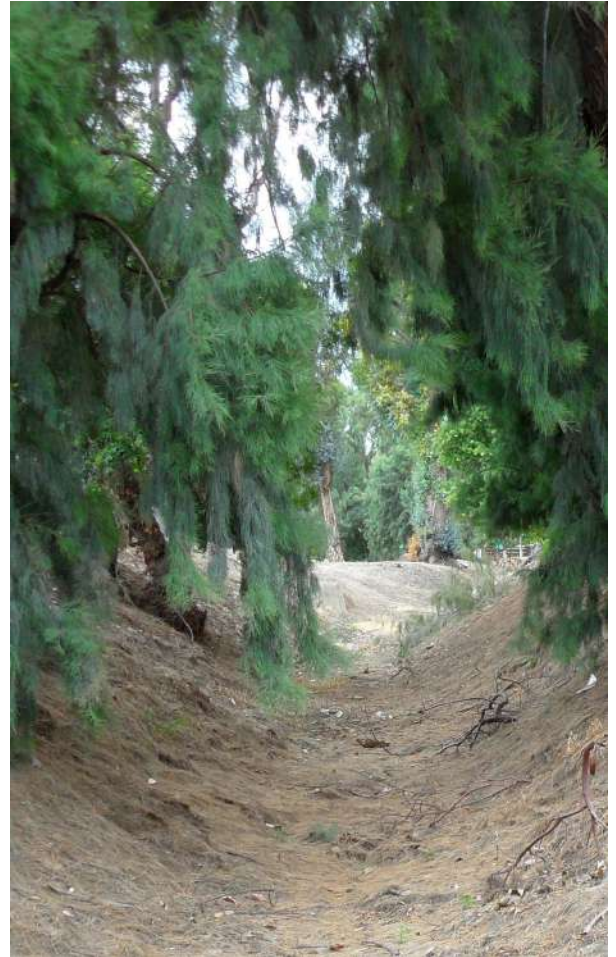


IS/MND Appendix E

Hydrology and Hydraulics Study



CITY OF IRVINE

HICKS CANYON WASH HYDROLOGY AND HYDRAULICS STUDY
FROM CULVER DR. TO PORTOLA PKWY.

DECEMBER 2019

CITY OF IRVINE

HICKS CANYON WASH

HYDROLOGY AND HYDRAULICS STUDY

FROM CULVER DRIVE TO PORTOLA PARKWAY

December 2019

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1. INTRODUCTION

The City of Irvine (City) has retained BKF Engineers (BKF) to perform a hydrology and hydraulics study of the existing Hicks Canyon Wash conveyances from Culver Drive to Portola Parkway in the City of Irvine, California. The purpose of this study is to examine the existing conveyances and develop alternatives that would allow the City of Irvine to pursue future landscaping improvements to the existing natural wash and the adjacent community trail from Culver Drive easterly to the westerly limits of Planning Area 5B Development. See Exhibit 1, Location Map.

The purpose of the study is to develop an approach for a future landscaping project to take place along the Hick Canyon Wash corridor. Presently, the existing channel section is poorly landscaped, as is the southerly portion of the overall trail corridor. The study developed 100-year flow rates, performed hydraulic analyses of the conveyance facilities, and developed alternatives for the management of 100-year flows in the corridor that could be implemented as a part of the future landscaping project.

Hicks Canyon Wash is comprised of two conveyances consisting of an existing subsurface 120-inch diameter cast-in-place-concrete-pipe (CIPP) and an earthen-sloped channel along the surface. The 120-inch pipe was built in 1977 as a part of the North Irvine Assessment District Storm Drain Facilities. The earthen channel was built at some point prior to the 120-inch pipe as part of local agricultural development.

The 120-inch CIPP (Pipe) begins at an inlet located approximately 725 feet east of Portola Parkway and approximately 120 feet North of Jeffrey Road. The Pipe continues approximately 1.9 miles westerly, under Portola Parkway and along Hicks Canyon Wash, under Yale Avenue, under Culver Drive and then joins with Orange County Public Works' (OCPW) Hicks Canyon Channel (Facility Number F27). The Pipe has a tributary area of approximately 1,636 acres, starting in the hillsides above the City of Irvine, to the East of the Eastern Transportation Corridor. The overall watershed includes Hicks Canyon and East Hicks Canyon as well as the area downstream of the canyons between Rattlesnake Reservoir and Syphon Reservoir. See Exhibit 2, 120-inch CIPP Hydrology Map.

The earthen-sloped channel (Channel) begins approximately 1,650 ft East of Yale Avenue and travels approximately 1.2 miles westerly, under Yale Avenue, and joins with OCPW's Hicks Canyon Channel (Facility Number F27). The Channel is an earthen trapezoidal channel with periodic drop structures that has experienced side slope erosion and an accumulation of sediment along the channel bottom. The drop structures are silted in and are virtually ineffective. The channel bottom varies from approximately 3 ft wide to 8 ft wide, the depth is approximately 8 feet, and side slopes range from vertical, at drop structure locations, to 2 feet horizontal to 1 foot vertical in most of the earthen channel reaches.

Flows tributary to the Channel include flows from five storm drain lines from adjacent residential developments. These pipes include a 30-inch pipe from Recodo, a 30-inch pipe from Tiempo, an 18-inch pipe from Quebrada, an 18-inch pipe from Urbino, and a 60-inch pipe that outlets to the channel from the residential trail between Urbino and

Brena. A portion of the surface of Yale Avenue also drains to the culverts beneath the street and subsequently to the Channel. The total tributary area is bounded to the east by the westerly limits of Planning Area 5B, to the south by the southerly lots of Alba East, Alba West, Delamesa East, Delamesa West, Palmatum, Glorieta East, Glorieta West, Kara East, Kara West, and Urbino, and to the north by the Hicks Canyon Wash community trail. See Exhibit 3, Rational Method Hydrology Map.

Research of record drawings and supporting hydrology studies was performed to determine areas tributary to the Hicks Canyon Wash conveyances. A summary of the record drawings and hydrology studies used in support of this report are attached in Appendix A: Hicks Canyon Wash Hydrology and Hydraulic Study (P.O. No. P01055) Summary of Collected Documents Used in Study.

2. HYDROLOGIC ANALYSIS

The Orange County Hydrology Manual, published in 1986, (Hydrology Manual) and Addendum No.1, published in 1995, provided the guidelines and procedures for the Unit Hydrograph and Rational Method analyses for the two conveyances in Hicks Canyon Wash. See Table 2-1 for a summary of the tributary flow rates to the two conveyances and see Appendix B: Hydrology Calculations for supporting calculations.

A. 120-Inch CIPP

The Unit Hydrograph Method was used to determine the peak flow rate directed to the 120-inch CIPP conveyance at its inlet located upstream of Portola Parkway. The tributary area was divided into three areas, the area tributary to Hicks Canyon Retarding Basin, the area tributary to East Hicks Canyon Retarding Basin, and the remaining area tributary to the 120-inch CIPP inlet. The parameters for the three areas used for the unit hydrograph study were taken from the "San Diego Creek Master Plan, Orange County, California," prepared by RBF Consulting and dated September 30, 2013 (Master Plan).

The unit hydrograph method analysis was performed with software developed by Advanced Engineering Software (AES) for the 100-year and 10-year storm events. The software was designed to accept watershed data and to perform unit hydrograph method analyses in accordance with the Hydrology Manual. The software defines subareas by means of upstream and downstream node numbers, lag time, development type S-curve, loss rates, peak rainfall depths, tributary area, and depth-area reduction factors. The depth-area reduction factors were approximately equal to 1.0 for all areas due to the small size of the overall watershed.

