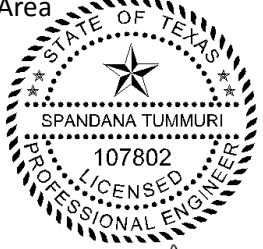



## **SAN JACINTO RIVER AUTHORITY RAW WATER SUPPLY MASTER PLAN DETAILED STRATEGY EVALUATION TECHNICAL MEMORANDUM**

<b>Project Name:</b>	Trinity Supplies Transfer to Highlands Service Area	  <b>FREES AND NICHOLS, INC.</b> TEXAS REGISTERED ENGINEERING FIRM F-2144
<b>Project Type:</b>	Existing Surface Water Source	
<b>Potential Supply Quantity (Rounded):</b>	50,000 acre-feet/year (45 MGD)	
<b>Development Timeline:</b>	10 years	
<b>Project Capital Cost:</b>	\$0 - \$109,681,000 (August 2017)	
<b>Unit Water Cost (Rounded):</b>	\$5 - \$549 per acre-feet (during loan period) \$5 - \$77 per acre-feet (after loan period)	

### **STRATEGY DESCRIPTION**

The San Jacinto River Authority (SJRA) is a wholesale water provider for various municipal, industrial, and irrigation retail customers in the San Jacinto River Basin. SJRA serves a substantial demand center of largely industrial water needs from its Highlands System. In the Highlands service area, Lake Houston is SJRA's primary source of supply; however, SJRA also has water rights in the Trinity River Basin that are used as a source of supply to meet the Highlands service area demands. In terms of conveyance capacity, SJRA delivers all the Highlands supplies by means of an extensive canal system. In addition to water rights diverted at Lake Houston, SJRA also contracts with Coastal Water Authority (CWA) to convey SJRA water rights from the lower Trinity River Basin to its Highlands service area.

SJRA's current supplies in the Trinity basin are represented by the Devers and CLCND water rights. The Devers water right (COA-5271) provides access to 56,000 acre-feet per year of supplies and the CLCND water right (COA-4279A) provides access to 30,000 acre-feet per year of supplies. It should be noted that the Devers water right has a firm yield of 56,000 acre-feet per year when it is backed up through agreement with the City of Houston (COH). SJRA's current contracted capacity in the CWA canal allows them to transfer up to 56,000 acre-feet per year (50 MGD) of supplies from the Trinity basin. As long as the demand in the Highlands service area on the Trinity Basin is approximately 56,000 acre-feet per year, SJRA has both the infrastructure capacity and the yield available to meet the Highlands demands using Trinity supplies. However, when the Highlands demands on Trinity supplies exceed 56,000 acre-feet per year, SJRA must increase infrastructure capacity to tap into the additional 30,000 acre-feet per year supplies from the CLCND water rights. In the eventuality that the Highlands demands on the Trinity system exceed the total 86,000 acre-feet per year, SJRA may contract for additional supplies from TRA's Lake Livingston. In addition to the availability of contractual capacity in the CWA system, capacity is also limited by the physical constraints imposed by COH in their own use of the canal system.

In April 2013, SJRA secured an option agreement with the Trinity River Authority (TRA) for the purchase of up to 50,000 acre-feet of water per year from Lake Livingston. Currently, this water supply may only be used within the Trinity River Basin and adjoining coastal basins; however, it can

be permitted in the future through TCEQ for transfer out of the Trinity Basin to either the Montgomery County or the Highlands service area. As part of this feasibility study, strategies to deliver Lake Livingston water were developed both for the Montgomery County and the Highlands service areas for the full amount of the water available under this option agreement from TRA.

The current options agreement essentially provides SJRA a right of first refusal to enter into a Water Supply Contract with TRA for an initial contract term of not less than 50 years, with provisions in the contract to reserve water at a reservation fee rate for up to 20 years or until water supply is actually used, when at such time the full take-or-pay system rate would go into effect. The options agreement requires SJRA and TRA to enter into a Service Area Agreement by April 2023 and a Water Supply Contract by April 2028.

It should be noted that the 50,000 acre-feet per year of water purchased from TRA may potentially be used to serve any location of the SJRA service area. When comparing the strategies for future selection, it should be noted that the Highlands and the Montgomery County strategies for delivering Livingston water must be treated as mutually exclusive or it should be considered that any of the TRA option amount dedicated to supply in one service area effectively reduces the potential strategy supply available in the other service area. Any volume in excess of this amount would require additional contracting with TRA or other parties.

## **STRATEGY ANALYSES**

The project analyses for supplies from TRA's Trinity supplies conveyed to the Highlands service area include evaluations of the potential amount of supply to be created, environmental factors involved in the project, permitting and development considerations, and an analysis of project cost.

### **Supply Development**

This strategy considers the use of both existing CLCND water right (after exhausting the usage of the Devers water right backed up by COH) and the potential use of the TRA's Livingston supplies to meet the demand in the Highlands service area. The available supply for this strategy includes the 30,000 acre-feet per year from CLCND water right and the additional contracted supplies of 50,000 acre-feet per year from TRA's Lake Livingston.

The identified supply of 50,000 acre-feet per year is allocated out of TRA's existing rights associated with Lake Livingston and the Wallisville Saltwater Barrier. This total supply of 403,200 acre-feet per year was determined to be firm and available for use by TRA in the 2016 Region H Regional Water Plan (RWP). The water right allowing access for the Livingston supply transfer to Highlands is COA 08-4248 and is stored water in Lake Livingston, permitted to be diverted anywhere downstream. It is assumed that the TRA supplies, when contracted, will be apportioned from TRA's Lake Livingston right and diverted at the CWA Main Canal along with SJRA's CLCND and Devers water rights. Only a minor amendment process will be required to utilize this water in the adjoining Trinity-San Jacinto coastal basin that the Highlands System serves.

