REGION H PROJECT ANALYSIS TECHNICAL MEMORANDUM

Project Name:	Wastewater Reclamation for Industry
Project ID:	REUS-007
Project Type:	Reuse
Potential Supply Quantity (Rounded):	67,200 ac-ft/yr (60 mgd)
Implementation Decade:	2060
Development Timeline:	10 years
Project Capital Cost:	$441,724,121 (Sept. 2018)
Unit Water Cost (Rounded):	$990 per ac-ft (during loan period) $527 per ac-ft (after loan period)

Strategy Description

The City of Houston (COH) holds Water Right Permit 5827 that allows the diversion and reuse of up to 580,923 ac-ft/yr in the San Jacinto River Basin or in the Trinity, Trinity-San Jacinto, and San Jacinto-Brazos basins through interbasin transfer. This permit relates to more than 30 individual wastewater treatment plant (WWTP) discharges located on the Houston Ship Channel, Greens Bayou, Buffalo Bayou, Cole Creek, Berry Bayou, Keegans Bayou, Brickhouse Gully, White Oak Bayou, Evans Gully, and Lake Houston. In an effort to protect and maintain freshwater inflows to Galveston Bay, the permit limits diversions to 50% of the volume discharged on a daily basis from each wastewater treatment plant.

In addition to other alternatives for reclaimed water use, this permit may also be used for service to industrial customers. One concept for service to industry has existed in the Region H Regional Water Plan (RWP) since the first plan in 2001. This approach considers using reclaimed wastewater effluent to replace existing surface water supplies that serve industrial demands for process and boiler feed waters. Under this project, municipal wastewater currently discharged to Buffalo Bayou will receive further treatment and will be offered as a high-quality water supply to industries. Reclaimed wastewater will be superior in quality to the raw water currently supplied, thus allowing industrial consumers to significantly reduce or eliminate their onsite water treatment costs. This project is applied within the industrial corridor of State Highway 225 and the Houston Ship Channel (San Jacinto Basin).

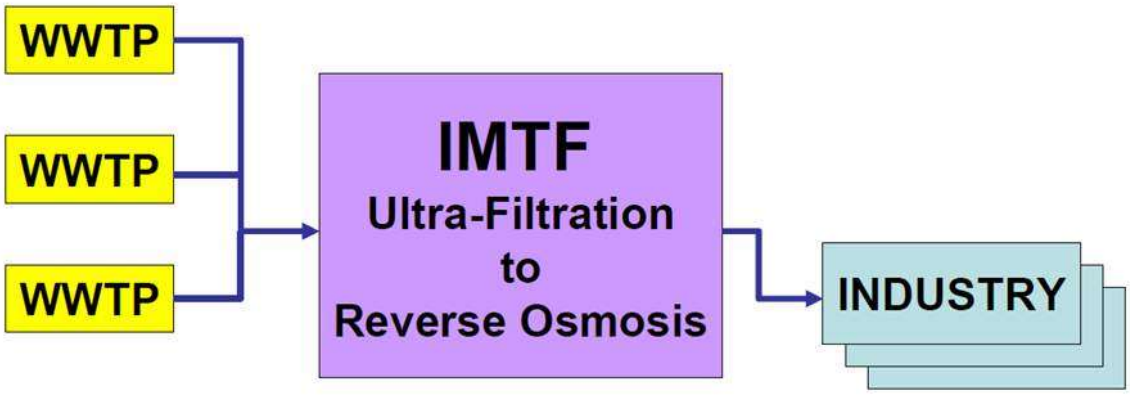
Strategy Analyses

The project analyses for Wastewater Reclamation for Industry include evaluations of the potential supply to be created, environmental factors involved in the project, permitting and development considerations, and an analysis of project cost.

Supply Development

Effluent from three of the City's wastewater treatment plants (Sims North, Sims South, and 69th Street) would be utilized. Secondary effluent would be pumped to an Integrated Membrane Treatment Facility (IMTF) as shown in *Figure 1*. After treatment, the reclaimed water would be piped to the industrial users along the south side of the Houston Ship Channel corridor.