For the area upstream of Hicks Canyon Retarding Basin, input parameters were taken from the Master Plan routing study from Node 824.00 to Node 38.00. The lag time was taken as $0.8 \cdot t_c$, where t_c is the time of concentration taken from the Master Plan rational method analysis from Node 824.00 to Node 38.00.

For the area upstream of East Hicks Canyon Retarding Basin, input parameters were taken from the Master Plan routing study from Node 810.00 to Node 47.00. The lag time was taken as $0.8 \cdot t_c$, where t_c is the time of concentration taken from the Master Plan rational method analysis from Node 810.00 to Node 347.00.

For the remaining area upstream of the 120-inch CIPP, input parameters were taken from the Master Plan routing study from areas upstream and including Node 22.00. The area used in the calculation was the sum of all of the upstream areas except those upstream of Hicks Canyon Basin and East Hicks Canyon Basin. The overall loss rate and pervious area fractions were calculated as a weighted average of the loss rates and pervious area fractions of those areas. The lag time was taken as $0.8 \cdot t_c$, where t_c is the time of concentration taken from the Master Plan rational method analysis from Node 21.00 to Node 22.00. The S-curve used was a blend of 10% valley-developed and 90% valley-undeveloped, similar to the unit hydrograph for Node 825.00 to Node 24.00, with the developed portion decreased to reflect the smaller area of developed land within the subarea.

In order to route the Hicks Canyon Basin and East Hicks Canyon Basin hydrographs through their respective retarding basins, a routing analysis was performed using the US Army Corps of Engineers Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) software. The HEC-HMS model uses source inflow data, reservoir stage-storage-discharge data, and basin junction data to calculate routed flow rates. Hydrographs created by AES were entered into the program as discharge gage data and designated as source inflow elements identified by the downstream node number from the AES calculations. Source inflow element Node 38.00 was routed through the Hicks Canyon Reservoir Element. The stage-storage-discharge data was taken from the RBF Routing Study Node 38.00 to Node 38.00. Source inflow element Node 47.00 was routed through the East Hicks Canyon Reservoir Element. The stage-storage-discharge data was taken from the RBF Routing Study Node 47.00 to Node 47.00. The outflows from the two basins were then combined with the source inflow element Node 22.00 to provide the total inflow into the 120-inch CIPP. See Exhibit 2, 120-inch CIPP Hydrology Map.

B. Channel

The Rational Method was used to determine the peak flow rates of the five existing storm drain pipes that drain to the Channel as well as the total peak flow within the Channel. Hydrologic boundaries were based on record drawings and supporting hydrology studies of the housing developments bordering Hicks Canyon Wash. The underlying hydrologic soil group is Type B as shown on Plate B of the Hydrology Manual. Subareas composed of the Channel itself were assumed to be barren, as the natural channel has little to no vegetation. For residential subareas, the land use was assumed to be 5-7 dwellings per acre as observed from aerial photographs of the watershed area, which is equivalent to 50% impervious area per page C-9, Figure C-4 of the Hydrology Manual. Subareas composed of only paved streets were assumed to be commercial, which is equivalent to 90% impervious area per page C-9, Figure C-4 of the Hydrology Manual.

The rational method analysis was performed with software developed by Advanced Engineering Software (AES). The software was designed to accept watershed data and to perform rational method analyses in accordance with the Hydrology Manual. The software defines subareas and routing paths by means of upstream and downstream node numbers, node elevation, travel distance, soil group, land use and type of conveyance. See Exhibit 3: Rational Method Hydrology Map for the locations of all node numbers used in the rational method analysis.

Table 2-1
Hydrology Calculations Summary

Conveyance	Tributary Area (AC)	10-Year Peak Flow (CFS)	100-Year Peak Flow (CFS)
120-Inch CIPP	1,636	889.7	1,316.8
Channel (Total)	110.9	167.76	273.60
60-Inch Pipe	83.6	143.26	232.21
18-Inch Pipe at Urbino	4.4	5.98	9.91
18-Inch Pipe at Quebrada	2.3	3.30	5.44
30-Inch Pipe at Tiempo	2.1	3.61	5.82
30-Inch Pipe at Recodo	6.7	6.00	9.49

3. HYDRAULIC ANALYSIS

Hydraulic Analyses were performed to determine the capacity of the Hicks Canyon Wash conveyances and develop alternatives for landscaping improvements within the natural channel area and community trail. See Appendix C: Hydraulic Calculations.

A. WSPGW

The hydraulic analysis of the 120-inch CIPP was conducted using the Water Surface and Pressure Gradient (WSPGW) computer software originally developed by Los Angeles County Flood Control District. WSPGW calculates frictional losses and corresponding velocities and depths in prismatic conveyances. The input parameters consist of stations and invert elevations as well as conveyance geometry and horizontal alignment changes. WSPGW also considers losses resulting from manhole structures and lateral junctions.

Geometric input for the 120-inch CIPP analysis and the 60-Inch pipe that outlets into the Channel was obtained from the Construction Plans for the Improvement of North Irvine Assessment District (NIAD Plans). Elevations were adjusted +2.40ft to account for the datum difference between NVGD29 and NAVD88. The 120-inch CIPP was modeled to Station 92+80.00, which is the westerly boundary of PA5B as shown on Exhibit 1. This approach assumed that the extension of the pipe under Portola Parkway to the upstream inlet was sized appropriately.

The 60-Inch pipe model was prepared to evaluate alternatives that considered modifications to this facility. The model was extended to the 120-inch CIPP, and Station 100+00.00= Station 0+00.00 on the NIAD Plans. The pipe was modeled only to Station 118+52.67/18+52.67 as the effects of tying into the 120-inch CIPP would not affect reaches further upstream.

B. HEC-RAS

The hydraulic analysis of the natural channel conveyance was conducted using the US Army Corps of Engineers Hydrologic Engineering Center HEC-RAS River Analysis System (HEC-RAS) software. HEC-RAS calculates water surface profiles for a network of natural and constructed channels. Input parameters include channel geometry, n-values along channel sections, flow rates along the channel, and upstream and downstream boundary flow depth conditions. Channel geometry was taken from the topographic map for the Hicks Canyon Wash that was prepared for this study. N-values for the channel were taken as 0.025 except at drop structure locations, where the n-value was 0.014. Flow rates were taken from the Rational Method study conducted as a part of this report and listed in Table 2-1. The downstream flow depth was calculated based on culvert analysis of the existing double 66-inch RCP under Culver Drive that join the downstream Hicks Canyon Channel (Facility Number F27). See Exhibit 4, HEC-RAS Work Map.

4. ALTERNATIVES

Alternatives for the management of storm water flow through the Hicks Canyon Wash corridor were developed for the purpose of guiding the forthcoming landscaping project. The alternatives focus on minimizing the long-term use of the existing earthen channel. In its present state, much of the channel is relatively barren, possesses many areas of erosion along its embankments, and its bottom has been infilled by the accumulation of sediment and debris. Therefore, the existing earthen channel is in poor condition and not effective for continued use as a flood control conveyance. Order of magnitude costs were determined for each alternative and are included in Appendix D.

Alternative 1: No Build

The first alternative preserves the Hicks Canyon Wash conveyances in their existing condition. While visual observations of the earthen channel concluded that it is in physically poor condition, there remained a need to evaluate its existing hydraulic viability.