A review of the demands identified in Task 1102 of this study for the Highlands service area indicated that SJRA's current supplies in the Trinity basin are sufficient to meet the anticipated future demand. It was noted in the supply availability analysis that the occasional lack of availability of the existing

Devers and CLCND water rights to meet the anticipated future demand coincided with hydrological dry conditions but this issue is addressed by the COH back up for Devers water rights during dry conditions. The assumption considered for the supply availability evaluation was that SJRA will use the contracted capacity of 50 MGD (approximately 56,000 acre-feet per year) in the CWA canal to transfer the supplies from the Devers water right diversion point (when it is backed up by the COH) to the Highlands service area. After using all of the Devers water right (backed up by the COH), the maximum shortage identified in the supply availability analysis was approximately 3,000 acre-feet per year. This amount was rounded up to 5,000 acre-feet per year for long-term strategy planning purposes. A shortage of 5,000 acre-feet per year over the entire planning horizon (2020-2070) is not a significant shortage and mostly arises from a lack of infrastructure capacity to transfer existing CLCND supplies from the Trinity basin.

There may be a future time when SJRA will be required to meet demands greater than the demands considered in this study. The demands in the Highlands service area could grow exponentially due to a new industrial customer locating to this area or due to exponential growth beyond what was projected in Task 1102. While it is uncertain who this potential customer and what the requested demand would be, the Strategy Options presented in this technical memorandum consider the possibility of meeting both the projected demand from Task 1102 and a future unknown demand. For the purposes of defining an upper bound on the potential demand increase, it is assumed that the maximum demand increase in the Highlands service area would be up to 50,000 acre-feet per year. SJRA can meet the demand increases ranging from 5,000 acre-feet per year (based on Task 1102) to 50,000 acre-feet per year by increasing the conveyance capacity to tap into the CLCND rights, exhaust the 30,000 acre-feet per year of CLCND water rights, and ultimately contract with TRA for an additional 20,000 acre-feet per year and also increase conveyance capacity commensurately. It should be noted that the 30,000 acre-feet per year of CLCND water rights does not reflect a firm supply and is also not backed up by any other water rights or contracts. To that end, there is some yield risk associated with SJRA's ability to access the CLCND supplies in the full amount for the 30,000 and 50,000 acre-feet per year options. There is no such yield risk associated with the 5,000 acre-feet per year option due to the anticipated firm yield of this right.

Two different strategy options were identified for transferring Trinity supplies to SJRA's East and South Canals in the Highlands service area. Since most of the high-demand customers are located on the downstream ends of SJRA's East and South Canals, conveyance of Trinity supplies to these canals was determined as the most feasible delivery approach in the Highlands service area.

Strategy Option 1 is based on contracting for additional capacity in the CWA canal to transfer supplies ranging from 5,000 to 50,000 acre-feet per year. Use of this water by SJRA requires various approaches to delivering the supply to meet demands within SJRA's Highlands service area. This additional capacity will provide SJRA access to their CLCND water rights so they can transfer the supplies to the Highlands service area to meet the long-term system shortages. Once the CLCND water rights are exhausted, SJRA can contract with TRA for additional supplies of 20,000 acre-feet per year from Lake Livingston. The cost incurred in this Strategy Option development is the purchase cost of additional capacity in the CWA canal to convey the CLCND water rights and purchase cost to contract for additional supply from TRA, if the shortages are greater than 30,000 acre-feet per year. *Table 1* includes a preliminary cost estimate for Strategy Option 1 for contracting additional conveyance capacity to deliver three different supply volumes, 5,000, 30,000, and 50,000 acre-feet per year.

The acquisition of additional capacity in the CWA Main Canal is subject to negotiations with COH and CWA. Strategy Option 2 is proposed as a way of approximating the maximum cost of conveyance for supplies greater than the current SJRA use within the CWA Main Canal. This strategy proposes a 21-mile long pipeline that parallels the current CWA Main Canal. The analysis of this hypothetical Strategy Option 2 can help SJRA determine the potential benefits when contracting for additional CWA Main Canal capacity. In this hypothetical option, it was assumed that the contracted supplies of 5,000, 30,000, and 50,000 acre-feet per year will be transferred from the Trinity basin to the Highlands service area by means of a hypothetical transmission system potentially owned and operated by SJRA. In any event, SJRA can use Strategy Option 1 as their first go-to option. However, the terms of such an agreement are uncertain at this time and this approximation serves as a means of evaluating the maximum anticipated project cost.

A hypothetical pipeline route was identified along the same easements as the CWA canal location. It was assumed that the transmission system will be owned and operated by SJRA. It was also assumed that the necessary upgrades will be made to the pump stations at SJRA's East and South Canal transfer location to accommodate the additional volumes of 5,000 30,000, and 50,000 acre-feet per year (these costs were not included in the cost estimate for the strategies discussed in this tech memo). In addition to the purchase cost of water from TRA, SJRA will have a significant investment in infrastructure for this option. *Table 2* includes a cost estimate for this hypothetical strategy option.

*Exhibit 1* includes the overall study area including the general confines of the transmission route considered for transferring supplies from TRA's Trinity diversion point to SJRA's East and South Canals in the Highlands service area. *Exhibit 1* also includes the CWA canal that is currently used to transfer the CLCND and Devers supplies to SJRA's South and East Canals. *Exhibit 2* includes the hydraulic grade lines for the pipeline route and the infrastructure details specific to the transmission route such as the length of the pipeline route and the pipe diameter required to transfer the supplies. The transmission route assumed for this analysis was considered viable at this stage of the feasibility evaluation. Therefore, the environmental considerations, the permitting requirements, and cost details for the alternatives are discussed in this technical memorandum. The strategy evaluation matrix was developed for the various options and capacities considered.

## **Environmental Considerations**

Following are some of the general environmental considerations associated with the transmission alignment identified for transferring supplies from Lake Livingston to Highlands service area in Option 2. A desktop-level survey was conducted to identify any environmental issues associated with the specific route. The details of the survey are summarized below.