Figure 1 – Proposed Reuse Project



Environmental Considerations

Effluent currently being discharged to Buffalo Bayou, Sims Bayou, and the Houston Ship Channel would be diverted to the new IMTF. A discharge of brine concentrate from the IMTF into the Houston Ship Channel could affect water quality, although the proposed discharge would be into the dredged channel below the saline elevation. Reclaiming effluent will reduce the impacts of the current WWTP discharges. Less effluent will be discharged into the receiving stream. However, these issues were addressed during the permitting of WR 5827. Minimal impact to the terrestrial habitats and terrestrial organisms adjacent to these bayous is expected as a result of the reduction of wastewater treatment plant discharges.

Current levels of wastewater discharge by industries into the Houston Ship Channel would remain unchanged. There are no water rights on the Houston Ship Channel that would be negatively impacted by this project. This project will treat 83 mgd of effluent to produce 60 mgd of delivered high-quality water (the other 23 mgd being brine discharge). This will offset an existing raw water demand which is currently met from other City of Houston surface water sources in the Trinity and San Jacinto basins.

Permitting and Development

Water rights permitting for this project has already been accomplished under Water Right Permit 5827. The terms of this permit specify the diversion rates and other terms for utilization of this supply. It should be noted that, since the identified supply would be taken directly from the plants without entry into waters of the state, the instream flow targets for diversion are not applicable. However, the 50 percent provision for bay and estuary inflows would be applied and would serve to protect baseflows from wastewater plants contributing to Galveston Bay.

Cost Analysis

Estimated costs for the project are shown in *Table 1*. Capital costs were scaled to a September 2018 equivalent cost using the Construction Cost Index and Producer Price Index in accordance with TWDB guidance. The costs presented in this memorandum do not include the purchase cost of water.

Table 1 – Wastewater Reclamation for Industry Project Cost

OPINION OF PROBABLE CONSTRUCTION COST					September 2018
ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
PROJECT CAPITAL COST SUMMARY					
1	CONSTRUCTION COST	1	LS	$273,460,000	$273,460,000
2	ENGINEERING, FINANCIAL, AND LEGAL SERVICES AND CONTINGENCIES	1	LS	$93,215,000	$93,215,000
3	LAND AND EASEMENTS	1	LS	$9,691,000	$9,691,000
4	ENVIRONMENTAL - STUDIES AND MITIGATION	1	LS	$8,810,000	$8,810,000
5	INTEREST DURING CONSTRUCTION	1	LS	$56,548,121	$56,548,121
	PROJECT CAPITAL COST				**$441,724,121**

ITEM	DESCRIPTION	ANNUAL TOTAL					
ANNUAL COST SUMMARY		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
1	DEBT SERVICE	$0	$0	$0	$0	$31,080,185	$31,080,185
2	OPERATION AND MAINTENANCE (O&M)	$0	$0	$0	$0	$33,753,700	$33,753,700
3	PUMPING ENERGY COSTS	$0	$0	$0	$0	$1,671,887	$1,671,887
4	PURCHASE COST OF WATER	$0	$0	$0	$0	$0	$0
	TOTAL ANNUAL COST	**$0**	**$0**	**$0**	**$0**	**$66,505,772**	**$66,505,772**

ITEM	DESCRIPTION	ANNUAL TOTAL					
ANNUAL COST SUMMARY		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
1	ANNUAL COST	$0	$0	$0	$0	$66,505,772	$66,505,772
2	YIELD	-	-	-	-	67,200	67,200
3	UNIT COST	$0	$0	$0	$0	$990	$990
	TOTAL UNIT COST						**$990**

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
CONSTRUCTION COST SUMMARY					
1	PUMP STATIONS	1	LS	$24,980,000	$24,980,000
2	PIPELINES	1	LS	$32,370,000	$32,370,000
3	PIPELINE CROSSINGS	1	LS	$17,550,000	$17,550,000
4	WASTEWATER RECLAMATION PLANTS	1	LS	$198,560,000	$198,560,000
	PROJECT COST				**$273,460,000**

