TECHNICAL MEMORANDUM

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FROM: Jason D. Afinowicz, P.E.

SUBJECT: Demand Scenario Evaluation (Task 1102)

DATE: July 15, 2016

PROJECT: Raw Water Supply Master Plan 16-015-1 (SJR15616)

STATE OF TEXAS
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F-2144

The San Jacinto River Authority (SJRA) engaged Freese and Nichols, Inc. (FNI) to develop a raw water supply master plan (RWSMP) for their Highlands Division and Lake Conroe Division which, in turn, would serve the Groundwater Reduction Plan (GRP) and The Woodlands Divisions. This RWSMP consists of four components:

- Evaluation of Demand Scenarios
- Evaluation of Supply Scenarios and Needs
- Preliminary Strategy Identification and Evaluation
- Strategy Evaluation and Selection

This memorandum summarizes the results of the evaluation of potential future water demands in order to determine need for future water supplies. This analysis is divided between the Highlands service area and Montgomery County below. This document summarizes the projection of the following demands within SJRA's service area:

- Industrial – Defined as the demands of wholesale industrial customers served by SJRA. In the Highlands service area, these demands are served from the system's raw water canals. In Montgomery County, these demands are served by lakeside diversions. These demands do not include industrial water use served through SJRA's municipal customers.
- Municipal – In the Highlands service area, these demands are defined as the demands of wholesale municipal customers who divert raw water from SJRA's canal system. In Montgomery County, demands are developed for the entirety of the county, of which SJRA serves a portion of the total demand through groundwater developed by The Woodlands Division, through surface water treatment and conveyance provided by the GRP Division, and, potentially, through other means that may be developed for provide water to meet the needs of the GRP Division's current contract and future Safe Harbor GRP customers. These demands may also include industrial and irrigation water supplies that are sold by municipalities and water utilities.
- Irrigation - Defined as the demands of wholesale irrigation customers served by SJRA. In the Highlands service area, these demands are served from the system's raw water canals. In Montgomery County,

these demands are served by lakeside diversions. These demands do not include irrigation water use served through SJRA's municipal customers.

Highlands Service Area

SJRA's Highlands service area provides raw water to industrial, irrigation, and municipal customers in eastern Harris County through a system of canals and Highlands Reservoir. Supplies originate from diversions made at Lake Houston or from the Trinity River by way of the Coastal Water Authority (CWA) Main Canal. Water diverted from the Trinity River is again diverted by SJRA at the intersection with SJRA's East and South Canals through pump stations. This configuration is shown in the attached *Exhibit 1*.

Principal customers for the Highlands Division industrial customers in Harris County. The remaining demands are made up of irrigators along the length of the canal systems and municipalities that divert water from the Highlands Main Canal between Lake Houston and Highlands Reservoir.

Raw Data Sources

SJRA provided the principal data for the demand scenario evaluation. Additional information was also utilized from the 2016 Region H Regional Water Plan (RWP), particularly relating to the long-term growth of industrial demands in eastern Harris County. The list below provides a comprehensive summary of information used in this analysis:

- Current peak day contracts for Highlands customers provided by SJRA dated July 2, 2015;
- Additional request for supply for Highlands customers totaling 17 MGD of peak day capacity provided by SJRA;
- Monthly water use by Highlands customers for the years 2008 through 2014 provided by SJRA; and
- Manufacturing water demand projections for Harris County, Trinity-San Jacinto Coastal Basin from the 2016 Region H RWP.

Demand Pattern Analysis

Demand patterns provide a substantial amount of information for both water demand and supply analysis and relate the peak demands experienced in a system to average annual water demands. An evaluation of demand patterns for Highlands water customers was conducted previously under a separate project titled *Water Availability for Highlands Industrial Customers* (14-122-6 [SJR14415]). This study examined the current demand patterns found in the Texas Commission on Environmental Quality (TCEQ) Water Availability Models (WAMs), which rely on the patterns to assign demands on a monthly basis in setting water diversion targets. As this study was focused on the diversion of water from SJRA's rights to meet mixed use demands in the Highlands System, an aggregate pattern based on combined water usage was developed for model purposes. However, individual demand curves were also generated at the same time for industrial, irrigation, and municipal patterns. These patterns are demonstrated below in *Figure 1*. Due to the overwhelming dominance of industrial demand, the demand-weighted average of all Highlands water usage is nearly identical to the industrial demand curve shown.

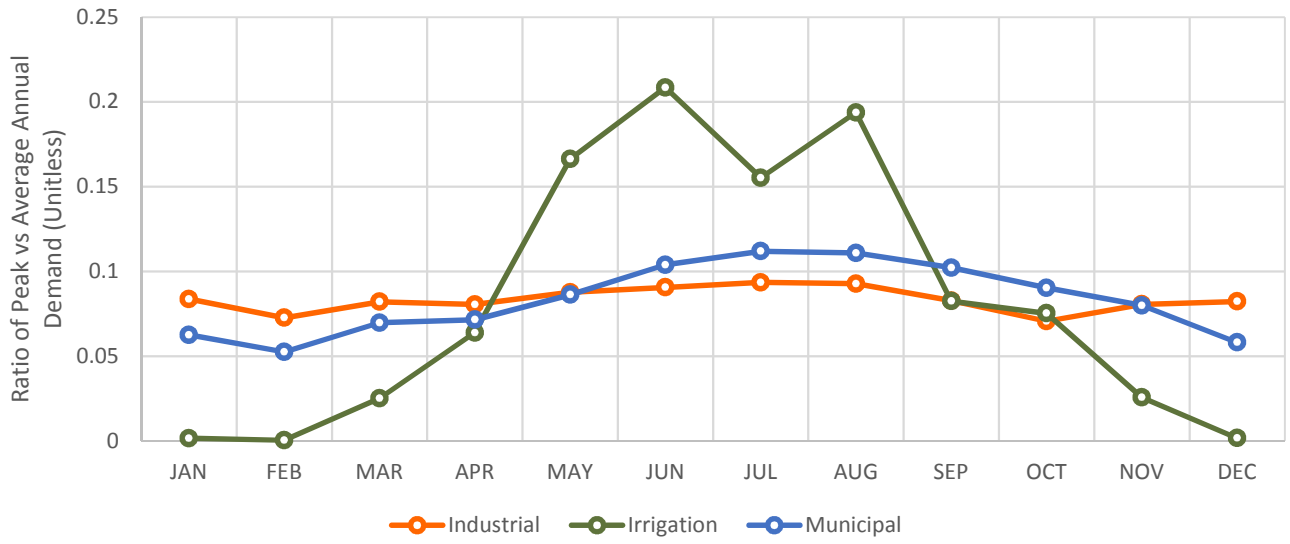


Figure 1 – Observed Highlands Demand Patterns

For the purpose of demand analysis, these patterns were used to establish a relationship between peak and average demands which is essential for translating Highlands contracts to water supply availability. Throughout this analysis, demands will be shown in units of Million Gallons per Day (MGD) when representing peak capacity and acre-feet per year (ac-ft/yr) when related to average annual demands.