1. Permitting coordination with the USACE, TPWD, and other natural resource agencies that may be required to construct the project may encounter obstacles pertaining to potential of the water supply pipeline to serve as a conduit for transferring the exotic invasive mollusk species *Dreissena polymorpha* (zebra mussel). The TPWD confirmed a population of zebra mussels residing within Lake Livingston during June 2016.
2. The USFWS IPaC webservice was consulted to obtain a list of federally-listed species and designated critical habitat segments that could occur within the general project area. The federally-protected species listed below, comprised of five bird species and four flowering plant species, were identified by the IPaC query as potentially occurring within the general

project area. Though some of these species have designated critical habitats, no critical habitat tracts/segments occur within the overall project area.

- I. Least tern (*Sterna antillarum*)
- II. Piping plover (*Charadrius melodus*)
- III. Red knot (*Calidris canutus rufa*)
- IV. Red-cockaded woodpecker (*Picoides borealis*)
- V. Whooping crane (*Grus americana*)
- VI. Navasota ladies' tresses (*Spiranthes parksii*)
- VII. Neches River rose-mallow (*Hibiscus dasycalyx*)
- VIII. Texas prairie dawn-flower (*Hymenoxys texana*)
- IX. Texas trailing phlox (*Phlox nivalis* spp. *texensis*)

Of these protected species, the following have potential to be affected by the proposed project, and would require a presence/absence survey of the selected/preferred pipeline alignment prior to construction should the project require permitting through the USACE for anticipated impacts to regulated waters of the U.S. (WOTUS).

- I. Red-cockaded woodpecker (*Picoides borealis*)
- II. Navasota ladies' tresses (*Spiranthes parksii*)
- III. Neches River rose-mallow (*Hibiscus dasycalyx*)
- IV. Texas prairie dawn-flower (*Hymenoxys texana*)
- V. Texas trailing phlox (*Phlox nivalis* spp. *texensis*)

3. Due the presence of streams, wetlands and ponds that could be deemed WOTUS and jurisdictional to Section 404 of the Clean Water Act (CWA) throughout the proposed alignment, acquiring a permit(s) through the USACE would be required prior to beginning construction activities. Pending the level of potential WOTUS impacts, project activities could likely be covered by a Nationwide Permit. The presence of zebra mussels within the Trinity River/Lake Livingston watershed could require that project activities obtain an Individual Permit. Nationwide Permits are typically obtained within 45 to 60 calendar days, but acquiring an Individual Permit typically requires a minimum of 180 days and a public comment period.
4. If no Federal funding or assistance would be used for construction of the proposed project, the need to complete the National Environmental Policy Act (NEPA) process would not be required. However, coordination with the USACE to obtain a CWA Section 404 permit, particularly an Individual Permit, could trigger the need to comply with the NEPA review process.
5. No potential archaeological/historical resources were impacted by this alignment.

All the environmental constraints must be addressed during the permitting and detailed feasibility study phases of the project development. At this stage, the environmental considerations are merely provided as a guide to understanding the potential issues associated with the alignment, and would require a thorough evaluation in the feasibility phase. Detailed environmental evaluation was not conducted for this hypothetical alignment.

## Permitting and Development

Although a water right permit exists for the development of the TRA supply, additional permitting will be required to divert TRA's Lake Livingston supplies at the CWA Main Canal pump station. The project will potentially reduce water within the Trinity River Basin below the pump station by as much as 50,000 acre-feet/year. This volume of water is already permitted for full consumptive use within the basin but this strategy considers the transmission of the supplies from the Trinity to the Trinity-San Jacinto River basin. This can be accomplished under the current permitting guidelines established in the Lake Livingston permit and may require a minor amendment or an inter-basin transfer. The project may result in as much as 50,000 acre-feet per year of additional flow in the receiving basins assuming 50 percent return flows through municipal effluent.

## Cost Analysis

Preliminary opinions of probable construction costs were developed based on planning-level details considered for the two options evaluated. Cost estimates were indexed to August 2017 dollars and the contract cost of water was included in these estimates to provide a more realistic comparison to other strategies. *Tables 1 and 2* below include a summary of the overall preliminary opinions of probable cost estimates. *Tables 3 through 8* include the detailed cost estimates for various supply volumes evaluated for each of the options. It should be noted that these cost estimates are preliminary planning level cost estimates and cannot be used for contracting or designing purposes. Detailed cost estimates must be developed during the feasibility or design phases of the study.

**Table 1. Summary of Preliminary Planning Level Cost Estimates for Transferring Trinity Supplies to Highlands using the Additional Capacity in the CWA Canal (Option 1)**

Strategy Option 1 Volumes (Acre-Feet per Year)	Capital Costs	Annual Costs (With Debt Service)	Annual Costs (Without Debt Service )	Unit Cost (\$/AF) (With Debt Service)	Unit Cost (\$/AF) (Without Debt Service)
5,000	-	\$24,000	\$24,000	\$5	\$5
30,000	-	\$142,000	\$142,000	\$5	\$5
50,000	-	\$2,136,000	\$2,136,000	\$43	\$43

**Table 2. Summary of Preliminary Planning Level Cost Estimates for Transferring Trinity Supplies to Highlands using a Hypothetical Potential Pipeline (Option 2)**

Strategy Option 2 Volumes (Acre-Feet per Year)	Capital Costs	Annual Costs (With Debt Service)	Annual Costs (Without Debt Service )	Unit Cost (\$/AF) (With Debt Service)	Unit Cost (\$/AF) (Without Debt Service)
5,000	\$28,797,000	\$2,745,000	\$335,000	\$549	\$67
30,000	\$83,994,000	\$8,218,000	\$1,189,000	\$274	\$40
50,000	\$109,681,000	\$13,013,000	\$3,835,000	\$260	\$77

**Table 3 – TRA’s Trinity Run-of-River Supplies Transfer to Highlands Service Area Cost Estimate for Option 1 Using Additional CWA Canal Capacity (5,000 acre-feet per year)**

OPINION OF PROBABLE CONSTRUCTION COST					September 18, 2017
ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>PROJECT CAPITAL COST SUMMARY</b>					
1	CONSTRUCTION COST	1	LS	\$0	\$0
2	ENGINEERING, FINANCIAL, AND LEGAL SERVICES AND CONTINGENCIES	1	LS	\$0	\$0
3	LAND AND EASEMENTS	1	LS	\$0	\$0
4	ENVIRONMENTAL - STUDIES AND MITIGATION	1	LS	\$0	\$0
5	INTEREST DURING CONSTRUCTION	1	LS	\$0	\$0
<b>PROJECT CAPITAL COST</b>					<b>\$0</b>

