous Construction Costs (30%)[1]				$ 337,000
Contingency (20%)				$ 225,000
CONSTRUCTION TOTAL				**$ 1,739,050**
Final Design				$ 150,000
Permitting				$ 35,000
PLANNING/DESIGN TOTAL				**$ 185,000**
TOTAL PROJECT COST				**$ 1,925,000**

(1) Includes Mobilization, Traffic Control, Construction Staking, Quality Control, SWPPP, and Construction Management

6.2. Sutro Terrace

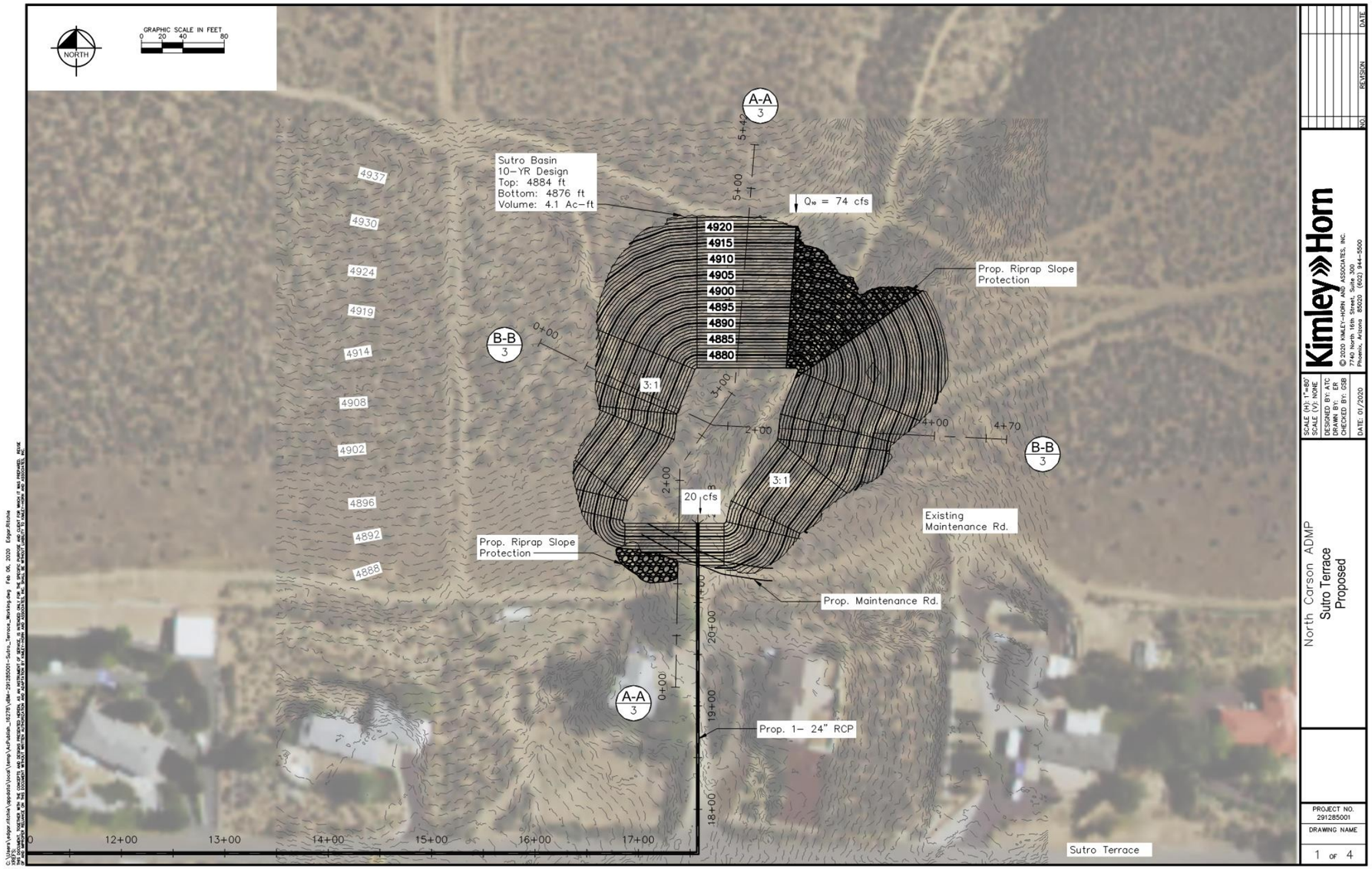


Figure 12: Sutro Terrace