Projections by Sector

Initial peak contract values were provided by SJRA for all demand sectors. These were translated to average demands based on the demand patterns described above.

Industrial Demand Projections

Current industrial demands were provided by SJRA as a peak capacity from the canal system and totaled approximately 83.7 MGD. Four alternatives were proposed for future demands:

1. Current Contracts – Contracts as presented by SJRA.
2. Expanded Contracts – SJRA contracts, plus additional requests for service as presented by SJRA.
3. Current Contracts + Region H Growth – Alternative 1 adjusted by contract holder for growth based on the Harris County Trinity-San Jacinto basin manufacturing growth projection in the 2016 Region H RWP.
4. Expanded Contracts + Region H Growth – Alternative 2 adjusted by contract holder for growth based on the Harris County Trinity-San Jacinto basin manufacturing growth projection in the 2016 Region H RWP.

Projections of average and peak industrial demand for the Highlands System are shown below in *Figure 2* and *Figure 3*, respectively.

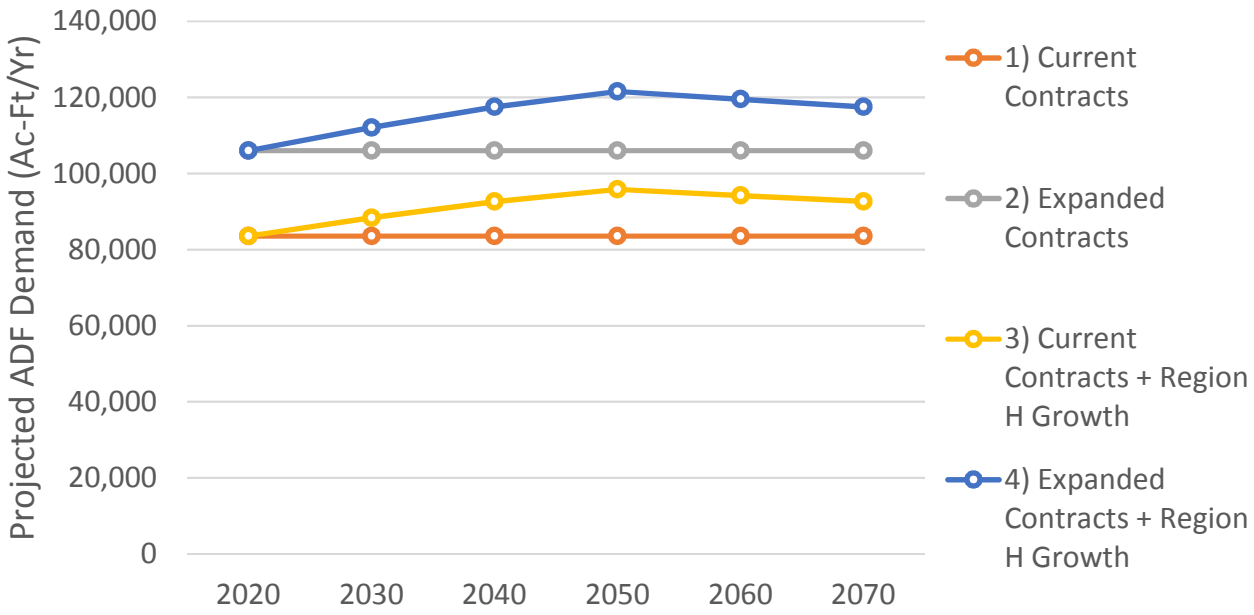


Figure 2 – Average Industrial Demand Projections for Highlands System

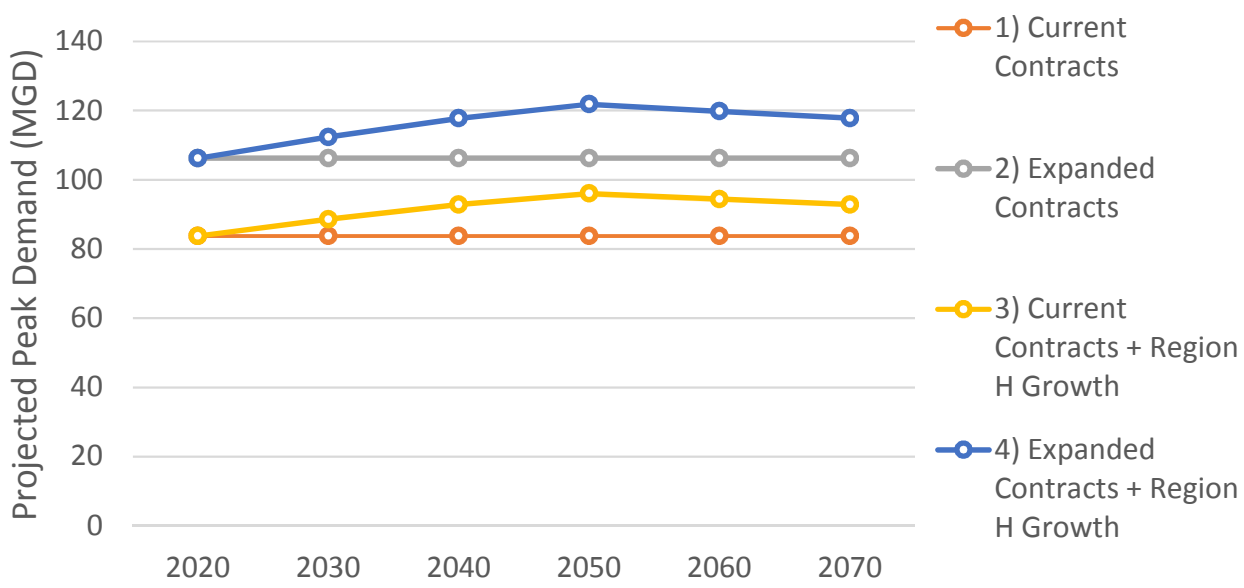


Figure 3 – Peak Industrial Demand Projections for Highlands System

Irrigation Demand Projections

Current irrigation demands were provided by SJRA as a peak capacity from the canal system and totaled approximately 4.6 MGD. Only one current-contracts alternative was considered for irrigation demands. The projection of average and peak irrigation demand for the Highlands System is shown below in *Figure 4* and *Figure 5*, respectively.