ITEM	DESCRIPTION	ANNUAL TOTAL					
ANNUAL COST SUMMARY		2020	2030	2040	2050	2060	2070
1	DEBT SERVICE	\$0	\$0	\$0	\$0	\$0	\$0
2	OPERATION AND MAINTENANCE (O&M)	\$0	\$0	\$0	\$0	\$0	\$0
3	PUMPING ENERGY COSTS	\$0	\$0	\$0	\$0	\$0	\$0
4	PURCHASE COST OF WATER	\$0	\$0	\$0	\$0	\$0	\$0
5	ADDITIONAL CWA CAPACITY	\$23,627	\$23,627	\$23,627	\$23,627	\$23,627	\$23,627
<b>TOTAL ANNUAL COST</b>		<b>\$23,627</b>	<b>\$23,627</b>	<b>\$23,627</b>	<b>\$23,627</b>	<b>\$23,627</b>	<b>\$23,627</b>

ITEM	DESCRIPTION	ANNUAL TOTAL					
ANNUAL COST SUMMARY		2020	2030	2040	2050	2060	2070
1	ANNUAL COST	\$23,627	\$23,627	\$23,627	\$23,627	\$23,627	\$23,627
2	YIELD	5,000	5,000	5,000	5,000	5,000	5,000
3	UNIT COST	\$5	\$5	\$5	\$5	\$5	\$5
<b>TOTAL UNIT COST</b>		<b>\$5</b>					

**Table 4 – TRA’s Trinity Run-of-River Supplies Transfer to Highlands Service Area Cost Estimate for Option 1 Using Additional CWA Canal Capacity (30,000 acre-feet per year)**

OPINION OF PROBABLE CONSTRUCTION COST						September 18, 2017	
ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL		
<b>PROJECT CAPITAL COST SUMMARY</b>							
1	CONSTRUCTION COST	1	LS	\$0	\$0		
2	ENGINEERING, FINANCIAL, AND LEGAL SERVICES AND CONTINGENCIES	1	LS	\$0	\$0		
3	LAND AND EASEMENTS	1	LS	\$0	\$0		
4	ENVIRONMENTAL - STUDIES AND MITIGATION	1	LS	\$0	\$0		
5	INTEREST DURING CONSTRUCTION	1	LS	\$0	\$0		
<b>PROJECT CAPITAL COST</b>					<b>\$0</b>		

ITEM	DESCRIPTION	ANNUAL TOTAL					
ANNUAL COST SUMMARY		2020	2030	2040	2050	2060	2070
1	DEBT SERVICE	\$0	\$0	\$0	\$0	\$0	\$0
2	OPERATION AND MAINTENANCE (O&M)	\$0	\$0	\$0	\$0	\$0	\$0
3	PUMPING ENERGY COSTS	\$0	\$0	\$0	\$0	\$0	\$0
4	PURCHASE COST OF WATER	\$0	\$0	\$0	\$0	\$0	\$0
5	ADDITIONAL CWA CAPACITY	\$141,763	\$141,763	\$141,763	\$141,763	\$141,763	\$141,763
<b>TOTAL ANNUAL COST</b>		<b>\$141,763</b>	<b>\$141,763</b>	<b>\$141,763</b>	<b>\$141,763</b>	<b>\$141,763</b>	<b>\$141,763</b>

ITEM	DESCRIPTION	ANNUAL TOTAL					
ANNUAL COST SUMMARY		2020	2030	2040	2050	2060	2070
1	ANNUAL COST	\$141,763	\$141,763	\$141,763	\$141,763	\$141,763	\$141,763
2	YIELD	30,000	30,000	30,000	30,000	30,000	30,000
3	UNIT COST	\$5	\$5	\$5	\$5	\$5	\$5
<b>TOTAL UNIT COST</b>		<b>\$5</b>					



**Table 5 – TRA’s Trinity Run-of-River Supplies Transfer to Highlands Service Area Cost Estimate for Option 1 Using Additional CWA Canal Capacity (50,000 acre-feet per year)**

OPINION OF PROBABLE CONSTRUCTION COST						September 18, 2017	
ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL		
<b>PROJECT CAPITAL COST SUMMARY</b>							
1	CONSTRUCTION COST	1	LS	\$0	\$0		
2	ENGINEERING, FINANCIAL, AND LEGAL SERVICES AND CONTINGENCIES	1	LS	\$0	\$0		
3	LAND AND EASEMENTS	1	LS	\$0	\$0		
4	ENVIRONMENTAL - STUDIES AND MITIGATION	1	LS	\$0	\$0		
5	INTEREST DURING CONSTRUCTION	1	LS	\$0	\$0		
<b>PROJECT CAPITAL COST</b>					<b>\$0</b>		

ITEM	DESCRIPTION	ANNUAL TOTAL					
ANNUAL COST SUMMARY		2020	2030	2040	2050	2060	2070
1	DEBT SERVICE	\$0	\$0	\$0	\$0	\$0	\$0
2	OPERATION AND MAINTENANCE (O&M)	\$0	\$0	\$0	\$0	\$0	\$0
3	PUMPING ENERGY COSTS	\$0	\$0	\$0	\$0	\$0	\$0
4	PURCHASE COST OF WATER	\$1,900,000	\$1,900,000	\$1,900,000	\$1,900,000	\$1,900,000	\$1,900,000
5	ADDITIONAL CWA CAPACITY	\$236,272	\$236,272	\$236,272	\$236,272	\$236,272	\$236,272
<b>TOTAL ANNUAL COST</b>		<b>\$2,136,272</b>	<b>\$2,136,272</b>	<b>\$2,136,272</b>	<b>\$2,136,272</b>	<b>\$2,136,272</b>	<b>\$2,136,272</b>