Hydraulic analyses of the 120-inch CIPP and the Channel show that they have sufficient capacity for tributary flows. However, the natural channel has experienced significant erosion and geotechnical instability of the slide slopes with one or two locations of sloughing or small slide-outs occurring. It is anticipated that this problem will continue with the removal of eucalyptus trees and their roots systems as the roots provide stability. In addition, the predominately barren channel surfaces are prone to erosion from storm water flows which could further exacerbate the geotechnical issues within the existing side slopes. Hydraulic analysis shows that the depth of flow varies from less than a foot to up to seven feet deep and are below the channel banks. However, flow velocities are between 7 and 9 feet per second in many locations along the channel, indicating that there are erosive flows during significant storm events. Given these issues, the possibility exists for slope failure during a storm event that could lead to the obstruction of the channel, loss of containment, and possible flooding of areas outside the channel. See Exhibit 5, Alternative1.

The cost for this alternative is assumed to be negligible given that it reflects the existing channel condition and no additional work is required to change the existing channel configuration.

Alternative 2: Vegetate Channel

The second alternative is to preserve the 120-inch CIPP in its existing condition but vegetate the Channel to reduce flow velocities within the channel. For this alternative, the n-value in the channel was increased to 0.060 to reflect the vegetated channel bottom and side slopes. The analysis shows containment of tributary flows with adequate freeboard of and a significant decrease in flow velocities along the channel. Adequate freeboard as defined in the Orange County Flood Control Design Manual Addendum 3 for 100 year flow is 1.5ft for subcritical flow and 3 ft for supercritical flow. Erosive flows are shown to occur in only two locations along channel. It should be noted, however, that geotechnical stability of the side slopes remains a concern that is

not addressed by this study. Additionally, remediation of the riprap energy dissipation pads would need to be undertaken as a part of this alternative, thus requiring permit coordination with the regulatory agencies. See Exhibit 6, Alternative 2.

The cost of landscaping the channel to achieve the higher n-value is considered included in the forthcoming landscape project to be undertaken by the City.

Alternative 3: All Laterals to 120-inch CIPP

The third alternative is to extend the five storm drain lines that connect with the natural channel to the 120-inch CIPP and fill in the existing Channel. This would include diverting flows from Yale Avenue to the 120-inch CIPP as well. The Yale Avenue flows are collected in catch basins on either side of the bridge over Hicks Canyon Wash. These flows discharge into two 36-inch culverts that convey Hicks Canyon Wash flows under Yale Avenue. For this alternative, the hydraulic analysis of the 120-inch CIPP was updated to reflect five new junctions with flows from the residential storm drain lines. The analysis shows that the 120-inch CIPP will convey the additional flows under pressure with the Hydraulic Grade Line lower than the existing grades over the pipe. A hydraulic analysis of the 60-inch pipe confirmed that the downstream connection to the 120-inch CIPP will not adversely affect hydraulics in the 60-inch line. See Exhibit 7, Alternative 3.

It should be noted that filling in the existing earthen channel will likely require the acquisition of permits from regulatory agencies such as the Army Corps of Engineers, the California Department of Fish and Wildlife, and the Regional Water Quality Control Board. However, the surface of the in-filled channel could be used to mitigate the impacts to the existing channel through the creation of habitat depressions. Water could be delivered to these depressions by means of low-flow diversions from the upstream storm drains.

The order-of-magnitude cost for this alternative is approximately \$2.6 million. This cost includes \$1.8 million for the import and placement of fill material which could be eliminated if the City chose to leave the abandoned sections of the Channel in their present configuration with minor landscaping improvements to provide for local drainage. This would reduce the estimated order of magnitude cost to approximately \$790,000.

With the forthcoming landscaping project to occur throughout the corridor, an opportunity exists to adjust grades downwards in combination with the landscaping design. This downward grade adjustment will generate material that can be used to backfill the channel. As such, the entire volume of channel backfill would not necessarily need to be imported.

An analysis was conducted to study the potential volume of material that could be borrowed from the landscaped areas outside of the channel section. Exhibit 10 shows the areas that were considered. For the depicted areas, both a 1-foot and 2-foot grade reduction were analyzed to determine the volume of material that could be potentially generated and used for channel backfill. Those volumes were then applied to the total import fill volume associated with the alternative. While more precise analyses will need to be performed in conjunction with the landscape design process, the 1-foot and 2-foot

grade reduction analyses intend to provide guidance that can be used in developing a precise landscaping plan.

When the 1-foot grade reduction is applied to the import volume associated with Alternative 3, the order-of-magnitude cost for the alternative is reduced from approximately \$2.6 million to \$2.3 million.

When the 2-foot grade reduction is applied to the import volume associated with Alternative 3, the order-of-magnitude cost for the alternative is reduced from approximately \$2.6 million to \$2.0 million.

Alternative 4: All Laterals to 120-inch CIPP, Except 60-inch RCP

The forth alternative is to extend the four smaller upstream storm drain lines that drain to the Channel to the 120-inch CIPP, preserve the existing 60-inch pipe outlet to the Channel, fill in the portion of the Channel upstream of the 60-inch pipe outlet, and vegetate the portion of the channel downstream of the 60-inch pipe outlet. This would include diverting flows from Yale Avenue, which discharges into the Yale Avenue culverts, to the 120-inch CIPP as well. This alternative avoids the need of the costly junction structure required to confluence the 60-inch pipe with the existing 120-inch CIPP. The junction of the smaller upstream pipes can be made relatively inexpensively. The analysis shows that that the 120-inch CIPP has capacity to convey the additional flows within the pipe. Vegetating the Channel downstream of the 60-inch pipe outlet will reduce flow velocities. See Exhibit 8, Alternative 4.

It should be noted that filling in the existing earthen channel will likely require the acquisition of permits from regulatory agencies such as the Army Corps of Engineers, the California Department of Fish and Wildlife, and the Regional Water Quality Control Board. However, the surface of the in-filled channel could be used to mitigate the impacts to the existing channel through the creation of habitat depressions. Water could be delivered to these depressions by means of low-flow diversions from the upstream storm drains.

The order of magnitude cost for this alternative is approximately \$2.0 million. This cost includes \$1.5 million for the import and placement of fill material which could be eliminated if the City chose to leave the abandoned sections of the Channel in their present configuration with minor local drainage improvements. This would reduce the estimated order of magnitude cost to \$510,000.

With the forthcoming landscaping project to occur throughout the corridor, an opportunity exists to adjust grades downwards in combination with the landscaping design. This downward grade adjustment will generate material that can be used to backfill the channel. As such, the entire volume of channel backfill would not necessarily need to be imported.

An analysis was conducted to study the potential volume of material that could be borrowed from the landscaped areas outside of the channel section. Exhibit 10 shows the areas that were considered. For the depicted areas, both a 1-foot and 2-foot grade reduction were analyzed to determine the volume of material that could be potentially

generated and used for channel backfill. Those volumes were then applied to the total import fill volume associated with the alternative. While more precise analyses will need to be performed in conjunction with the landscape design process, the 1-foot and 2-foot grade reduction analyses intend to provide guidance that can be used in developing a precise landscaping plan.

When the 1-foot grade reduction is applied to the import volume associated with Alternative 4, the order-of-magnitude cost for the alternative is reduced from approximately \$2.0 million to \$1.7 million.

When the 2-foot grade reduction is applied to the import volume associated with Alternative 4, the order-of-magnitude cost for the alternative is reduced from approximately \$2.0 million to \$1.5 million.