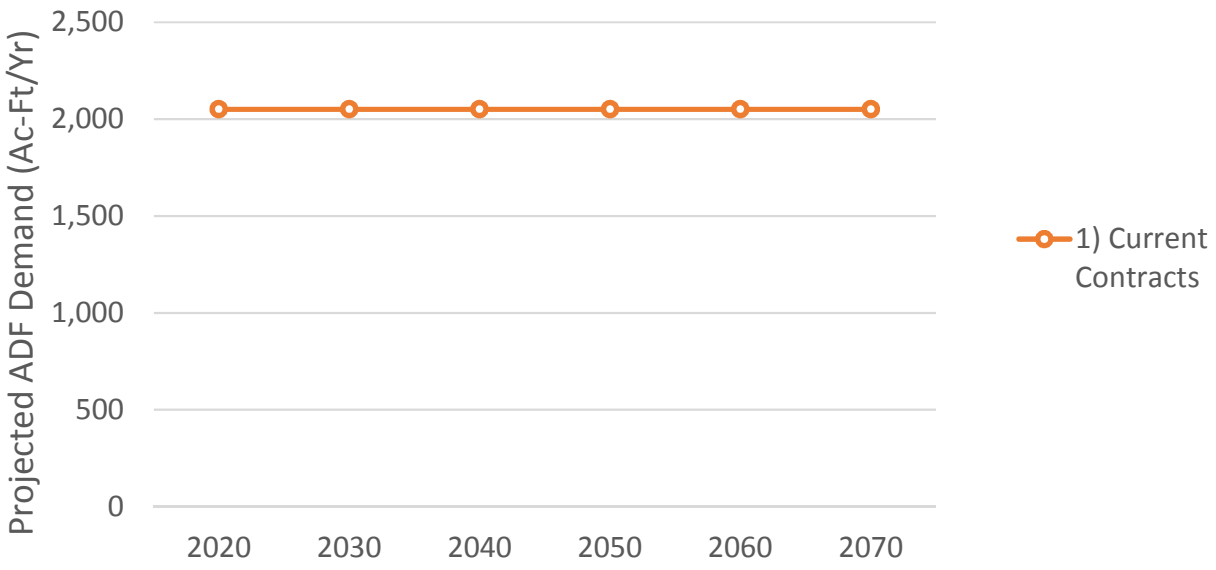


Figure 4 – Average Irrigation Demand Projection for the Highlands System

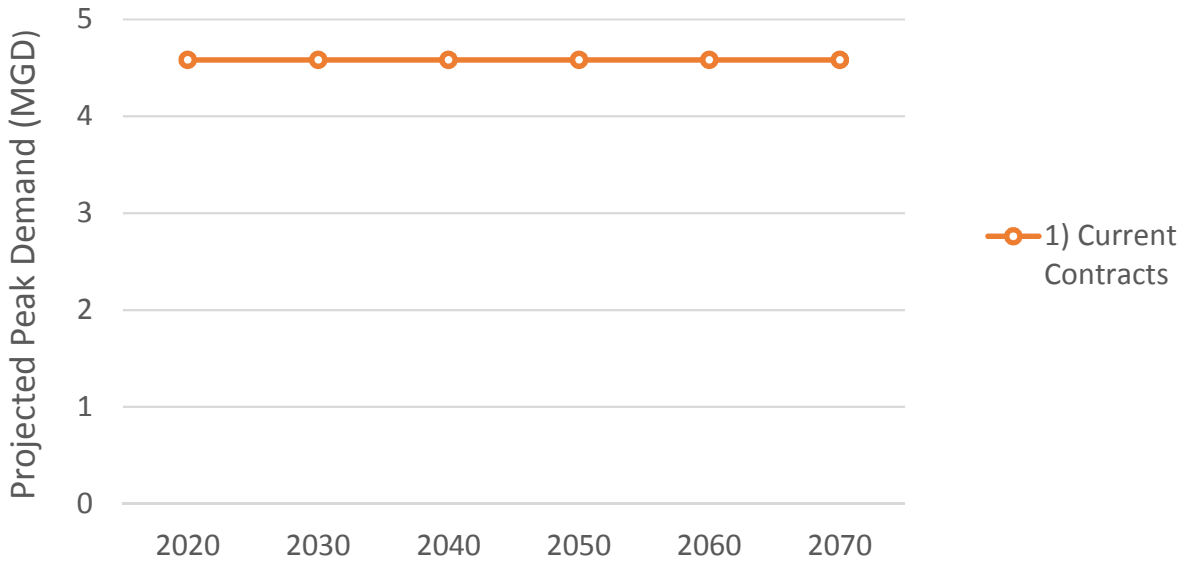


Figure 5 – Peak Irrigation Demand Projection for the Highlands System

Municipal Demand Projections

Current municipal demands were provided by SJRA as a peak capacity from the canal system and totaled approximately 2.3 MGD. Two alternatives were proposed for future demands:

1. Current Contracts – Contracts as presented by SJRA.
2. Current Contracts + Region H Growth – Alternative 1 adjusted by contract holder for growth based on the Water User Group municipal growth projections for Crosby MUD, Harris County MUD 50, and Newport MUD in the 2016 Region H RWP.

Projections of average and peak municipal demand for the Highlands System is shown below in *Figure 6* and *Figure 7*, respectively. In addition to these demands, the potential also exists for SJRA to serve the continued development of additional utilities east of the San Jacinto River in Harris County. Although this scenario is not well defined at this point in time, the opportunity exists for further supply for municipal use in this area beyond that shown by the projections considered in this study.