ITEM	DESCRIPTION	ANNUAL TOTAL					
ANNUAL COST SUMMARY		2020	2030	2040	2050	2060	2070
1	ANNUAL COST	\$2,136,272	\$2,136,272	\$2,136,272	\$2,136,272	\$2,136,272	\$2,136,272
2	YIELD	50,000	50,000	50,000	50,000	50,000	50,000
3	UNIT COST	\$43	\$43	\$43	\$43	\$43	\$43
<b>TOTAL UNIT COST</b>		<b>\$43</b>					

**Table 6 – TRA’s Trinity Run-of-River Supplies Transfer to Highlands Service Area Cost Estimate for Option 2 Using a Hypothetical Pipeline (5,000 acre-feet per year)**

OPINION OF PROBABLE CONSTRUCTION COST						October 31, 2017	
ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL		
<b>PROJECT CAPITAL COST SUMMARY</b>							
1	CONSTRUCTION COST	1	LS	\$18,058,809	\$18,058,809		
2	ENGINEERING, FINANCIAL, AND LEGAL SERVICES AND CONTINGENCIES	1	LS	\$5,597,910	\$5,597,910		
3	LAND AND EASEMENTS	1	LS	\$3,216,667	\$3,216,667		
4	ENVIRONMENTAL - STUDIES AND MITIGATION	1	LS	\$1,030,924	\$1,030,924		
5	INTEREST DURING CONSTRUCTION	1	LS	\$892,642	\$892,642		
<b>PROJECT CAPITAL COST</b>					<b>\$28,796,952</b>		
ITEM	DESCRIPTION	ANNUAL TOTAL					
ANNUAL COST SUMMARY		2020	2030	2040	2050	2060	2070
1	DEBT SERVICE	\$2,409,710	\$2,409,710	\$0	\$0	\$0	\$0
2	OPERATION AND MAINTENANCE (O&M)	\$234,668	\$234,668	\$234,668	\$234,668	\$234,668	\$234,668
3	PUMPING ENERGY COSTS	\$100,533	\$100,533	\$100,533	\$100,533	\$100,533	\$100,533
4	PURCHASE COST OF WATER	\$0	\$0	\$0	\$0	\$0	\$0
<b>TOTAL ANNUAL COST</b>		<b>\$2,744,911</b>	<b>\$2,744,911</b>	<b>\$335,201</b>	<b>\$335,201</b>	<b>\$335,201</b>	<b>\$335,201</b>
ANNUAL COST SUMMARY		2020	2030	2040	2050	2060	2070
1	ANNUAL COST	\$2,744,911	\$2,744,911	\$335,201	\$335,201	\$335,201	\$335,201
2	YIELD	5,000	5,000	5,000	5,000	5,000	5,000
3	UNIT COST	\$549	\$549	\$67	\$67	\$67	\$67
<b>TOTAL UNIT COST</b>		<b>\$228</b>					
ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL		
<b>CONSTRUCTION COST SUMMARY</b>							
1	PUMP STATIONS	1	LS	\$3,605,350	\$3,605,350		
2	PIPELINES	1	LS	\$14,297,709	\$14,297,709		
3	PIPELINE CROSSINGS	1	LS	\$155,751	\$155,751		
<b>PROJECT COST</b>					<b>\$18,058,809</b>		
<b>OPERATION AND MAINTENANCE (O&amp;M) COST SUMMARY</b>							
1	PUMP STATIONS	2.5	%	\$3,605,350	\$90,134		
2	PIPELINES	1.0	%	\$14,297,709	\$142,977		
3	PIPELINE CROSSINGS	1.0	%	\$155,751	\$1,558		
<b>ANNUAL OPERATION AND MAINTENANCE COST</b>					<b>\$234,668</b>		
<b>PUMP STATION CONSTRUCTION COSTS</b>							
1	412 HP Pump Station with Intake	1.0	LS	\$3,605,350	\$3,605,350		
<b>PUMP STATIONS TOTAL COST</b>					<b>\$3,605,350</b>		
<b>PIPELINE CONSTRUCTION COSTS</b>							
1	24" Diameter Pipeline (Rural Soil)	101,331.0	LF	\$125	\$12,625,883		
2	24" Diameter Pipeline (Urban Soil)	7,031.0	LF	\$238	\$1,671,826		
<b>PIPELINES TOTAL COST</b>					<b>\$14,297,709</b>		
<b>PIPELINE CROSSING CONSTRUCTION COST</b>							
1	24" Diameter Pipeline Crossing (Directional, Rock)	500.0	LF	\$312	\$155,751		
<b>PIPELINE CROSSINGS TOTAL COSTS</b>					<b>\$155,751</b>		

**Table 7 – TRA’s Trinity Run-of-River Supplies Transfer to Highlands Service Area Cost Estimate for Option 2 Using a Hypothetical Pipeline (30,000 acre-feet per year)**