Alternative 5: All Laterals to 120-inch CIPP; 60-inch RCP to Culver Drive

The fifth alternative is to extend the four smaller upstream storm drain lines and the Yale Avenue culvert flow to the 120-inch CIPP and extend the 60-inch pipe to the existing double 66-inch RCP that convey flows under Culver Drive. The 60-inch pipe would be extended along the downstream alignment of the Hicks Canyon Wash and then transition from 60-inch RCP to a double 66-inch RCP to join the existing pipes. This alternative avoids the costly junction structure with the 120-inch CIPP, but also allows for complete infill of the existing channel. The analysis of the 120-inch CIPP shows that the pipe has capacity to convey the additional flows within the pipe. The analysis of the 60-inch pipe extension shows downstream connection to the 66-inch RCP will not adversely affect hydraulics in the 60-inch line. See Exhibit 9, Alternative 5.

Similar to the other alternatives, it should be noted that filling in the existing earthen channel will likely require the acquisition of permits from regulatory agencies such as the Army Corps of Engineers, the California Department of Fish and Wildlife, and the Regional Water Quality Control Board. However, the surface of the in-filled channel could be used to mitigate the impacts to the existing channel through the creation of habitat depressions. Water could be delivered to these depressions by means of low-flow diversions from the upstream storm drains.

The order-of-magnitude cost for this alternative is approximately \$2.9 million. This cost includes \$1.7 million for the import and placement of fill material which could be eliminated if the City chose to leave the abandoned sections of the Channel in their present configuration with minor local drainage improvements. This would reduce the estimated order of magnitude cost to \$1.2 million.

With the forthcoming landscaping project to occur throughout the corridor, an opportunity exists to adjust grades downwards in combination with the landscaping design. This downward grade adjustment will generate material that can be used to backfill the channel. As such, the entire volume of channel backfill would not necessarily need to be imported.

An analysis was conducted to study the potential volume of material that could be borrowed from the landscaped areas outside of the channel section. Exhibit 10 shows

the areas that were considered. For the depicted areas, both a 1-foot and 2-foot grade reduction were analyzed to determine the volume of material that could be potentially generated and used for channel backfill. Those volumes were then applied to the total import fill volume associated with the alternative. While more precise analyses will need to be performed in conjunction with the landscape design process, the 1-foot and 2-foot grade reduction analyses intend to provide guidance that can be used in developing a precise landscaping plan.

When the 1-foot grade reduction is applied to the import volume associated with Alternative 5, the order-of-magnitude cost for the alternative is reduced from approximately \$2.9 million to \$2.6 million.

When the 2-foot grade reduction is applied to the import volume associated with Alternative 5, the order-of-magnitude cost for the alternative is reduced from approximately \$2.9 million to \$2.4 million.

5. RECOMMENDATIONS

Table 5-1 is an alternative evaluation matrix based on alternative cost, permitting requirements, geotechnical concerns, and hydraulic concerns rated 1-5, with 1 being the least optimal and 5 being the most optimal rating.

Table 5-1
Alternative Evaluation Matrix

Alternative	Cost	Permitting Requirements	Geotechnical Concerns	Hydraulic Concerns	Total
1	5	5	1	1	Not Viable
2*	5	3	1	2	11
3	2	1	5	5	13
4	3	1	2	3	9
5	1	1	5	5	12

*The landscaping associated with Alternative 2 is considered included in the City's forthcoming landscaping project for the Hicks Canyon Wash corridor.

Based on the results of our analysis and the matrix above, Alternative 3, the junctioning of all storm drains with the existing 120-inch CIPP is the optimal solution, addressing geotechnical and hydraulic concerns. While this alternative is not the least-cost option, and may require a significant permitting effort, this alternative does result in a substantial reduction of risk for flooding issues throughout the Hicks Canyon Wash corridor.