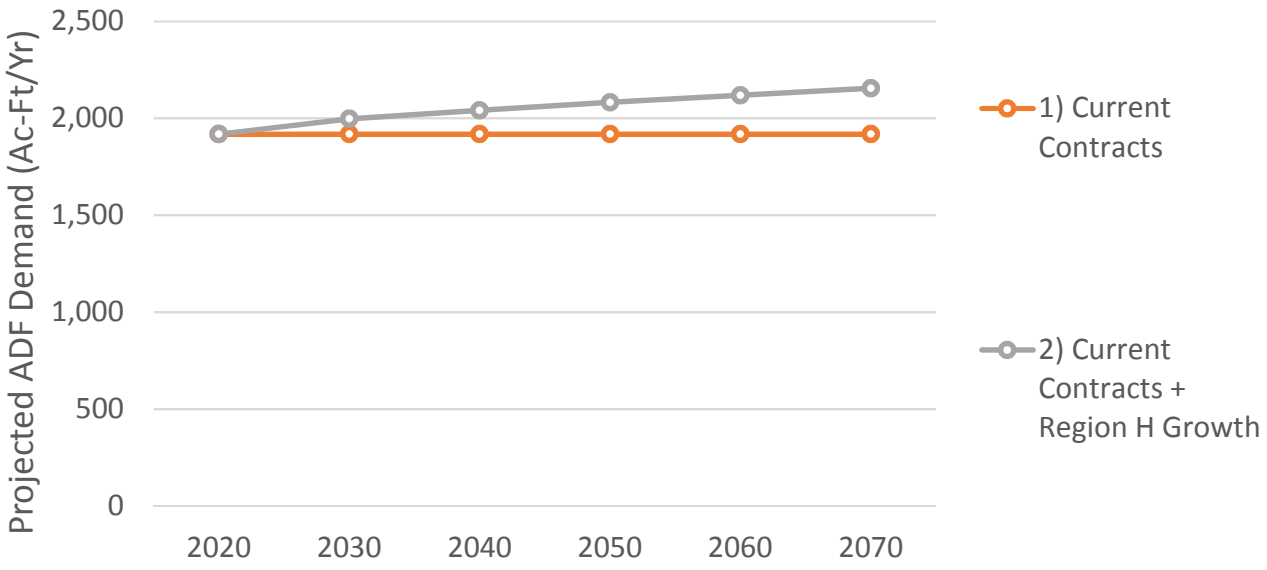


Figure 6 – Average Municipal Demand Projection for Highlands System

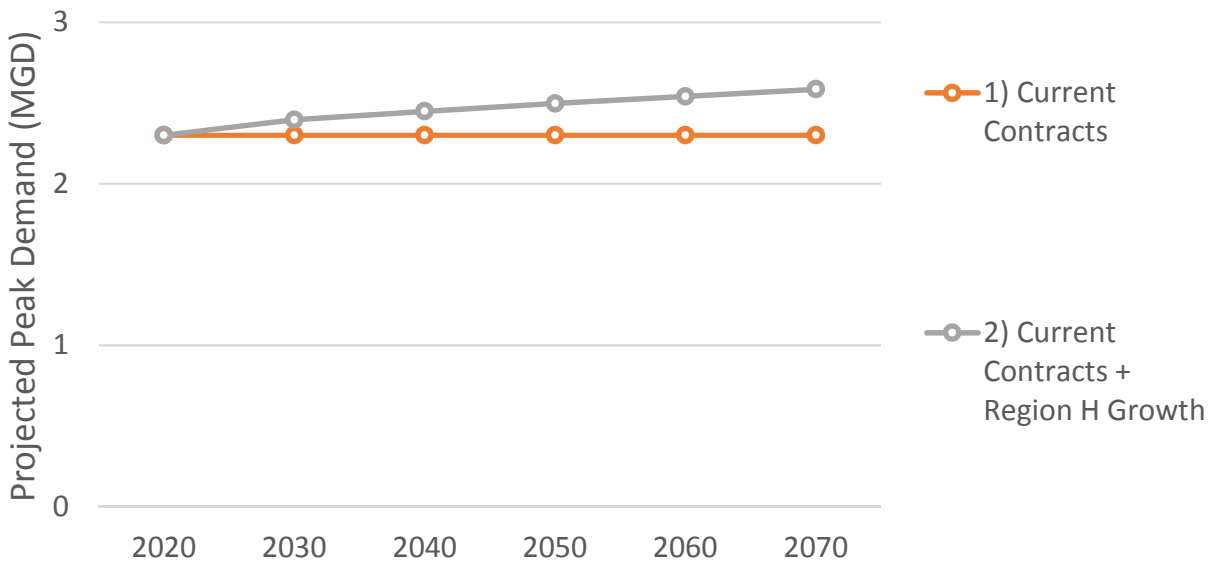


Figure 7 – Peak Municipal Demand Projection for Highlands System

Recommended Demand Scenarios

The projections described above were presented to SJRA at a workshop on February 26, 2016. Based on discussions during and following the workshop, two scenarios were recommended for further consideration of future demand and needs analysis. These scenarios are described below in *Table 1*.

Table 1 – Recommended Demand Scenarios for Further Study

System	Scenario	Industrial Projection	Irrigation Projection	Municipal Projection
Highlands	1	(2) Expanded Contracts	(1) Current Contracts	(1) Current Contracts
Highlands	2	(4) Expanded Contracts + Region H Growth	(1) Current Contracts	(2) Current Contracts + Region H Growth

The resulting projections are detailed below in *Figure 8* and *Figure 9*. The projected increase in demand ranges from approximately eight percent to almost 24 percent above current peak contract levels.