OPINION OF PROBABLE CONSTRUCTION COST						October 31, 2017	
ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL		
<b>PROJECT CAPITAL COST SUMMARY</b>							
1	CONSTRUCTION COST	1	LS	\$58,894,797	\$58,894,797		
2	ENGINEERING, FINANCIAL, AND LEGAL SERVICES AND CONTINGENCIES	1	LS	\$18,175,309	\$18,175,309		
3	LAND AND EASEMENTS	1	LS	\$3,239,394	\$3,239,394		
4	ENVIRONMENTAL - STUDIES AND MITIGATION	1	LS	\$1,080,924	\$1,080,924		
5	INTEREST DURING CONSTRUCTION	1	LS	\$2,603,630	\$2,603,630		
<b>PROJECT CAPITAL COST</b>					<b>\$83,994,055</b>		
ITEM DESCRIPTION		ANNUAL TOTAL					
ANNUAL COST SUMMARY		2020	2030	2040	2050	2060	2070
1	DEBT SERVICE	\$7,028,566	\$7,028,566	\$0	\$0	\$0	\$0
2	OPERATION AND MAINTENANCE (O&M)	\$741,009	\$741,009	\$741,009	\$741,009	\$741,009	\$741,009
3	PUMPING ENERGY COSTS	\$447,987	\$447,987	\$447,987	\$447,987	\$447,987	\$447,987
4	PURCHASE COST OF WATER	\$0	\$0	\$0	\$0	\$0	\$0
<b>TOTAL ANNUAL COST</b>		<b>\$8,217,563</b>	<b>\$8,217,563</b>	<b>\$1,188,996</b>	<b>\$1,188,996</b>	<b>\$1,188,996</b>	<b>\$1,188,996</b>
ANNUAL COST SUMMARY		2020	2030	2040	2050	2060	2070
1	ANNUAL COST	\$8,217,563	\$8,217,563	\$1,188,996	\$1,188,996	\$1,188,996	\$1,188,996
2	YIELD	30,000	30,000	30,000	30,000	30,000	30,000
3	UNIT COST	\$274	\$274	\$40	\$40	\$40	\$40
<b>TOTAL UNIT COST</b>		<b>\$118</b>					
ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL		
<b>CONSTRUCTION COST SUMMARY</b>							
1	PUMP STATIONS	1	LS	\$10,137,400	\$10,137,400		
2	PIPELINES	1	LS	\$47,926,728	\$47,926,728		
3	PIPELINE CROSSINGS	1	LS	\$830,670	\$830,670		
<b>PROJECT COST</b>					<b>\$58,894,797</b>		
<b>OPERATION AND MAINTENANCE (O&amp;M) COST SUMMARY</b>							
1	PUMP STATIONS	2.5	%	\$10,137,400	\$253,435		
2	PIPELINES	1.0	%	\$47,926,728	\$479,267		
3	PIPELINE CROSSINGS	1.0	%	\$830,670	\$8,307		
<b>ANNUAL OPERATION AND MAINTENANCE COST</b>					<b>\$741,009</b>		
<b>PUMP STATION CONSTRUCTION COSTS</b>							
1	1642 HP Pump Station with Intake	1.0	LS	\$10,137,400	\$10,137,400		
<b>PUMP STATIONS TOTAL COST</b>					<b>\$10,137,400</b>		
<b>PIPELINE CONSTRUCTION COSTS</b>							
1	54" Diameter Pipeline (Rural Soil)	101,331.0	LF	\$415	\$42,086,291		
2	54" Diameter Pipeline (Urban Soil)	7,031.0	LF	\$831	\$5,840,437		
<b>PIPELINES TOTAL COST</b>					<b>\$47,926,728</b>		
<b>PIPELINE CROSSING CONSTRUCTION COST</b>							
1	54" Diameter Pipeline Crossing (Directional, Rock)	500.0	LF	\$1,661	\$830,670		
<b>PIPELINE CROSSINGS TOTAL COSTS</b>					<b>\$830,670</b>		

**Table 8 – TRA’s Trinity Run-of-River Supplies Transfer to Highlands Service Area Cost Estimate for Option 2 Using a Hypothetical Pipeline (50,000 acre-feet per year)**

OPINION OF PROBABLE CONSTRUCTION COST						October 31, 2017	
ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL		
<b>PROJECT CAPITAL COST SUMMARY</b>							
1	CONSTRUCTION COST	1	LS	\$77,765,797	\$77,765,797		
2	ENGINEERING, FINANCIAL, AND LEGAL SERVICES AND CONTINGENCIES	1	LS	\$24,170,692	\$24,170,692		
3	LAND AND EASEMENTS	1	LS	\$3,214,141	\$3,214,141		
4	ENVIRONMENTAL - STUDIES AND MITIGATION	1	LS	\$1,130,924	\$1,130,924		
5	INTEREST DURING CONSTRUCTION	1	LS	\$3,399,882	\$3,399,882		
<b>PROJECT CAPITAL COST</b>					<b>\$109,681,437</b>		
ITEM DESCRIPTION		ANNUAL TOTAL					
ANNUAL COST SUMMARY		2020	2030	2040	2050	2060	2070
1	DEBT SERVICE	\$9,178,069	\$9,178,069	\$0	\$0	\$0	\$0
2	OPERATION AND MAINTENANCE (O&M)	\$1,029,944	\$1,029,944	\$1,029,944	\$1,029,944	\$1,029,944	\$1,029,944
3	PUMPING ENERGY COSTS	\$904,793	\$904,793	\$904,793	\$904,793	\$904,793	\$904,793
4	PURCHASE COST OF WATER	\$1,900,000	\$1,900,000	\$1,900,000	\$1,900,000	\$1,900,000	\$1,900,000
<b>TOTAL ANNUAL COST</b>		<b>\$13,012,806</b>	<b>\$13,012,806</b>	<b>\$3,834,737</b>	<b>\$3,834,737</b>	<b>\$3,834,737</b>	<b>\$3,834,737</b>
ANNUAL COST SUMMARY		2020	2030	2040	2050	2060	2070
1	ANNUAL COST	\$13,012,806	\$13,012,806	\$3,834,737	\$3,834,737	\$3,834,737	\$3,834,737
2	YIELD	50,000	50,000	50,000	50,000	50,000	50,000
3	UNIT COST	\$260	\$260	\$77	\$77	\$77	\$77
<b>TOTAL UNIT COST</b>		<b>\$138</b>					
ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL		
<b>CONSTRUCTION COST SUMMARY</b>							
1	PUMP STATIONS	1	LS	\$16,819,050	\$16,819,050		
2	PIPELINES	1	LS	\$59,908,410	\$59,908,410		
3	PIPELINE CROSSINGS	1	LS	\$1,038,337	\$1,038,337		
<b>PROJECT COST</b>					<b>\$77,765,797</b>		
<b>OPERATION AND MAINTENANCE (O&amp;M) COST SUMMARY</b>							
1	PUMP STATIONS	2.5	%	\$16,819,050	\$420,476		
2	PIPELINES	1.0	%	\$59,908,410	\$599,084		
3	PIPELINE CROSSINGS	1.0	%	\$1,038,337	\$10,383		
<b>ANNUAL OPERATION AND MAINTENANCE COST</b>					<b>\$1,029,944</b>		
<b>PUMP STATION CONSTRUCTION COSTS</b>							
1	3590 HP Pump Station with Intake	1.0	LS	\$16,819,050	\$16,819,050		
<b>PUMP STATIONS TOTAL COST</b>					<b>\$16,819,050</b>		
<b>PIPELINE CONSTRUCTION COSTS</b>							
1	60" Diameter Pipeline (Rural Soil)	101,331.0	LF	\$519	\$52,607,863		
2	60" Diameter Pipeline (Urban Soil)	7,031.0	LF	\$1,038	\$7,300,547		
<b>PIPELINES TOTAL COST</b>					<b>\$59,908,410</b>		
<b>PIPELINE CROSSING CONSTRUCTION COST</b>							
1	60" Diameter Pipeline Crossing (Directional, Rock)	500.0	LF	\$2,077	\$1,038,337		
<b>PIPELINE CROSSINGS TOTAL COSTS</b>					<b>\$1,038,337</b>		