6. EXHIBITS

Exhibit 1: Location Map

Exhibit 2: 120-Inch Pipe Hydrology Map

Exhibit 3: Hicks Canyon Wash Hydrology Map

Exhibit 4: HEC-RAS Work Map

Exhibit 5: Alternative 1

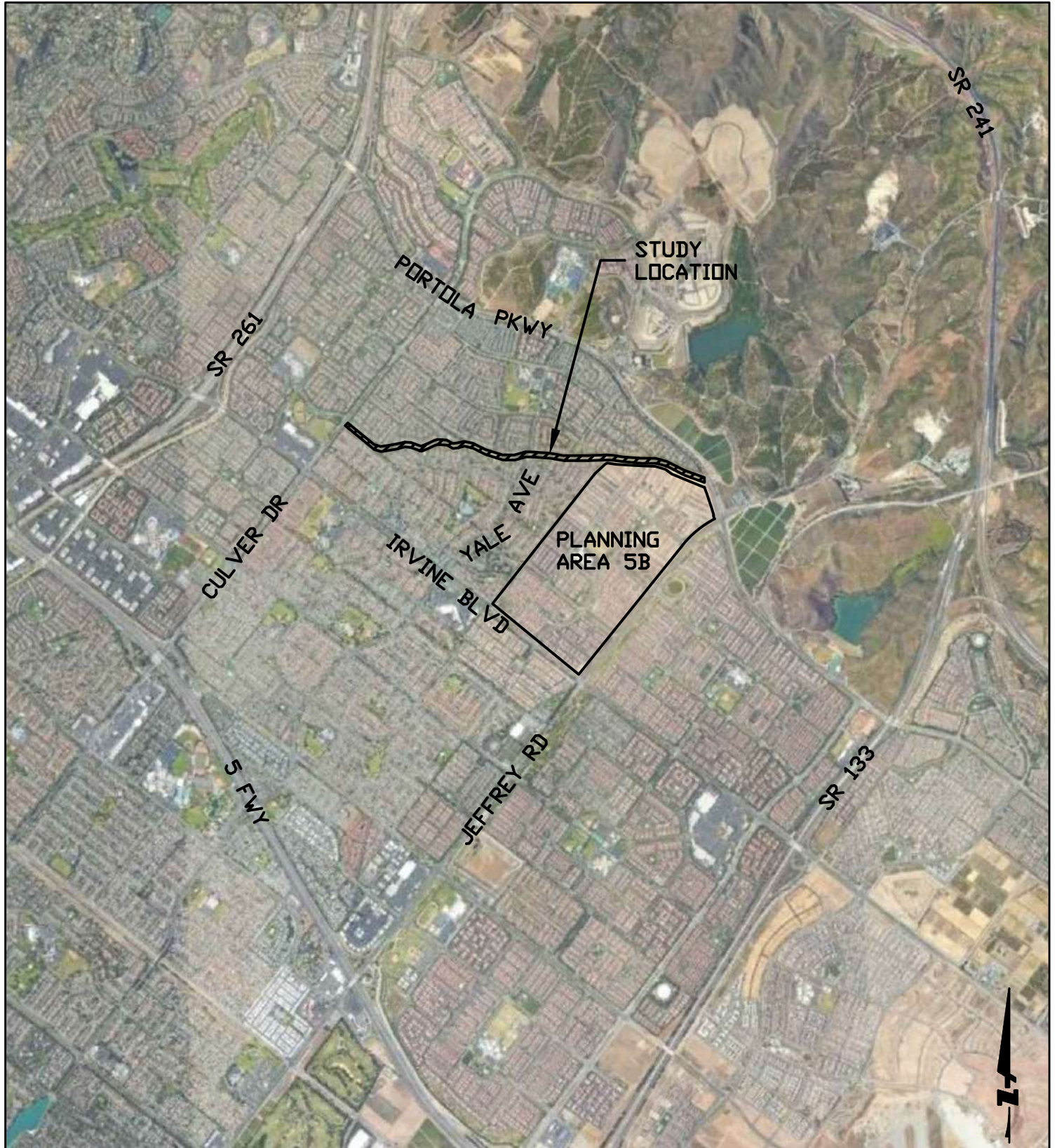
Exhibit 6: Alternative 2

Exhibit 7: Alternative 3

Exhibit 8: Alternative 4

Exhibit 9: Alternative 5