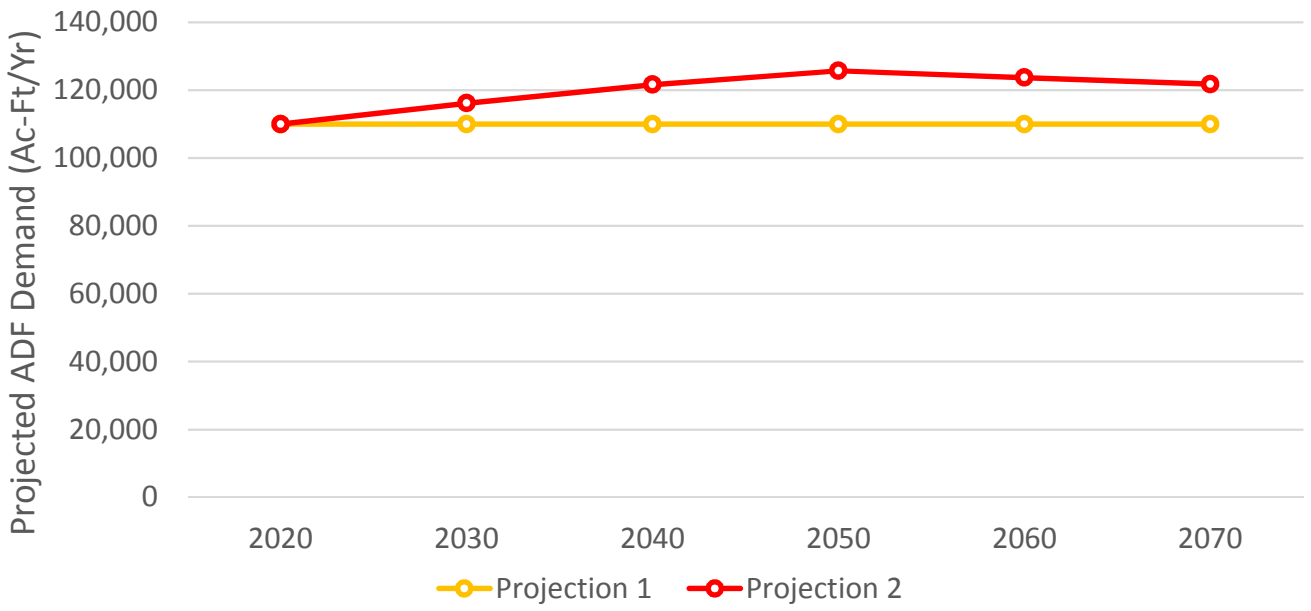


Figure 8 – Recommended Average Demand Projection Scenarios for Highlands System

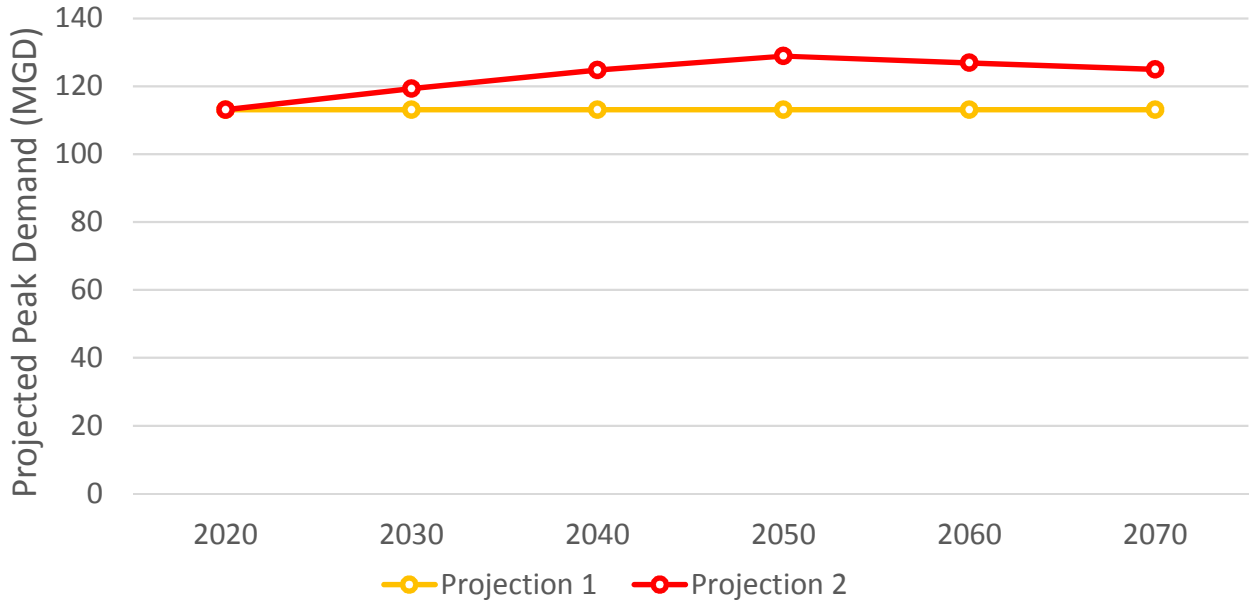


Figure 9 – Recommended Peak Demand Projection Scenarios for Highlands System

Montgomery County

SJRA's Montgomery County service area provides a combination of raw and treated water to industrial, irrigation, and municipal customers throughout the county. Raw water supplies are currently diverted from Lake Conroe

while treated water is sourced from Lake Conroe and provided to GRP customers through pipeline infrastructure.

Principal customers for the Lake Conroe Division are Entergy, the SJRA GRP Division and, subsequently, the SJRA Woodlands Division. The remaining demands are made up of irrigators diverting from the perimeter of Lake Conroe. This configuration is shown in the attached *Exhibit 1*.

Raw Data Sources

A wide range of sources was used for the Montgomery County demand scenario evaluation. This breadth of data was required because of the characteristics of Montgomery County demands as diverse municipal demand centers. The list below provides a comprehensive summary of information used in this analysis:

- Current peak day contracts for Lake Conroe industrial and irrigation customers provided by SJRA dated July 2, 2015;
- Additional request for supply for Lake Conroe industrial customers totaling 7 MGD of peak day capacity provided by SJRA;
- Surface water supply approach and Total Qualifying Demand (TQD) from SJRA GRP dated March 2011;
- Population projections and per-capita demand estimates from the Regional Groundwater Update Project (RGUP);
- Per-capita demands and baseline conservation figures from the 2016 Region H RWP;
- Manufacturing water demand projections for Montgomery County from the 2016 Region H RWP.
- Manufacturing water use data from Texas Water Development Board (TWDB) for the period from 2004 through 2008;
- Conservation projections from the SJRA Water Conservation Plan (WCP);
- Estimates of exempt groundwater use for Montgomery County provided by TWDB;
- SJRA Geographic Information System (GIS) coverage of GRP participants;
- TCEQ GIS coverage of Public Water Supply (PWS) boundaries; and
- U.S. Census GIS coverage of 2010 Census units.

Demand Pattern Analysis

In Montgomery County, demands are less dominated by any particular type of use than in the aforementioned Highlands System. Information developed under a separate study titled *Update of SJRA Water Conservation and Drought Contingency Plans* (13-0651, 13-0652, 13-0653, 13-0654 [SJR13285]) proposed curves for irrigation and municipal use. Irrigation use patterns were based on 2011 diversions provided by SJRA while municipal patterns were held at a constant level reflecting the role of the SJRA surface water treatment plant in providing baseline flow to customers without peaking. Municipal use patterns reflected water use patterns from The Woodlands for the period from 2000 through 2012. Industrial demand patterns were investigated in a separate study related to the analysis of alternatives to surface water supplies which modeled the forced evaporation rates from Lewis Creek Reservoir (12-012 [SJR11395]). This pattern represents the true water demand if cooling water were pumped directly from Lake Conroe without the interception of water by Lewis Creek Reservoir. These patterns are demonstrated below in *Figure 10*.