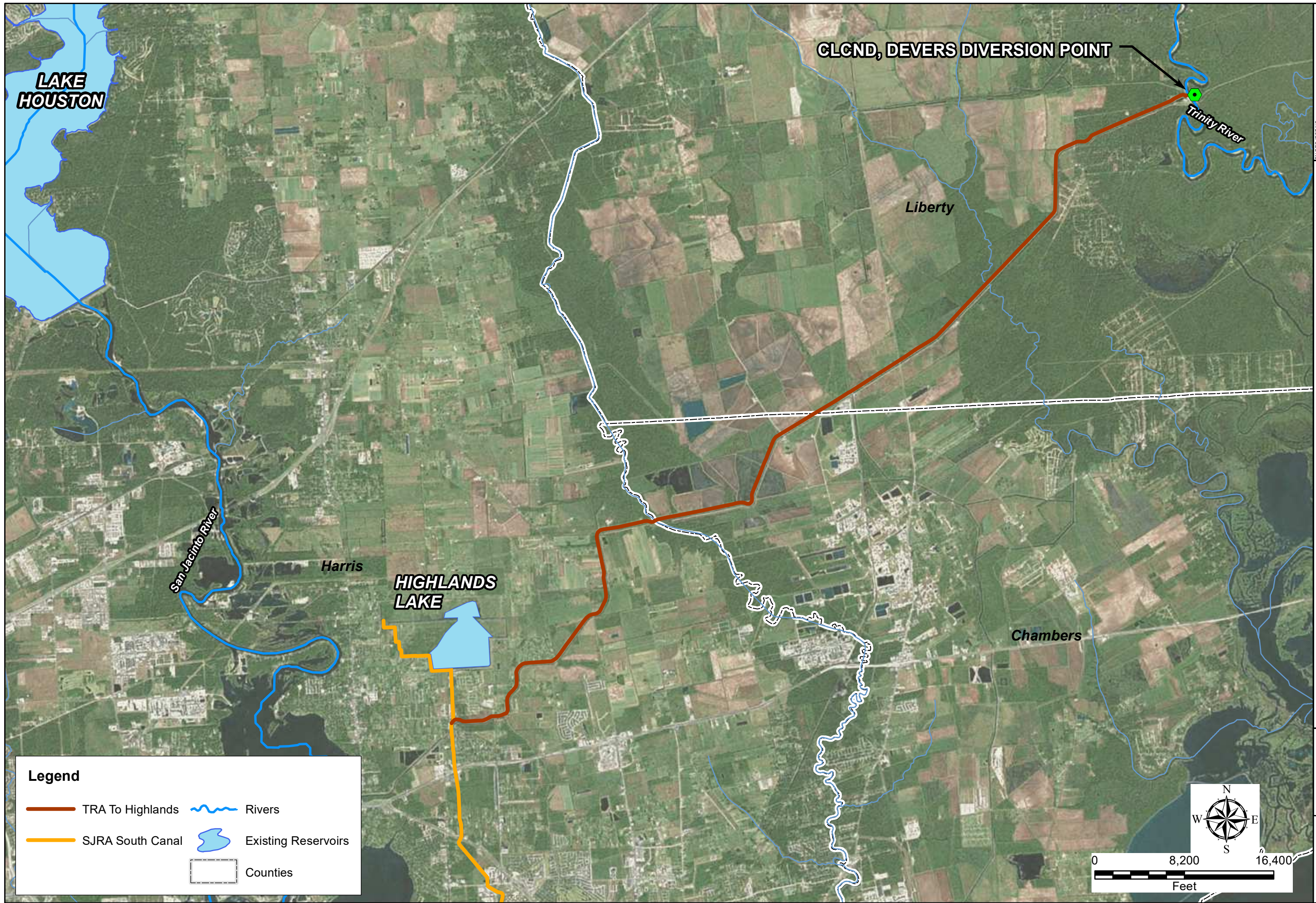
## WATER MANAGEMENT STRATEGY EVALUATION

Based on the analysis provided above, the Trinity supplies transfer to Highlands project was evaluated across eleven different criteria for the purpose of quick comparison against alternative projects that may be incorporated into the Regional Water Plan. The results of this evaluation can be seen in *Table 3* below.

**Table 3 - Screening Criteria and Scores for Trinity Supplies Transfer to Highlands Strategy**

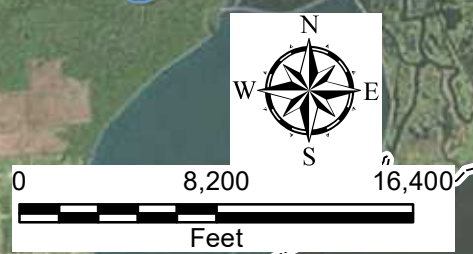
Criteria	Rating					
	Conveyance for 3,000 ac-ft/yr	Conveyance for 30,000 ac-ft/yr	Conveyance for 50,000 ac-ft/yr	New Transmission for 3,000 ac-ft/yr	New Transmission for 30,000 ac-ft/yr	New Transmission for 50,000 ac-ft/yr
	Option 1a	Option 1b	Option 1c	Option 2a	Option 2b	Option 2c
Cooperation	3	3	3	4	4	4
Cost	4	4	4	3	3	3
Diversification	3	3	3	3	3	3
Environmental	3	3	3	3	3	3
Funding	2	2	2	2	2	2
Land Acquisition	4	4	4	3	3	3
Legal	3	3	3	3	3	3
Location	1	3	3	1	3	3
Magnitude	3	3	3	3	3	3
Other Supplies	4	4	4	3	3	3
Public	4	4	4	3	3	3
Scalability	1	1	1	1	1	1
Schedule	4	4	4	3	3	3
Yield Risk	4	2	3	4	2	3
<b>Weighted Score*</b>	<b>340</b>	<b>340</b>	<b>346</b>	<b>286</b>	<b>286</b>	<b>292</b>