Figure 13: Sutro Terrace Storm Drain

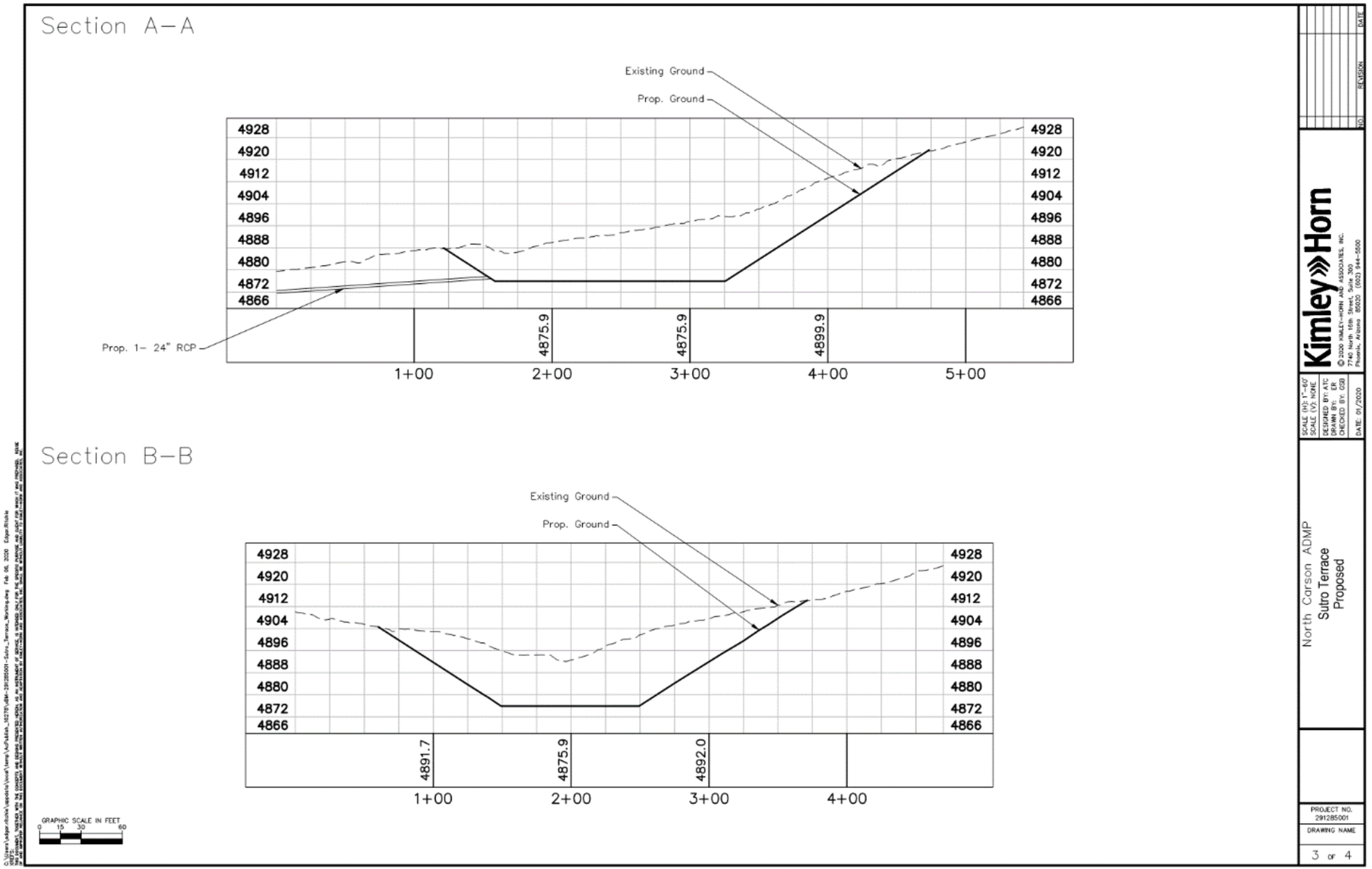


Figure 14: Sutro Terrace Profile View

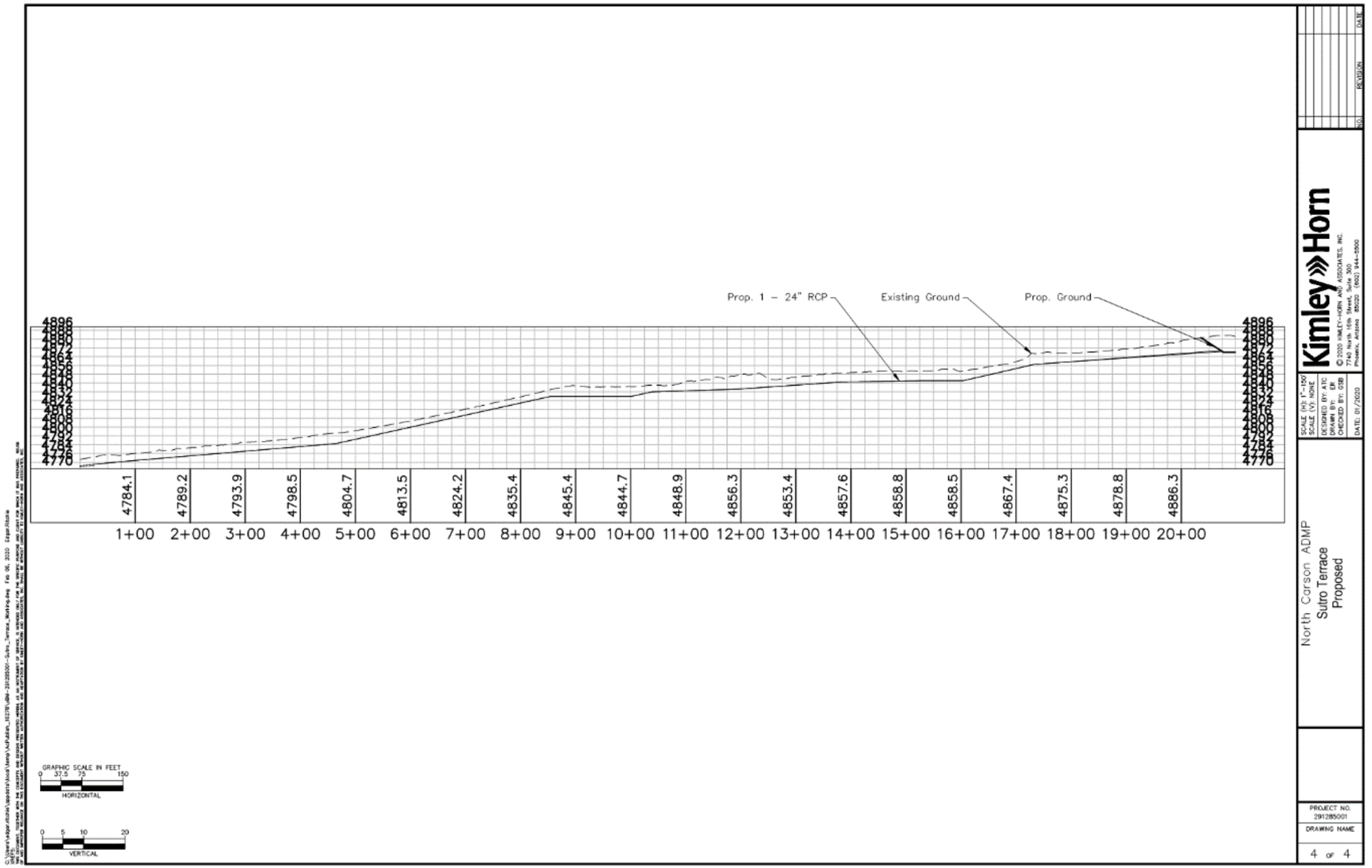


Figure 15: Sutro Terrace Profile View

Table 3: Sutro Terrace Drain and Basin

Kimley»Horn

Project: ***North Carson Area Drainage Plan***
Location **#8 - Sutro Terrace Storm Drain and Basins**
Level of Protection **10-year**
Designed by: **ATC** Date: 2/5/2020
Checked by: **GSB** Date: 2/5/2020