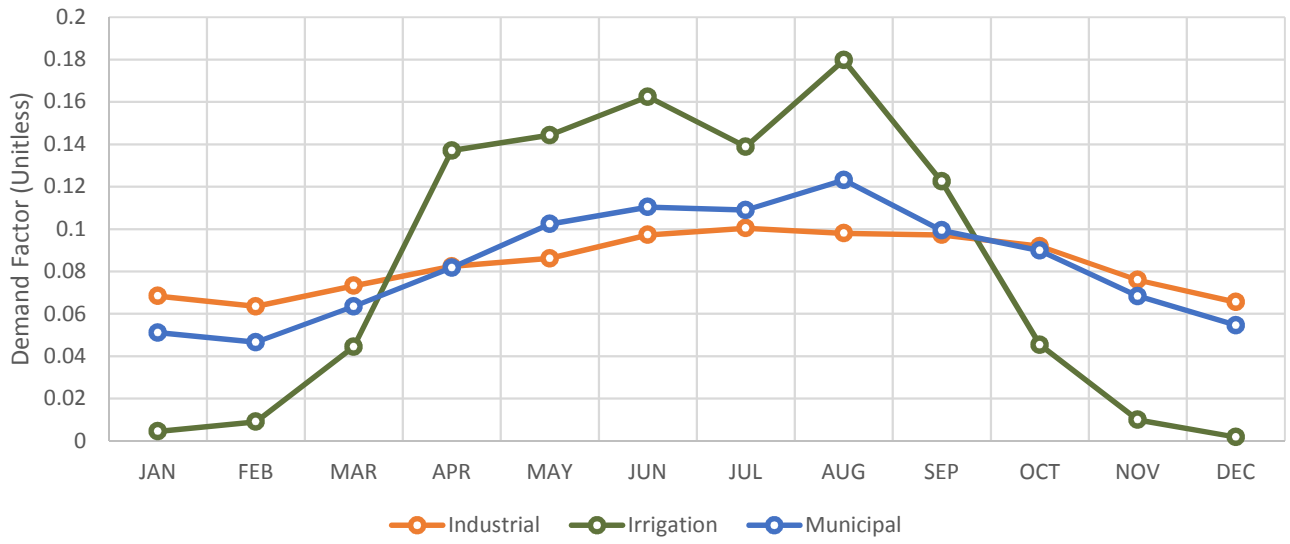


Figure 10 – Observed and Anticipated Montgomery County Demand Patterns

Development of Demand Units

The use of population and demand datasets for municipal demands required the development of spatial coverages to represent current and future demand units. This process was carried out using three spatial data layers:

- SJRA GIS coverage of GRP participants,
- TCEQ GIS coverage of PWS boundaries, and
- U.S. Census GIS coverage of 2010 Census units.

The layers were merged in the order above of descending priority. That is, information from the SJRA GRP layer was considered the highest-priority layer in the dataset and the Census blocks were considered the lowest. An area was first assigned to a GRP boundary, followed by a PWS boundary, and then, finally, to a Census tract boundary if the area did not lie within one of the other two layers. The resultant demand center layer can be seen below in *Figure 11*.

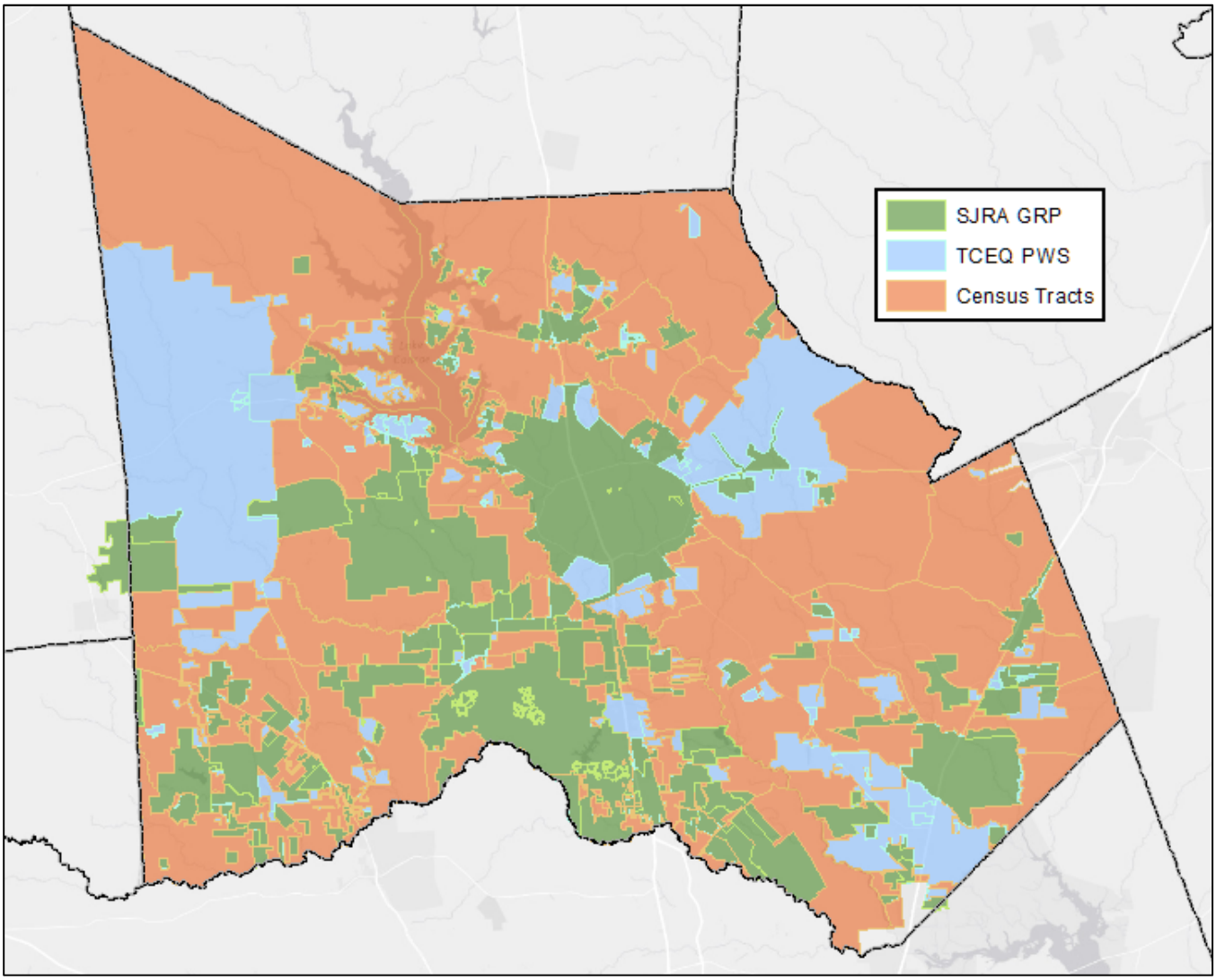


Figure 11 – Demand Unit Layer for Montgomery County

Projections by Sector

Initial peak contract values were provided by SJRA for all demand sectors. These were translated to average demands based on the demand patterns described above.