\*Based on weighting methodology adopted in Preliminary Strategy Identification and Evaluation (Task 1104)



**Legend**

- TRA To Highlands
- SJRA South Canal
- Rivers
- Existing Reservoirs
- Counties



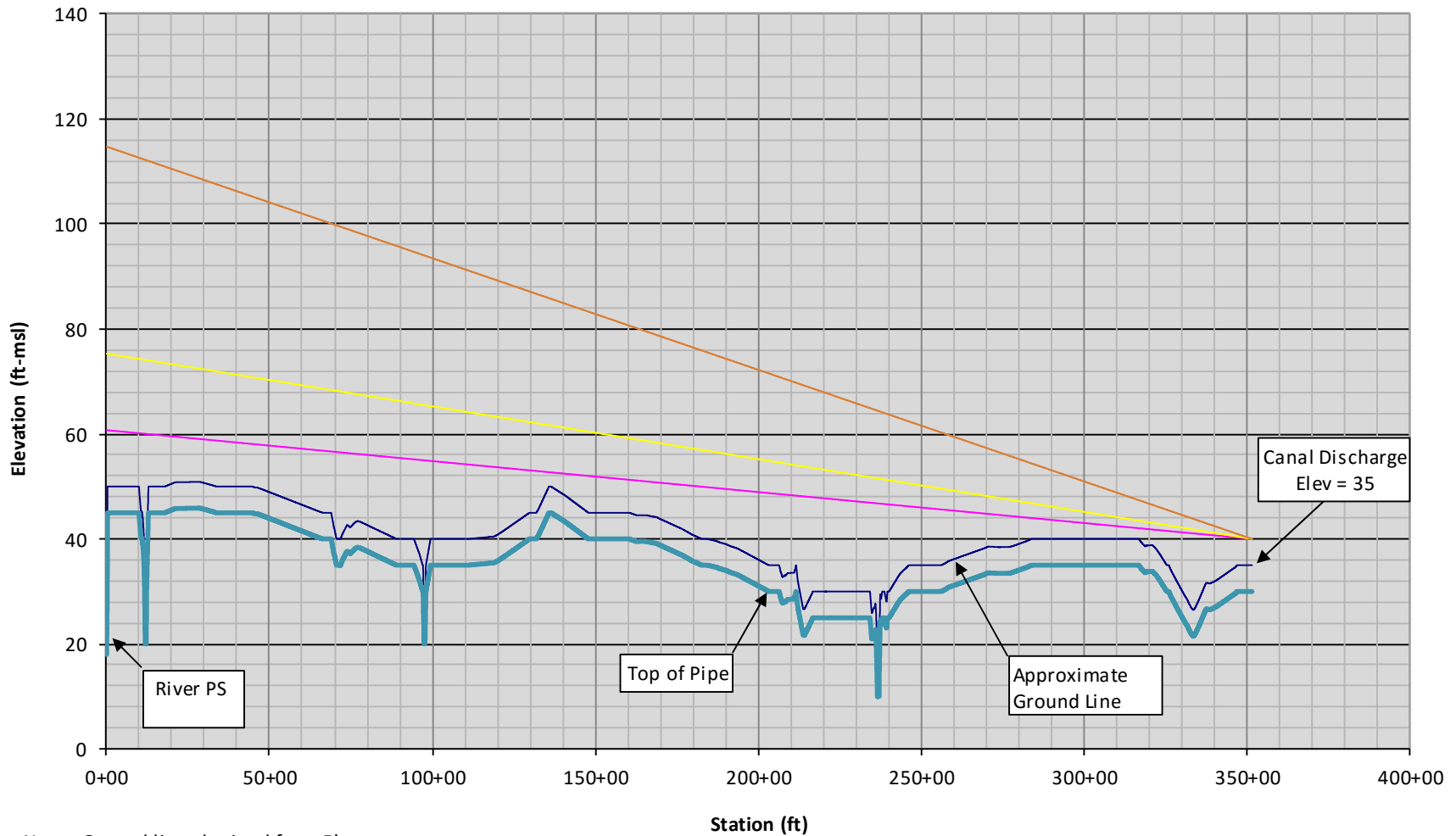
PROJECT NO.	SJRA161816
DATE CREATED	5/17/2017
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas South Central
FILE NAME	Exhibit_1_LakeLivingstonToHighlands
PREPARED BY	DML

SJRA RAW WATER SUPPLY MASTER PLAN  
 Highlands Service Area  
**TRA's Trinity Run-of-River Supplies  
 Transfer to Highlands Strategy**

**FREESE AND NICHOLS, INC.**  
 10497 TOWN AND COUNTRY WAY, SUITE 600  
 HOUSTON, TEXAS 77024  
 P: (713) 600-6800  
 F: (713) 600-6801

**30" Raw Water Pipeline  
 TRA Run-of-River Diversion Point Highlands Service Area  
 Transfer Option**

Q=6.6 MGD (1.5 PF), Dia=30in, C=120, H<sub>L</sub>=0.58 fpt,  
 Q=8.9 MGD (1.0 PF), Dia=30in, C=120, H<sub>L</sub>=1.00 fpt,  
 Q=13.4 MGD (0.75 PF), Dia=30in, C=120, H<sub>L</sub>=2.12 fpt



**Exhibit 2. TRA's Trinity Run-of-River Diversion Point to Highlands Service Area Transfer Strategy Hydraulic Grade Line**