Item Description	Unit	Unit Price	Qty	Cost
Storm Drain (24'' Pipe)	LF	$ 155	2,520	$ 390,600
Catch Basins	EA	$ 5,000	5	$ 25,000
Storm Drain Manhole	EA	$ 7,000	4	$ 28,000
Basin Earthwork (Export)	CY	$ 10	37,500	$ 375,000
Riprap	SY	$ 75	1,010	$ 75,750
Basin Landscape (Passive)	SF	$ 2	92,700	$ 185,400
Land Acquisition	SF	$ 4	115,875	$ 463,500
Utility Conflicts	EA	$ 30,000	10	$ 300,000
Maintenance Roadway	SY	$ 15	200	$ 3,000
Roadway Pavement	SF	$ 5	13,210	$ 66,050
Construction Subtotal				**$ 1,913,000**
Removals (5%)				$ 95,650
Miscellaneous Construction Costs (30%)[1]				$ 574,000
Contingency (20%)				$ 383,000
CONSTRUCTION TOTAL				**$ 2,965,650**
Design Concept Report				$ 75,000
Final Design				$ 250,000
Permitting				$ 35,000
PLANNING/DESIGN TOTAL				**$ 360,000**
TOTAL PROJECT COST				**$ 3,326,000**

(1) Includes Mobilization, Traffic Control, Construction Staking, Quality Control, SWPPP, and Construction Management