Exhibit 10: Possible Borrow Location Map

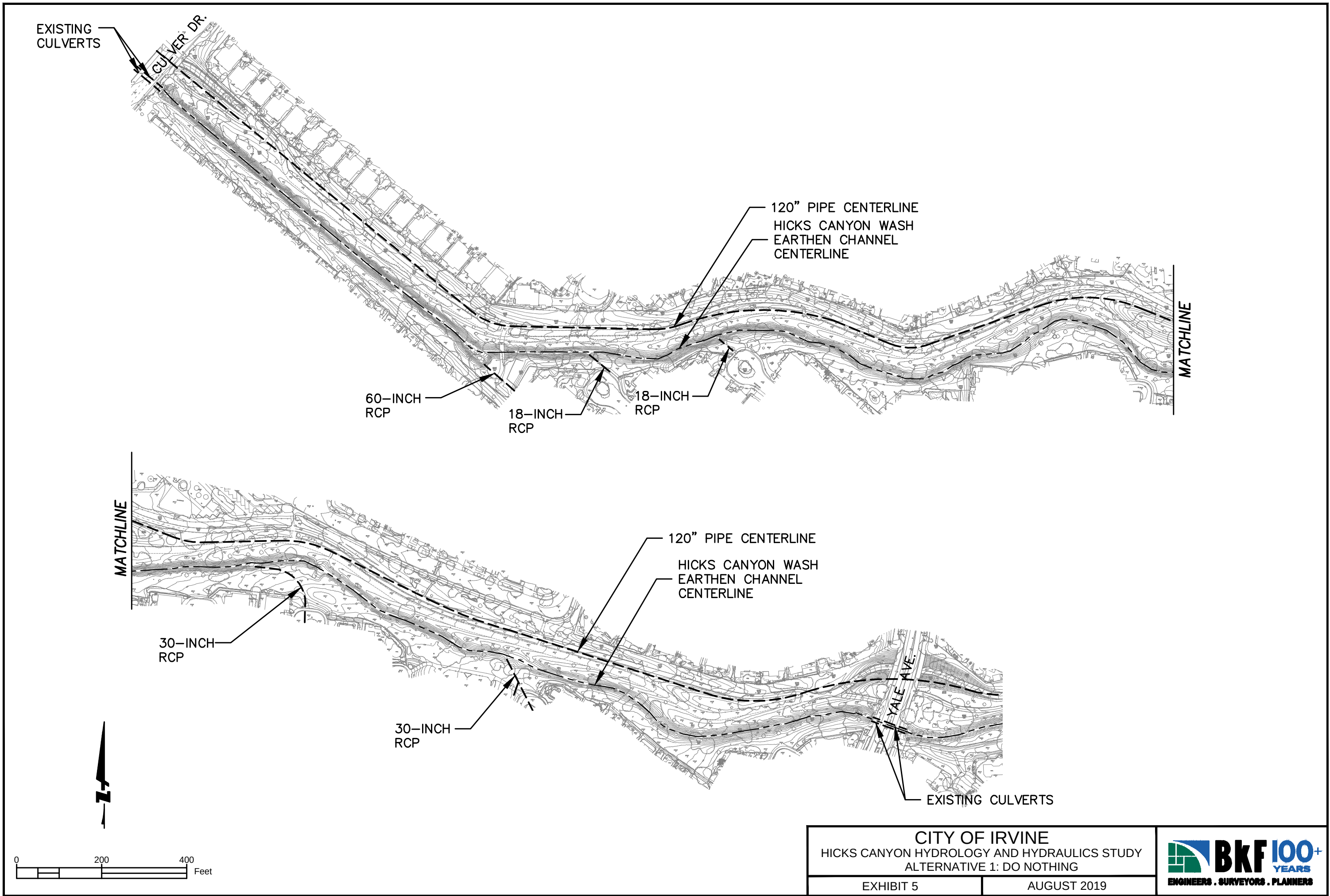


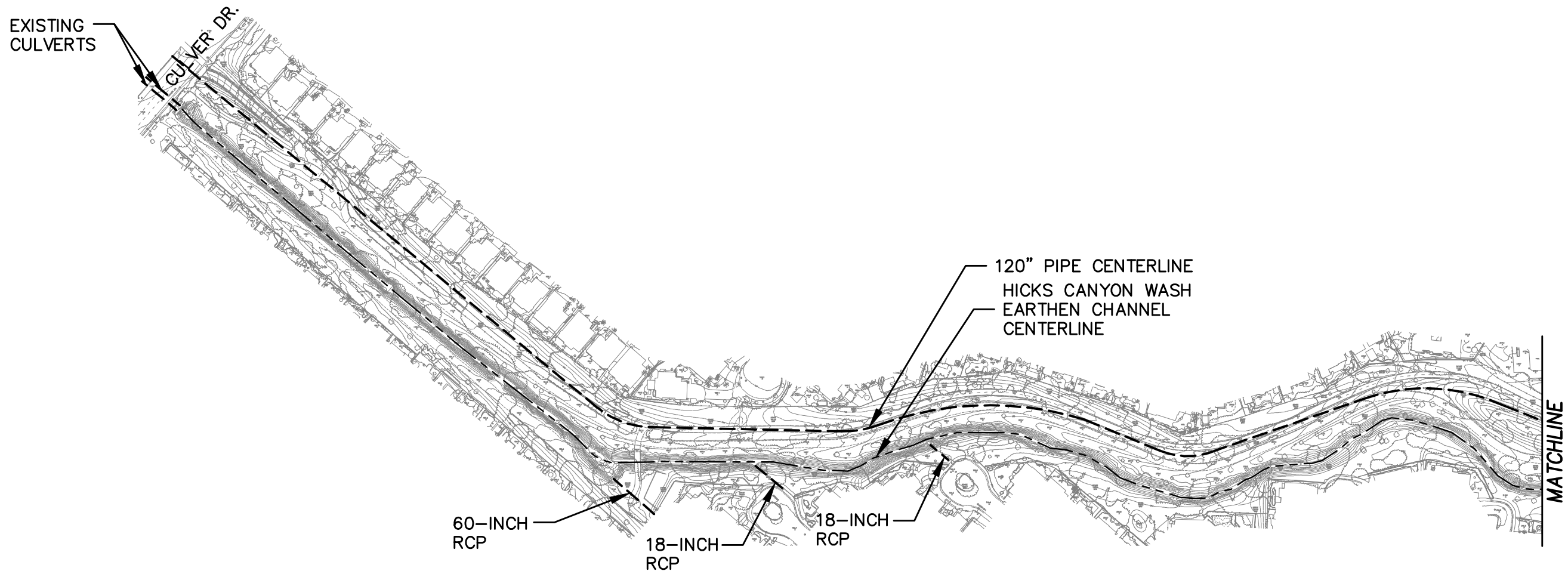
CITY OF IRVINE
HICKS CANYON HYDROLOGY AND HYDRAULICS STUDY
LOCATION MAP

EXHIBIT 1

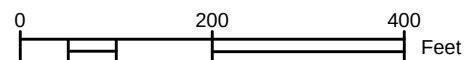
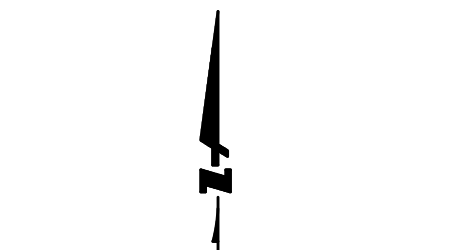
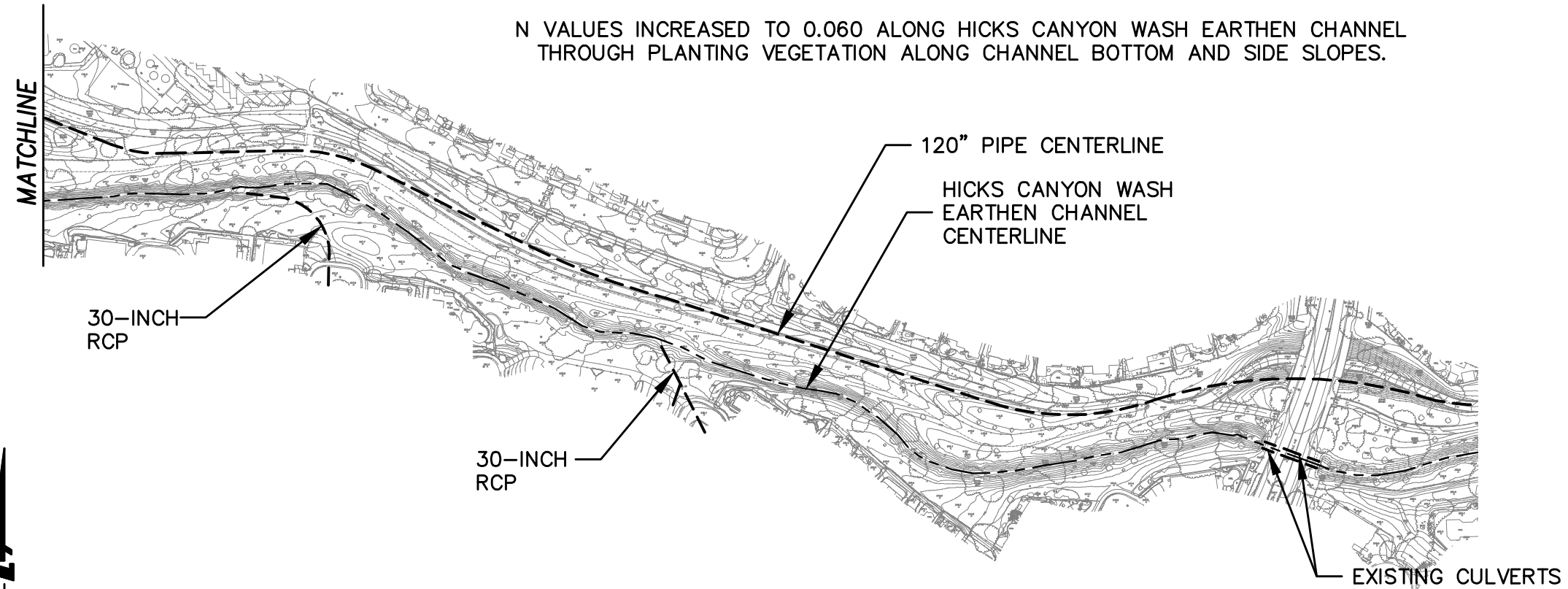
AUGUST 2019