Industrial Demand Projections

Current industrial demands were provided by SJRA as an average capacity and totaled approximately 7 MGD. Four alternatives were proposed for future demands:

1. Current Contracts – Contracts as presented by SJRA.
2. Expanded Contracts – SJRA contracts, plus additional requests for service as presented by SJRA.
3. Current Contracts + Region H Growth – Alternative 1 adjusted by contract holder for growth based on the Montgomery County steam electric power growth projection in the 2016 Region H RWP.

4. Expanded Contracts + Region H Growth – Alternative 2 adjusted by contract holder for growth based on the Montgomery County steam electric power growth projection in the 2016 Region H RWP.

Projections of average and peak industrial demand for Montgomery County are shown below in *Figure 12* and *Figure 13*, respectively.

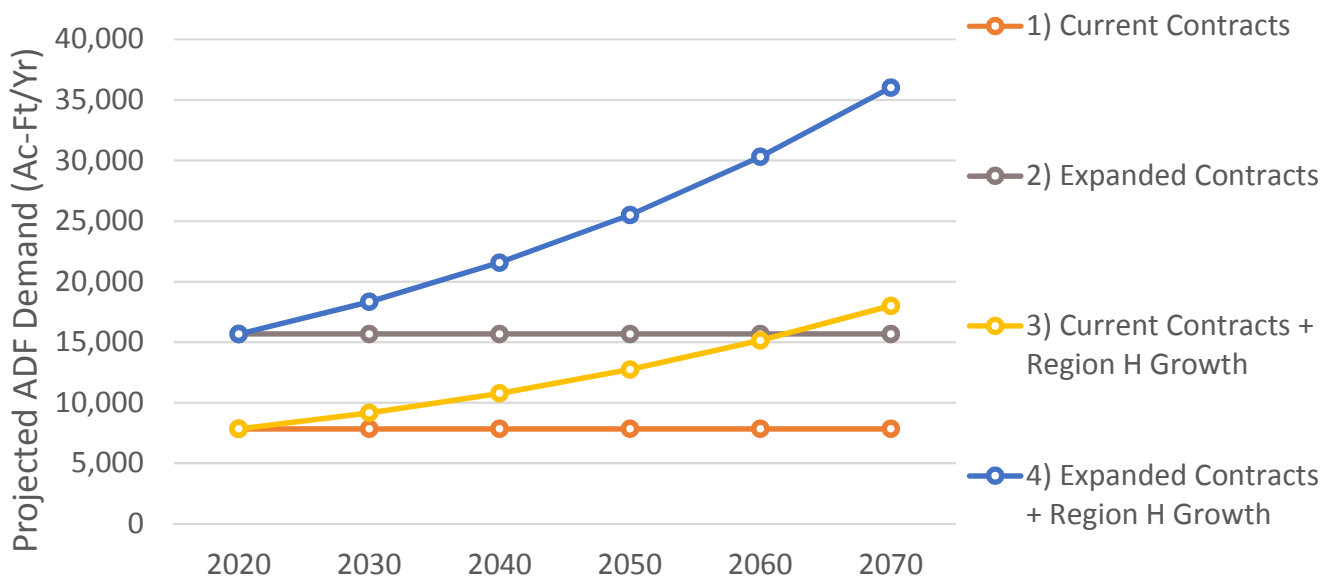


Figure 12 – Average Industrial Demand Projections for Montgomery County

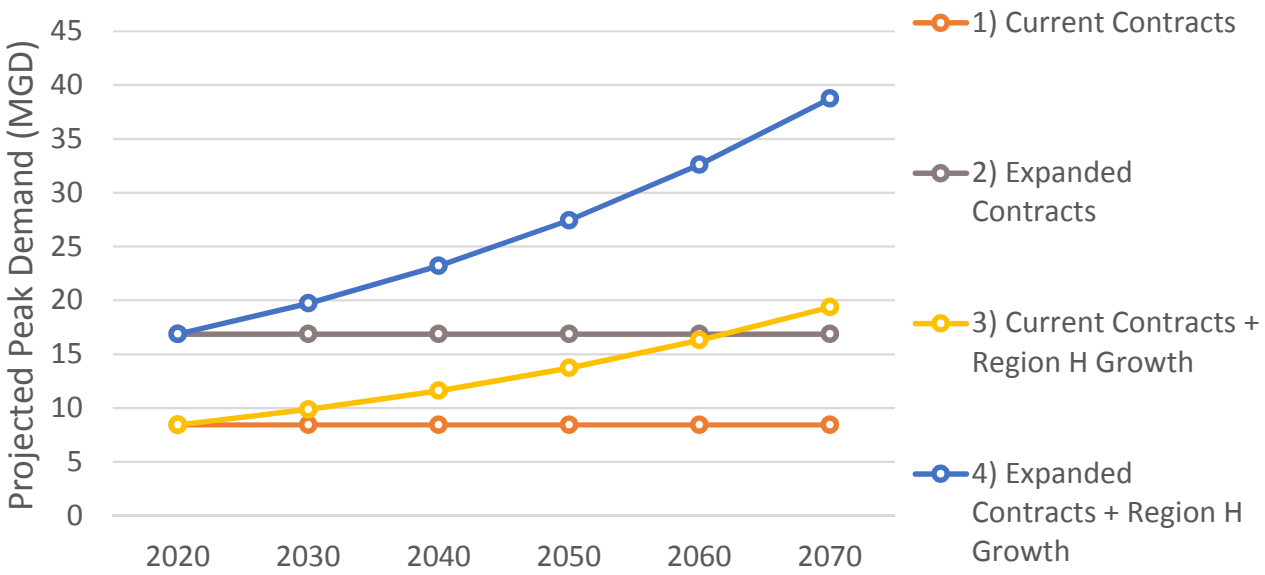


Figure 13 – Peak Industrial Demand Projections for Montgomery County

Irrigation Demand Projections

Current irrigation demands were provided by SJRA as a peak capacity and totaled approximately 2.9 MGD. Only one current-contracts alternative was considered for irrigation demands. The projection of average and peak irrigation demand for Montgomery County is shown below in *Figure 14* and *Figure 15*, respectively.