6.3. Goni Canyon Creek Tiered Basins

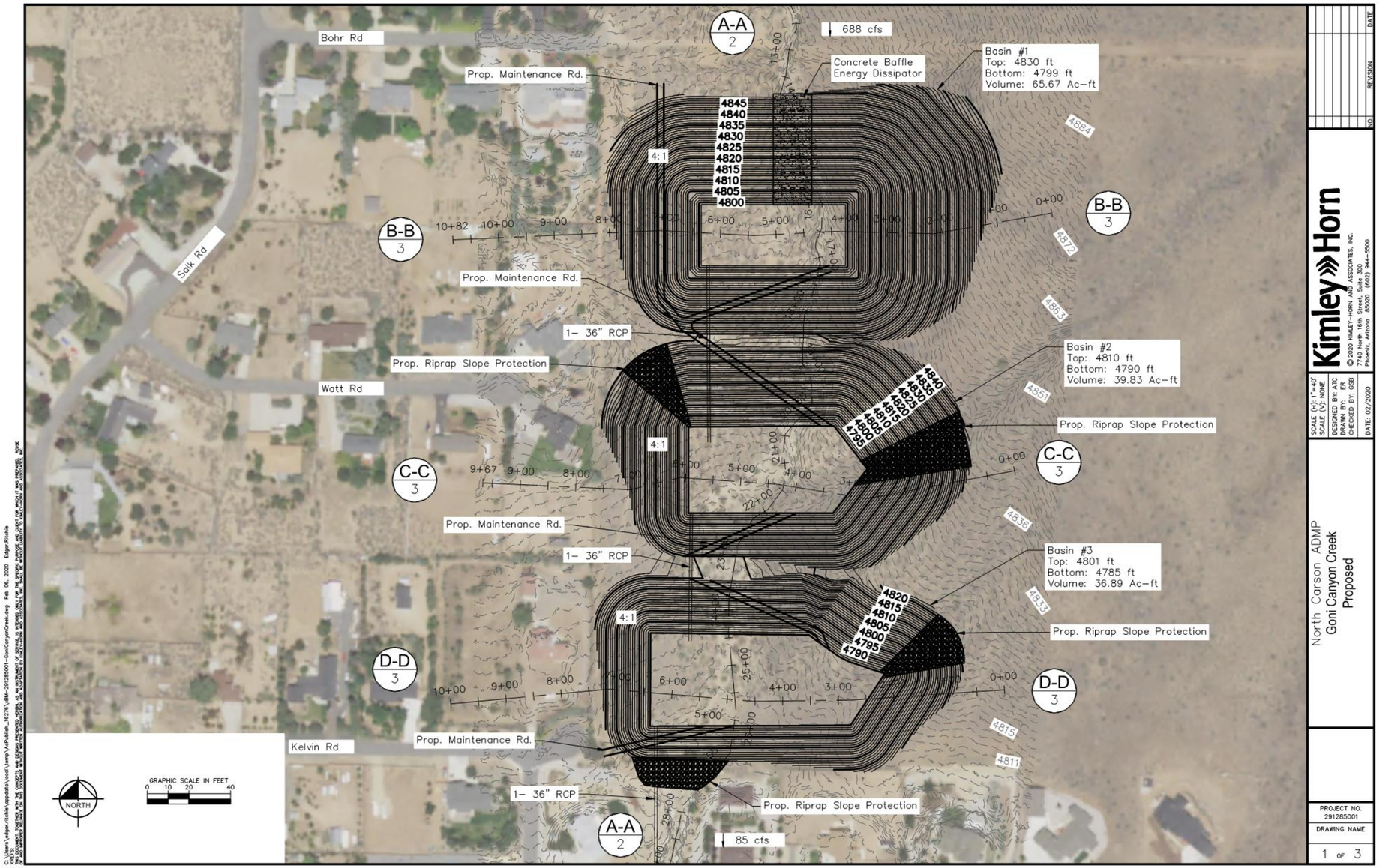


Figure 16: Goni Canyon Creek Tiered Basins

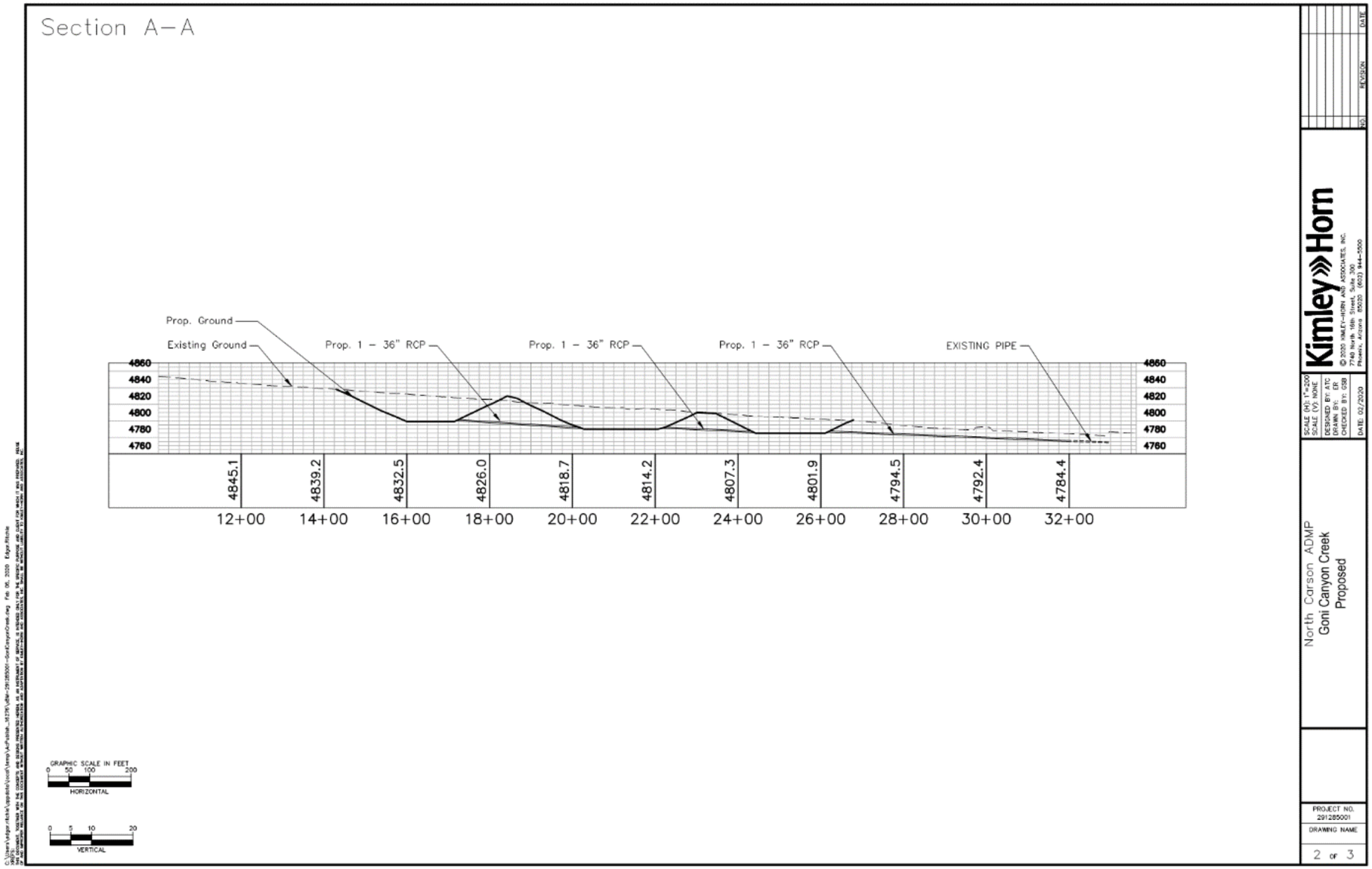


Figure 17: Goni Canyon Creek Profile View

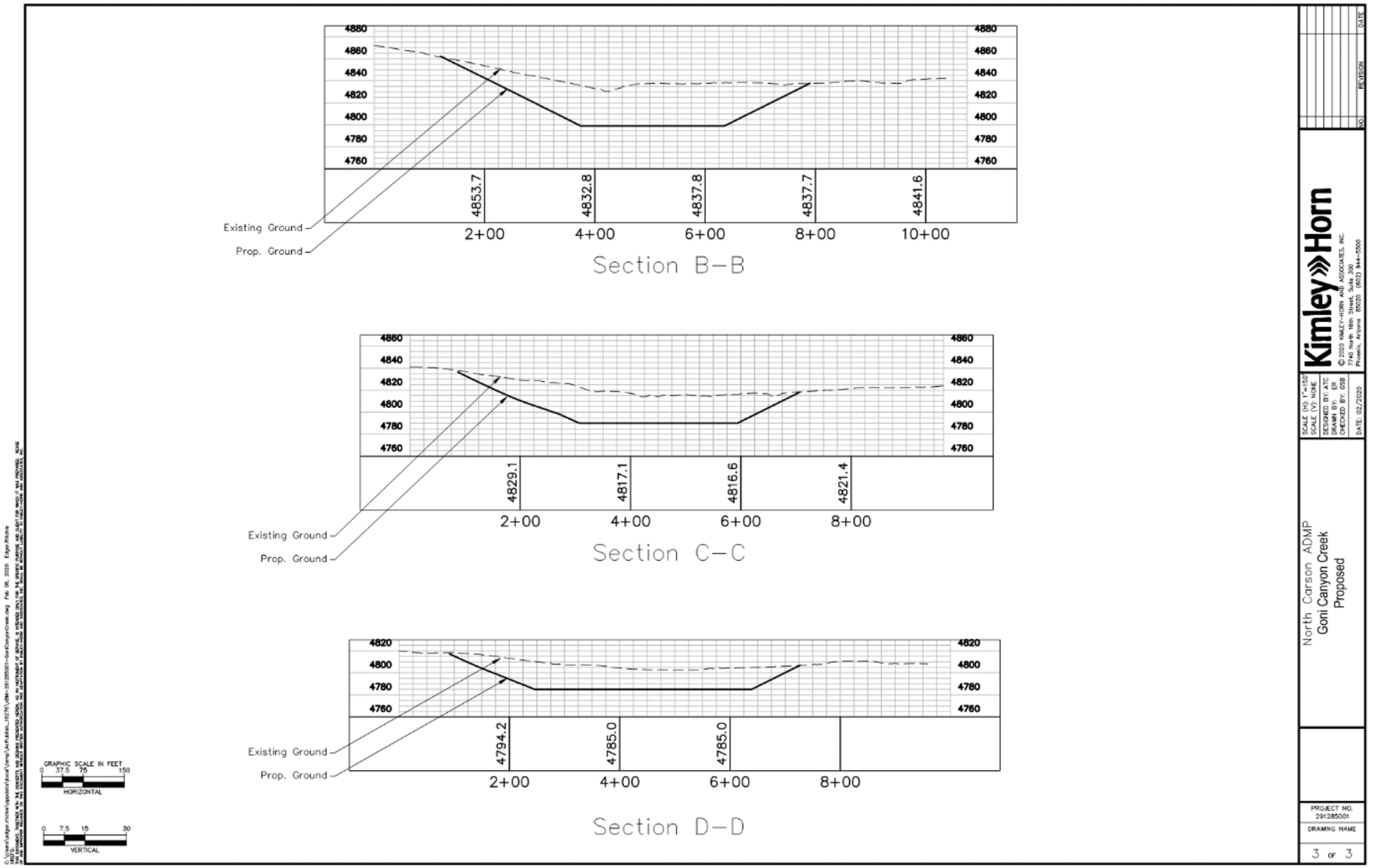


Figure 18: Goni Canyon Creek Profile View

Table 4: Goni Canyon Creek Tiered Basins

Kimley»Horn

Project: ***North Carson Area Drainage Plan***
Location **#2 - Goni Canyon Creek Tiered Basins**
Level of Protection **100-year**
Designed by: **ATC** Date: 2/5/2020
Checked by: **GSB** Date: 2/5/2020