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
OPERATION AND MAINTENANCE (O&M) COST SUMMARY					
1	PUMP STATIONS	2.5	%	$24,980,000	$624,500
2	PIPELINES	1.0	%	$32,370,000	$323,700
3	PIPELINE CROSSINGS	1.0	%	$17,550,000	$175,500
4	WASTEWATER RECLAMATION PLANTS	1.0	LS	$32,630,000	$32,630,000
	ANNUAL OPERATION AND MAINTENANCE COST				**$33,753,700**

This project has a unique cost dynamic. The industries will participate in this project only if it can be proven that their specific total water cost can be reduced. Reclamation saves an equivalent quantity of existing City of Houston Trinity River water supplies. The exact cost benefit of this project can only

be determined through negotiation of firm supply contracts with the industry customers.

Substitution of reclaimed wastewater would potentially increase the industries' cost of water. However, the reclaimed water could save the industries money since reclaimed water will require less treatment (and in many cases no additional treatment) after it is delivered to the industrial consumers. The use of reclaimed municipal wastewater may be an economical alternative to current supplies.

Water Management Strategy Evaluation

Based on the analysis provided above, the Wastewater Reclamation for Industry project was evaluated across eleven different criteria for the purpose of quick comparison against alternative strategies that may be incorporated into the Regional Water Plan. The results of this evaluation can be seen in the table below.

CRITERIA	RATING	EXPLANATION
Cost	2	High costs related to treatment of water prior to delivery. However, this may be offset through water rate for providing higher quality water to industry.
Location	4	Conveyance required for project implementation.
Water Quality	4	Proposed project would provide a higher quality water to industrial customers.
Environmental Land and Habitat	4	Majority of projects are to be constructed in already-developed areas or existing rights-of-way.
Environmental Flows	2	Project will reduce the level of flows returned to streams to a level planned for during permitting process.
Local Preference	3	Mixed support between COH and industrial stakeholders.
Institutional Constraints	3	Property acquisition required for project development.
Development Timeline	4	Project will require lead time to get stakeholders on board, develop final project concept, and design and construct the project.
Sponsorship	3	COH requires support from industrial stakeholders in order to push the project forward.
Vulnerability	4	Potential impacts related to damage to critical infrastructure.
Impacts on Other WMS	2	This project competes with water that may be utilized by the COH Reuse project.

The Wastewater Reclamation for Industry concept includes up to 22 miles of pipelines for collection of effluent and distribution to industries. The majority of this development will be in urbanized areas with limited impacts to habitat such as existing industrial facilities. The project may potentially reduce return flows to the Houston Ship Channel by as much as 67,200 ac-ft/yr. However, this reduction in return flows may also correlate to a reduction in diversions of surface water from other basins. These diversions are already permitted for consumptive use under the City of Houston's Water Right 5827 which accounts for environmental flows. Wastewater Reclamation for Industry is not anticipated to impact agricultural land or production.

Water User Group Application

The Wastewater Reclamation for Industry project was evaluated on a basis of several criteria to determine the Water User Groups (WUGs) to which it may be applied. Consideration was given to the proximity of the project to identified needs, the volume of the supply made available, the quality of the water provided, and the unit cost of the strategy as well as other factors that may relate to the suitability of the strategy to the WUGs served.

CRITERIA	WUG SUITABILITY
Proximity	Project is intended to serve customers along the Houston Ship Channel.
Size	The capacity of this project is intended to serve a portion of water demands by industry and may allow for reapplication of their current raw water supplies to other users.
Water Quality	This project provides treated but non-potable water for industrial use. This represents an improvement over the raw water currently sold to the target industries and may reduce their treatment burden.
Unit Cost	This high unit cost may be offset by reduced needs for treatment. However, the cost makes this water suitable only for industrial purposes.
Other Factors	The reliability of this supply is potentially higher than the current raw water supplies that may be curtailed by drought conditions, making it more attractive to industry.

Location Map