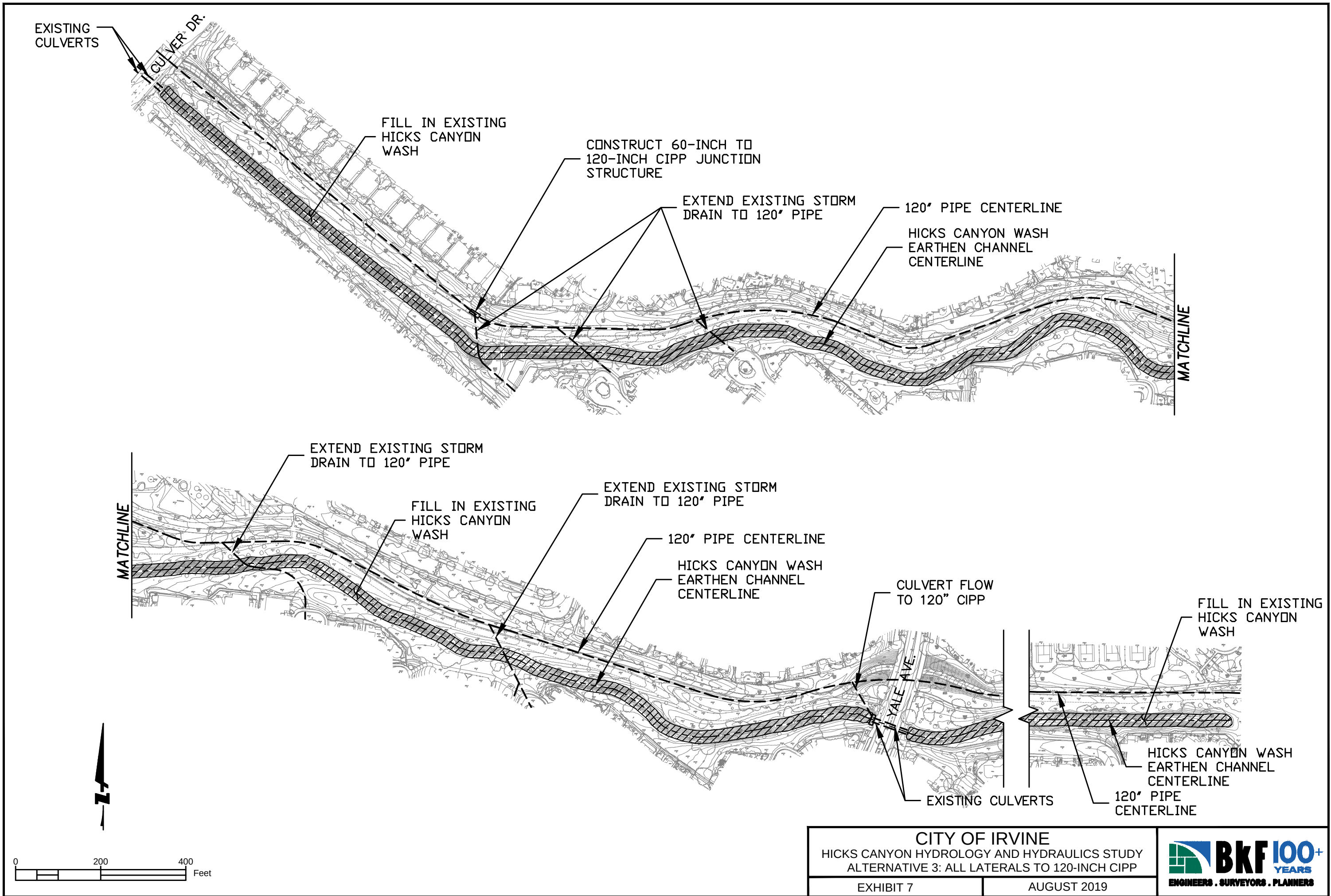


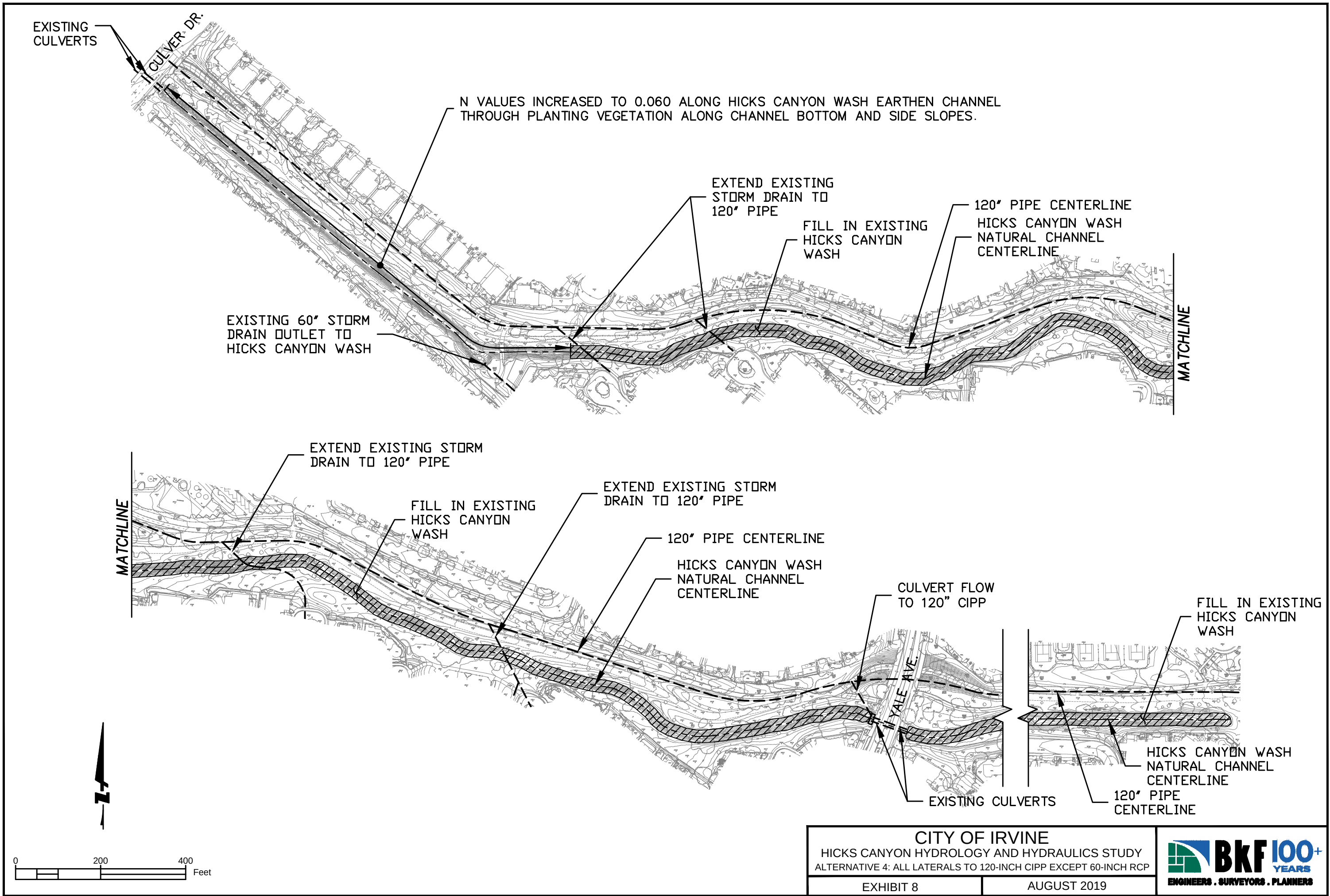


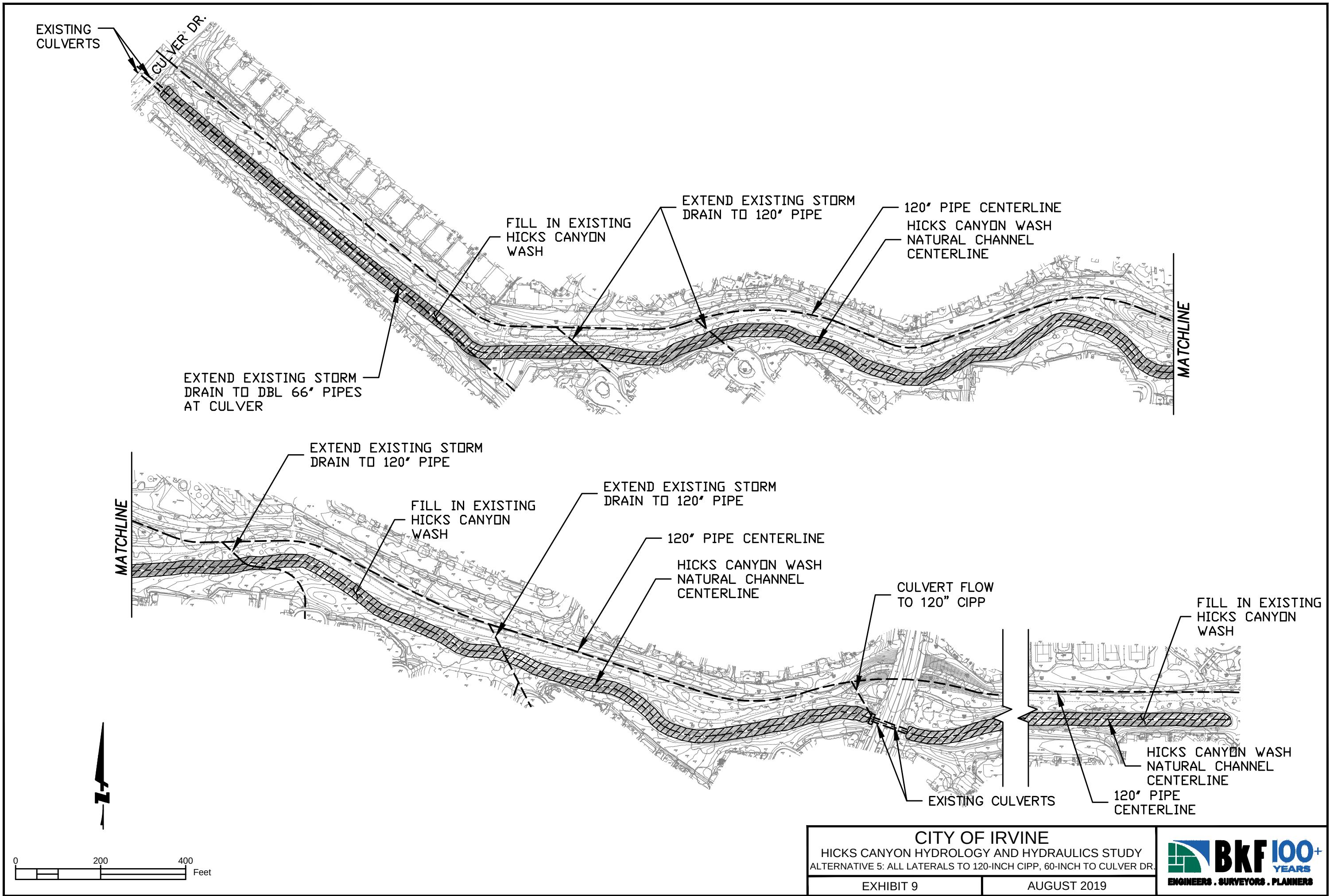


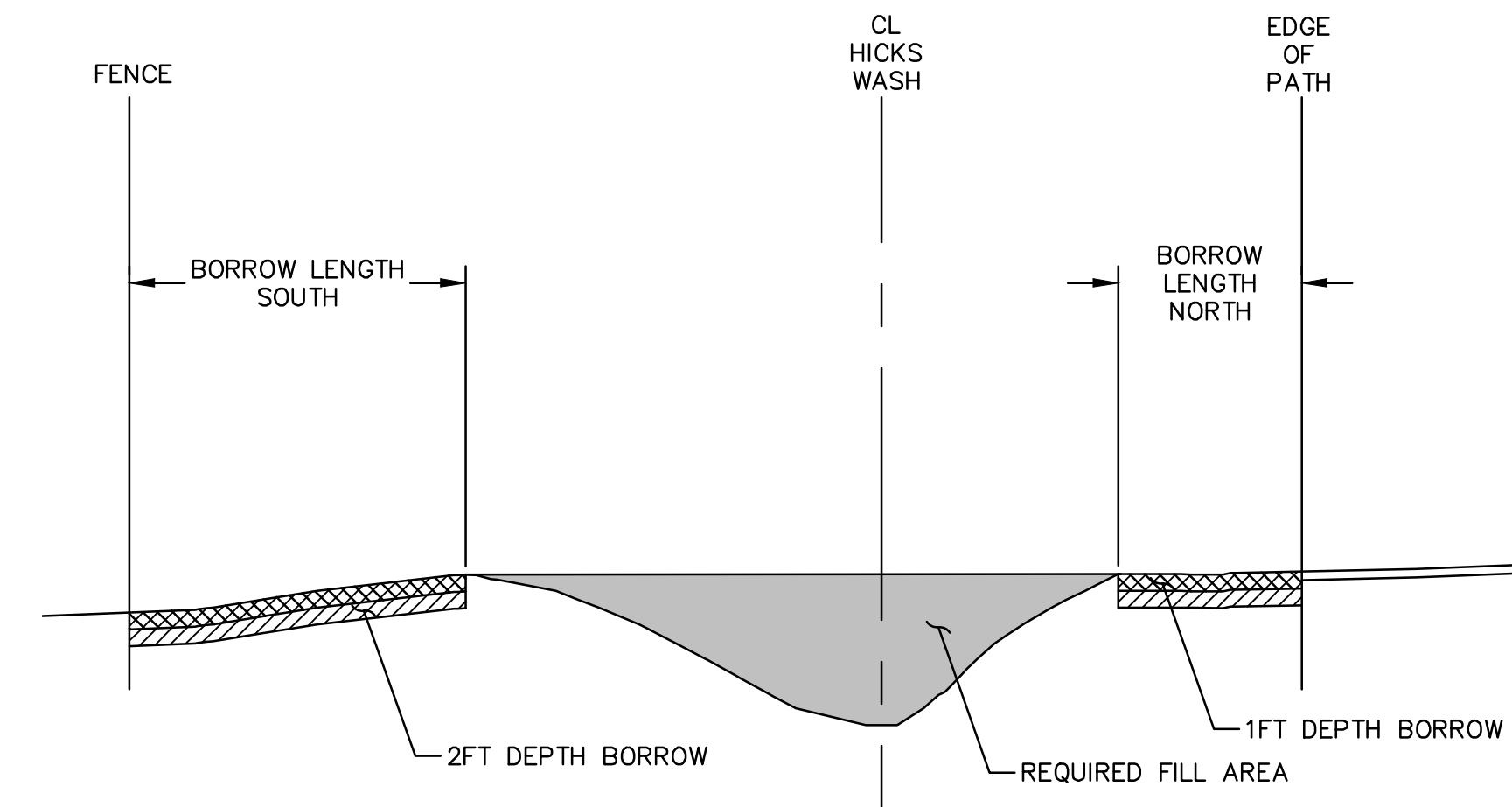
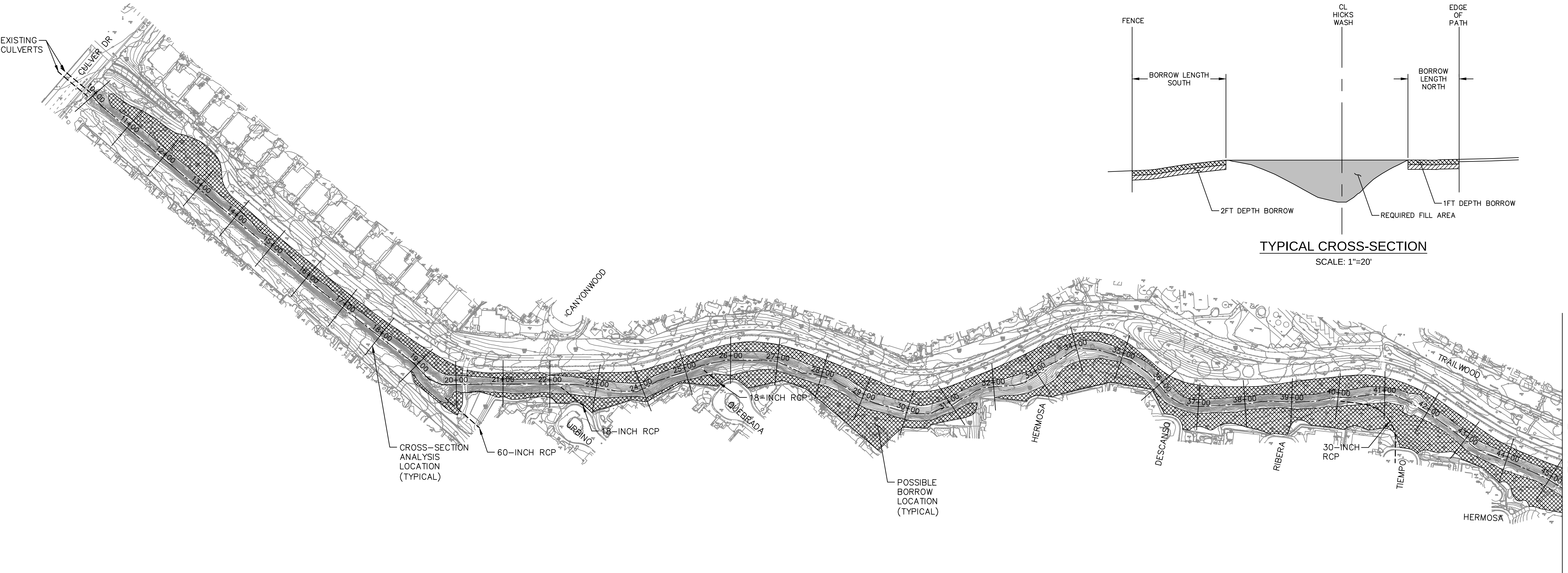
N VALUES INCREASED TO 0.060 ALONG HICKS CANYON WASH EARTHEN CHANNEL THROUGH PLANTING VEGETATION ALONG CHANNEL BOTTOM AND SIDE SLOPES.











TYPICAL CROSS-SECTION
SCALE: 1"=20'