Item Description	Unit	Unit Price	Qty	Cost
Roadway Pavement	SF	$ 5	5,800	$ 29,000
Storm Drain (36'' Pipe)	LF	$ 225	1,160	$ 261,000
Catch Basins	EA	$ 5,000	3	$ 15,000
Storm Drain Manhole	EA	$ 7,000	3	$ 21,000
Concrete Baffle Energy Dissipator	EA	$ 250,000	1	$ 250,000
Maintenance Roadway	SY	$ 15	2,280	$ 34,200
Utility Conflicts	EA	$ 30,000	4	$ 120,000
Basin Earthwork (Export)	CY	$ 10	420,800	$ 4,208,000
Riprap	SY	$ 75	2,660	$ 199,500
Basin Landscaping (Passive)	SF	$ 2	716,200	$ 1,432,400
Construction Subtotal				$ 6,571,000
Removals (5%)				$ 328,550
Miscellaneous Construction Costs (30%)[1]				$ 1,972,000
Contingency (20%)				$ 1,315,000
CONSTRUCTION TOTAL				**$ 10,186,550**
Design Concept Report				$ 120,000
Final Design				$ 450,000
Permitting				$ 150,000
PLANNING/DESIGN TOTAL				**$ 720,000**
TOTAL PROJECT COST				**$ 10,907,000**

(1) Includes Mobilization, Traffic Control, Construction Staking, Quality Control, SWPPP, and Construction Management

6.4. North Goni Road Basin

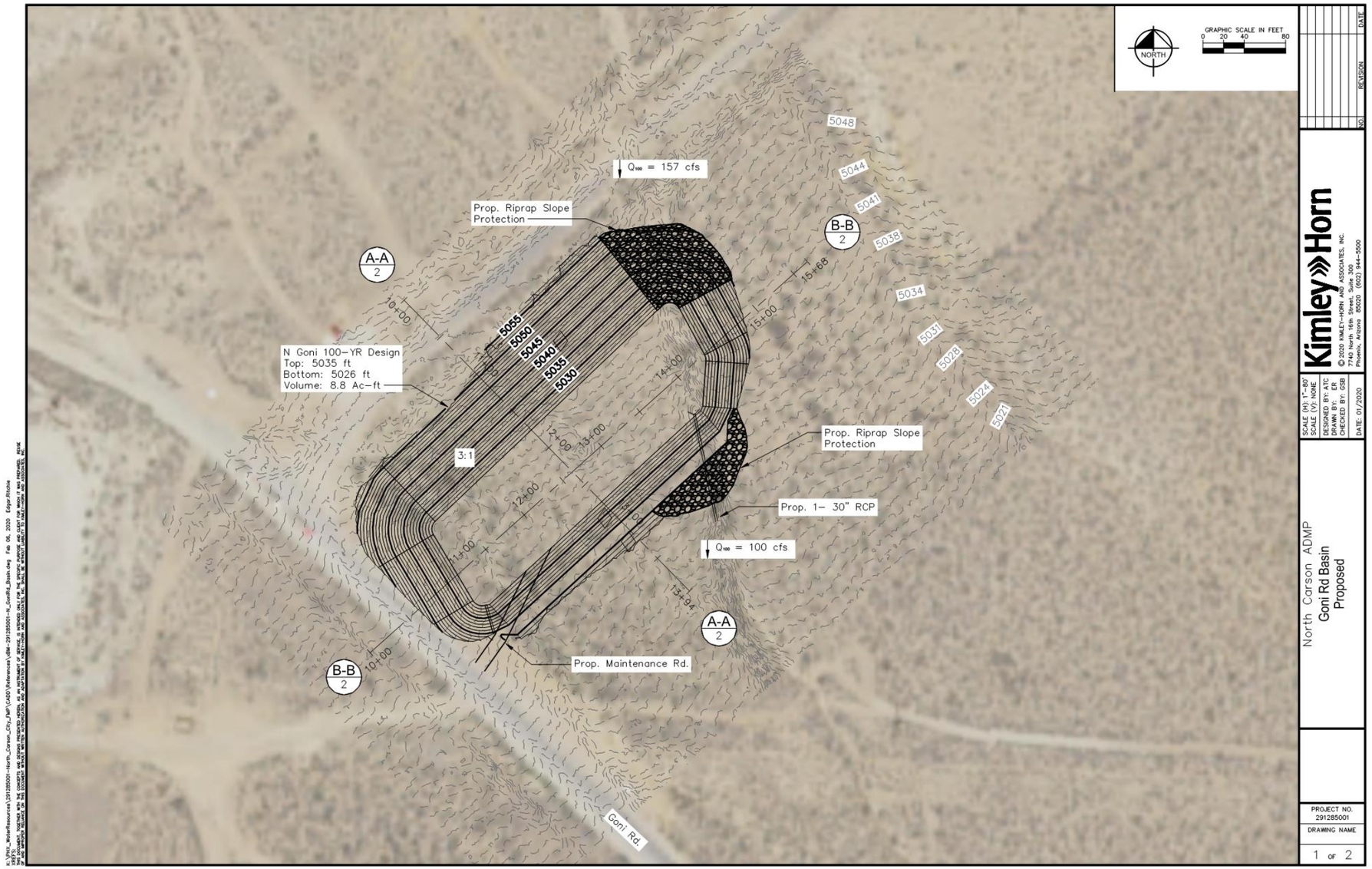


Figure 19: North Goni Road Basin

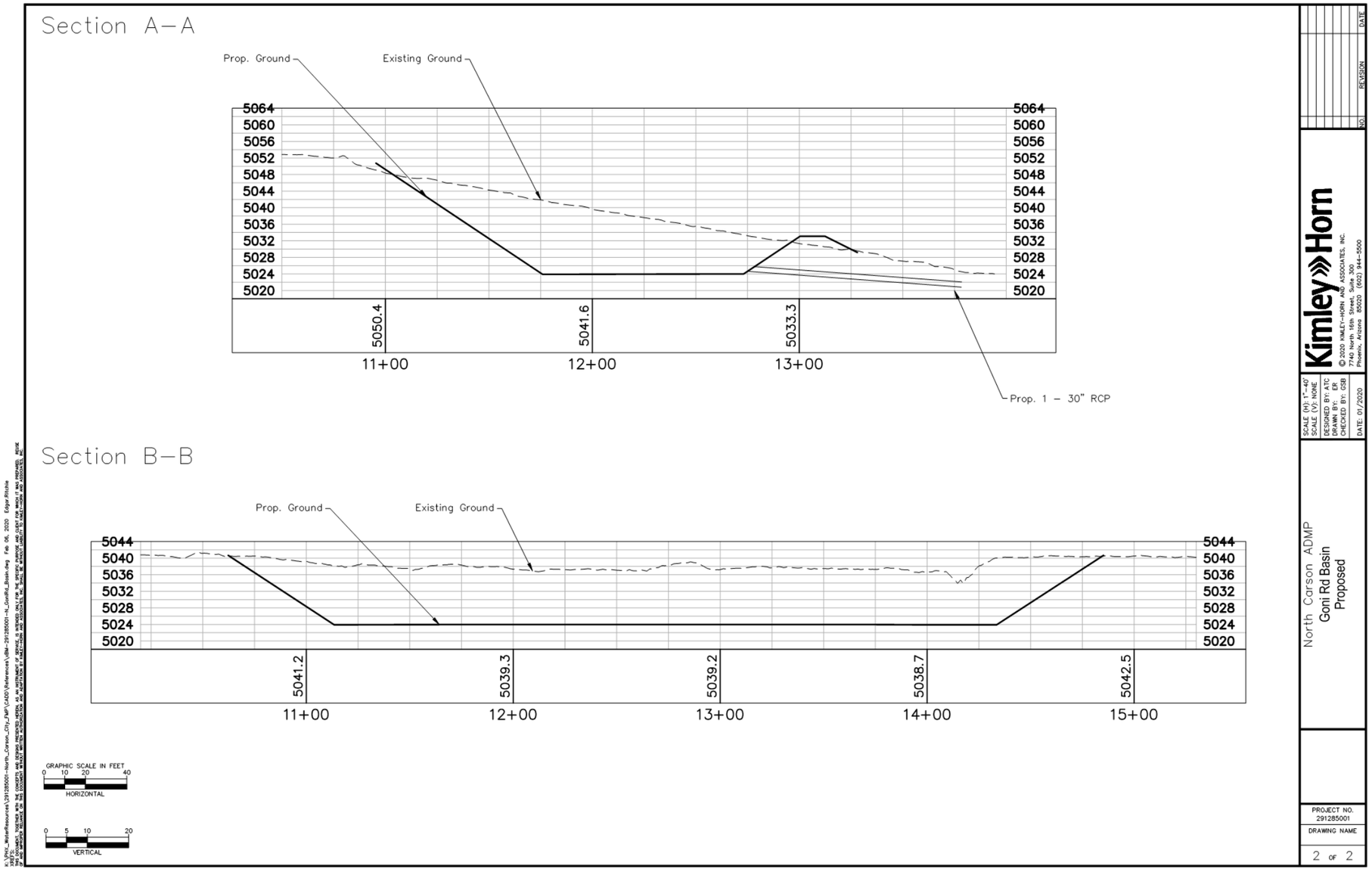


Figure 20: North Goni Road Basin Profile View

Table 5: North Goni Road Basin

Kimley»Horn

Project: ***North Carson Area Drainage Plan***
Location **#6 - North Goni Rd. Basin**
Level of Protection **100-year**
Designed by: **ATC** Date: 2/5/2020
Checked by: **GSB** Date: 2/5/2020

Item Description	Unit	Unit Price	Qty	Cost
Basin Earthwork (Export)	CY	$ 10	31,200	$ 312,000
Riprap	SY	$ 75	1,120	$ 84,000
Storm Drain (30" Pipe)	LF	$ 190	110	$ 20,900
Maintenance Roadway	SY	$ 15	1,430	$ 21,450
Basin Landscaping (Passive)	SF	$ 2	93,400	$ 186,800
Land Acquisition	SF	$ 4	116,750	$ 467,000
Construction Subtotal				$ 1,093,000
Removals (5%)				$ 54,650
Miscellaneous Construction Costs (30%)[1]				$ 328,000
Contingency (20%)				$ 219,000
CONSTRUCTION TOTAL				**$ 1,694,650**
Final Design				$ 150,000
Permitting				$ 35,000
PLANNING/DESIGN TOTAL				**$ 185,000**
TOTAL PROJECT COST				**$ 1,880,000**

(1) Includes Mobilization, Traffic Control, Construction Staking, Quality Control, SWPPP, and Construction Management

7. Proposed Conditions Results

Table 6 shows the change in Probable BCR with the updated costs developed for the Preferred Alternatives. The overall costs increased mostly due to earthwork unit costs and a better understanding of quantities. The cost increases resulted in lower BCRs, pushing the Goni Canyon Creek and North Goni Road Basins below 1. It is important to note that the BCRs presented in this report and this table are preliminary in nature. It is anticipated that further refinement of the BCRs will be developed as part of follow-on work efforts while developing FEMA grant applications. These refinements should result in higher BCRs once all factors are considered but may not achieve BCRs above 1 for Goni Canyon Creek and North Goni Road Basins.

Table 6: Updated Decision Matrix

Ranking	AOI ID	Name	Level of Protection	Project's Initial Cost ($)	No. of Potential Structures Benefited	No. Structures > 0.5 ft in the 100-year storm	No. Structures > 1 ft in the 100-year storm	No. of Structures in ex FEMA Floodplain	10-yr Potential Damage ($)	25-yr Potential Damage ($)	50-yr Potential Damage ($)	100-yr Potential Damage ($)	500-yr Potential Damage ($)	Annualized Loss ($)	Present Day Benefit Value (75 year service life)	Maximum Probable BCR*	Public Input No. of Dots	Removes SFHA?	Impacts Regional Traffic Flow?	Impacts Businesses ?	Impacts Critical Facilities?
1	7	Maxwell Basin	100-year	$ 1,925,000	19	4	2	7	$ 1,700,000	$ 2,400,000	$ 3,200,000	$ 5,000,000	$ 13,500,000	$ 321,000	$ 4,557,031	2.37	3	y	y	y	n
2	8	Sutro Terrace Storm Drain and Basins	10-year	$ 3,326,000	166	16	6	0	$ 2,300,000	$ 3,000,000	$ 3,600,000	$ 4,200,000	$ 5,700,000	$ 315,000	$ 4,471,853	1.34	9	n	n	n	n
3	2	Goni Canyon Creek Tiered Basins	100-year	$ 10,907,000	59	11	3	20	$ 3,600,000	$ 4,500,000	$ 6,100,000	$ 8,100,000	$ 16,200,000	$ 549,600	$ 7,802,319	0.72	4	y	y	y	n
4	6	North Goni Road Basin	100-year	$ 1,880,000	22	4	2	0	$ 600,000	$ 700,000	$ 900,000	$ 1,300,000	$ 2,100,000	$ 83,800	$ 1,189,655	0.63	8	y	y	y	n

The following figures for each preferred alternative show the before and after flow depth pre and post project. An additional figure is included that shows the change in flood depths. Since each of the preferred alternatives is designed to provide 100-year protection, only those results are show.

7.1. Maxwell Basin, North Goni Road Basin, and Goni Canyon Creek Tiered Basins

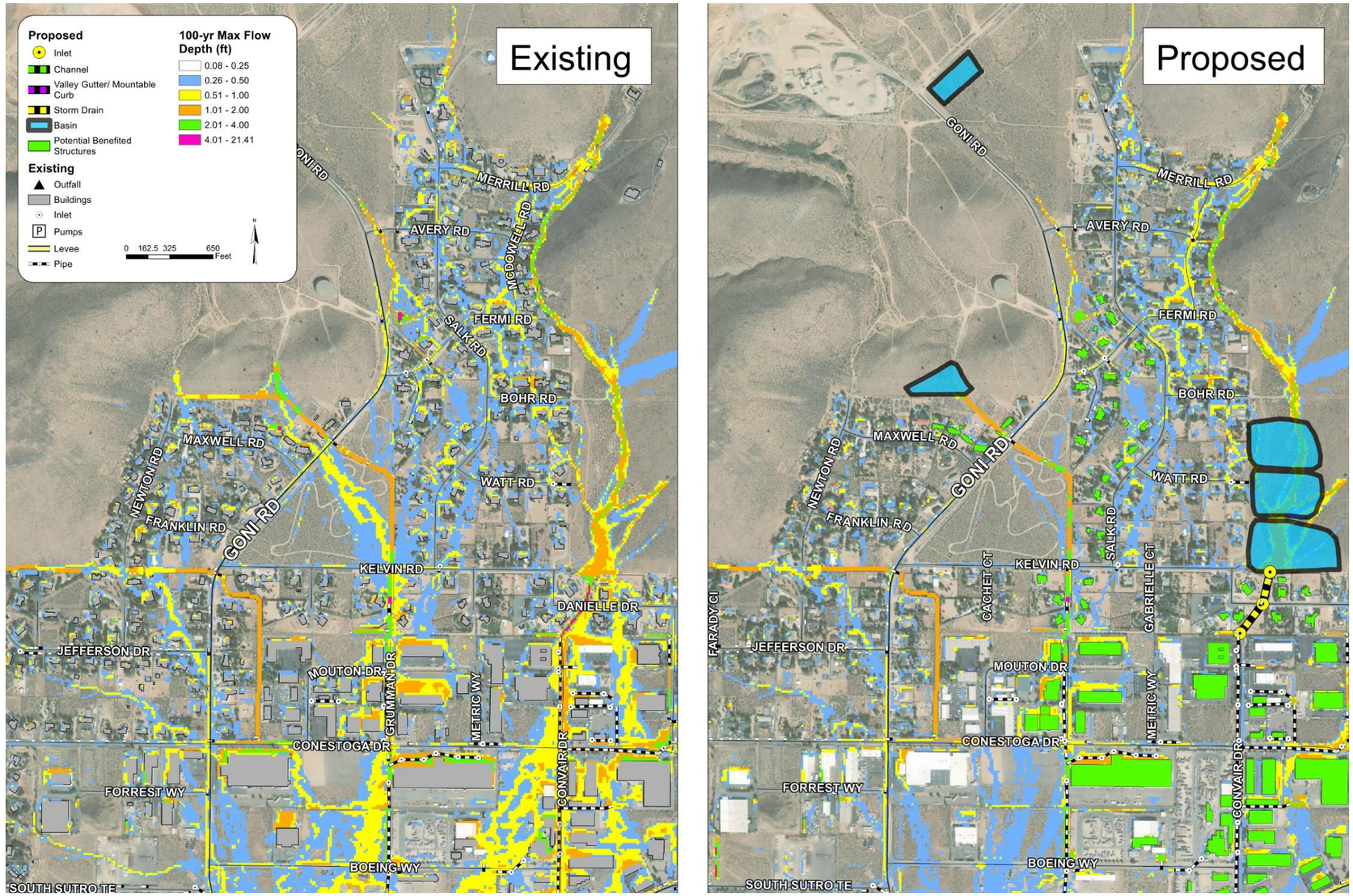


Figure 21: Flow Discharge for Maxwell, North Goni, & Goni Canyon Creek

7.2. Sutro Terrace Storm Drain and Basins

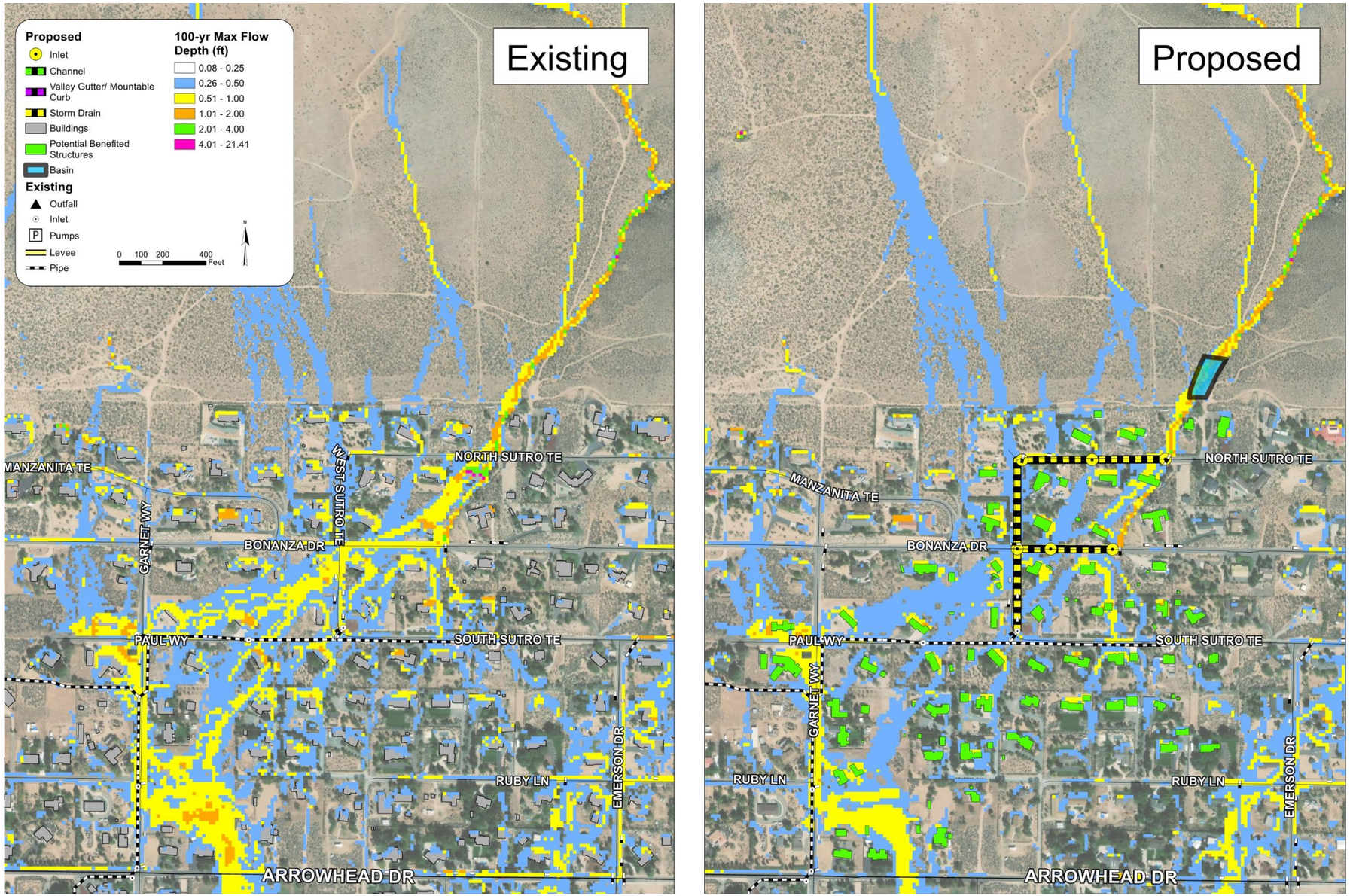


Figure 22: Flow Discharge from Sutro Terrace Basin

7.3. Flow Depth Difference Pre vs. Post Projects

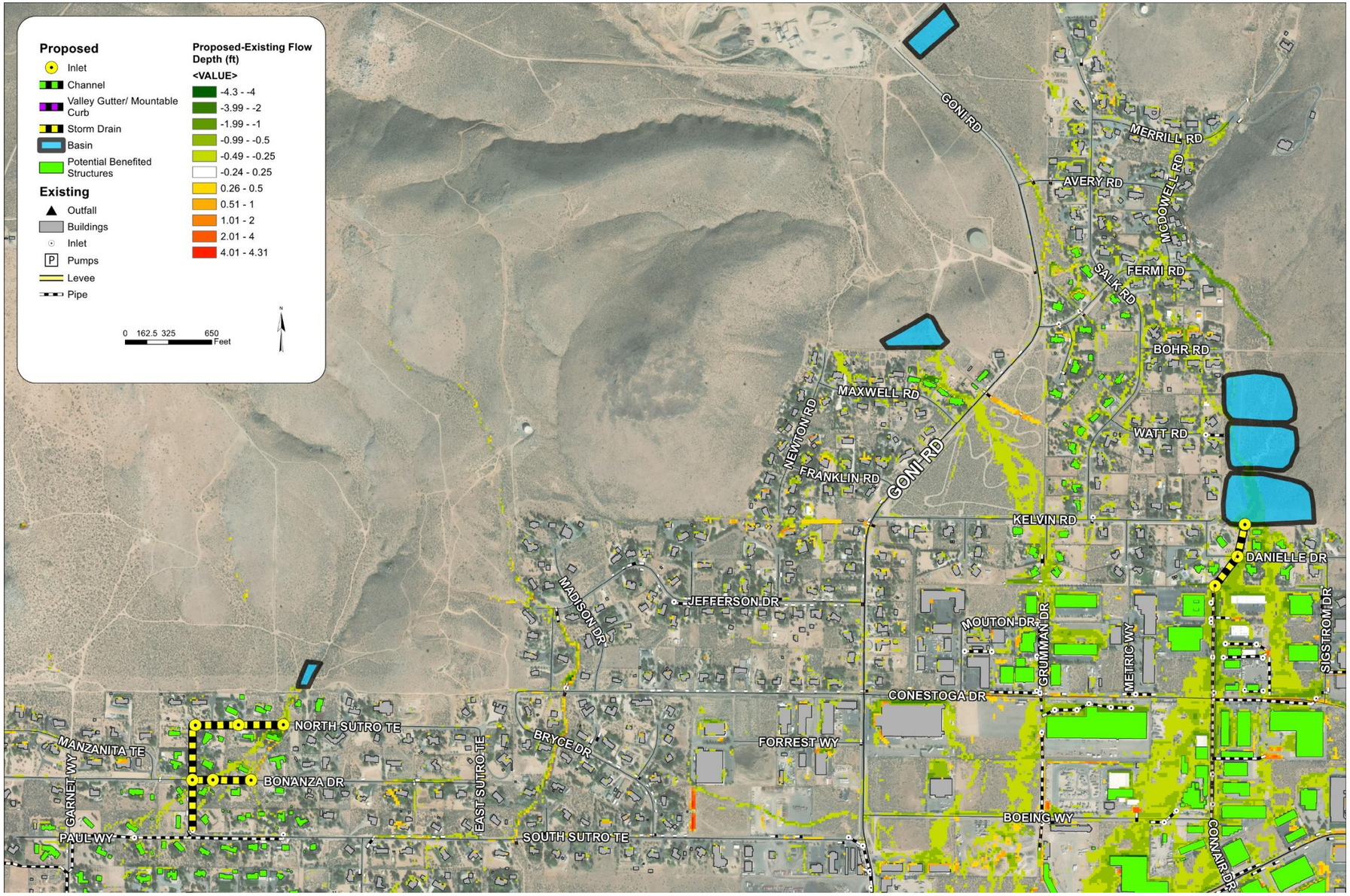


Figure 23: Flow Depth Comparison

8. Conclusion

The goal of the North Carson Area Drainage Plan was to build on previous project efforts to identify flood hazards and mitigation solutions for the area of Carson City roughly north of I-580 and Highway 50. In doing so, nine Areas of Mitigation Interest were identified with high-level conceptual design projects per developed. Based on factors such as cost, public input, and level of protection, these nine AOMI's were further reduced to four preferred alternatives. The design and cost of the four preferred alternatives were further refined. Each of the preferred alternatives had an initial Benefit Cost Ratio greater than one (1). The intent is that these four projects can be submitted to FEMA as part of a future grant application for funding to support construction. The potential cost of each project did increase with this further refinement, but a BCR greater than one (1) is still likely achievable for each during the grant preparation period when the BCR is finalized based on all factors. Since the overarching goal of the project was to identify viable projects for the FEMA grant application process, the four selected projects (preferred alternatives) represent another advancement in mitigating flood hazards in the northern portion of Carson City.

Figure 24: Scenic View

Appendix A

Public Meeting Materials


North Carson Area
DRAINAGE PLAN


North Carson Area
DRAINAGE PLAN

Appendix B

Electronic Submittal