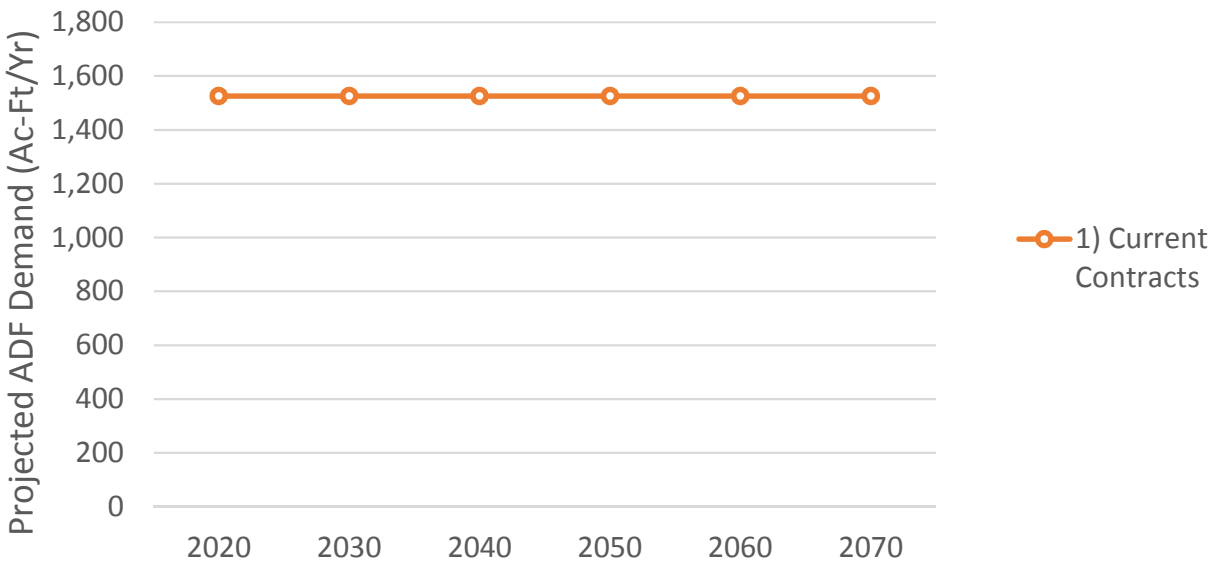


Figure 14 – Average Irrigation Demand Projection for Montgomery County

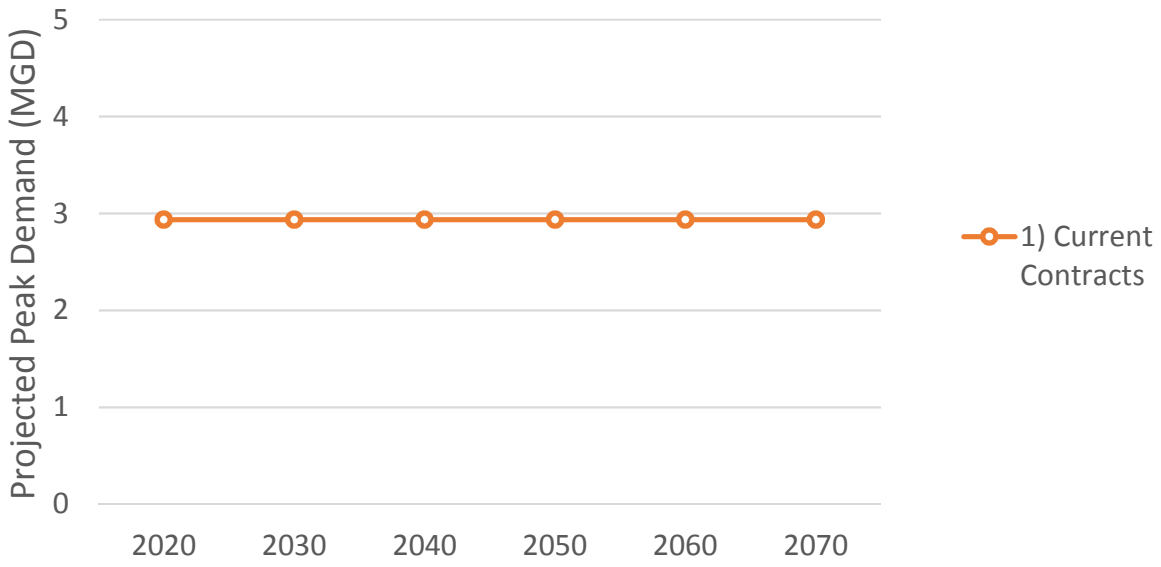


Figure 15 – Peak Irrigation Demand Projection for Montgomery County

Municipal Demand Projections

Current municipal demands were represented by the 2016 level of surface water delivery presented in the SJRA GRP and totals approximately 22.3 MGD. A total of nine alternatives was considered for municipal demands:

1. Current Contracts – Current surface water supplies as presented by SJRA GRP.
2. RGUP Population + Region H GPCD – Population projections from the RGUP with per-capita demands applied from the 2016 Region H RWP. These projections represent a total county municipal demand and must be adjusted to account for supplies from other sources or providers.
3. RGUP Population + RGUP GPCD – Population projections and per-capita demands from the RGUP. These projections represent a total county municipal demand and must be adjusted to account for supplies from other sources or providers.
4. RGUP Population + Region H GPCD + Region H Industrial – Alternative 2, plus the addition of manufacturing demand presented in the 2016 Region H RWP. This demand is separate and apart from the industrial demand described above for SJRA as it is served directly by municipalities. Analysis of historic water usage in the county indicated that approximately 95 percent of this demand is served by the City of Conroe while the remaining 5 percent is served by the Woodlands. These demands have been applied to these demand units accordingly.
5. RGUP Population + RGUP GPCD + Region H Industrial – Alternative 3, plus the addition of manufacturing demand presented in the 2016 Region H RWP as described above.
6. RGUP Population + Region H GPCD + Region H Industrial + Baseline Conservation – Alternative 4, with reductions made for the baseline or passive conservation projections developed by TWDB for the 2016 Region H RWP.
7. RGUP Population + RGUP GPCD + Region H Industrial + Baseline Conservation – Alternative 5, with reductions made for the baseline or passive conservation projections developed by TWDB for the 2016 Region H RWP.
8. RGUP Population + Region H GPCD + Region H Industrial + SJRA Conservation – Alternative 4, with reductions made for the level of conservation recommended in the SJRA WCP (1 percent annual reduction).
9. RGUP Population + RGUP GPCD + Region H Industrial + SJRA Conservation – Alternative 5, with reductions made for the level of conservation recommended in the SJRA WCP.

It should be noted that many of these demands are gross, aggregate demands for the county which may include demands served by others or through supplies other than SJRA-supplied surface water. Consideration for these issues will be given below in the section titled *Alternative Supply Scenarios*. The projection of average and peak municipal demand for Montgomery County are shown below in *Figure 16* and *Figure 17*, respectively.

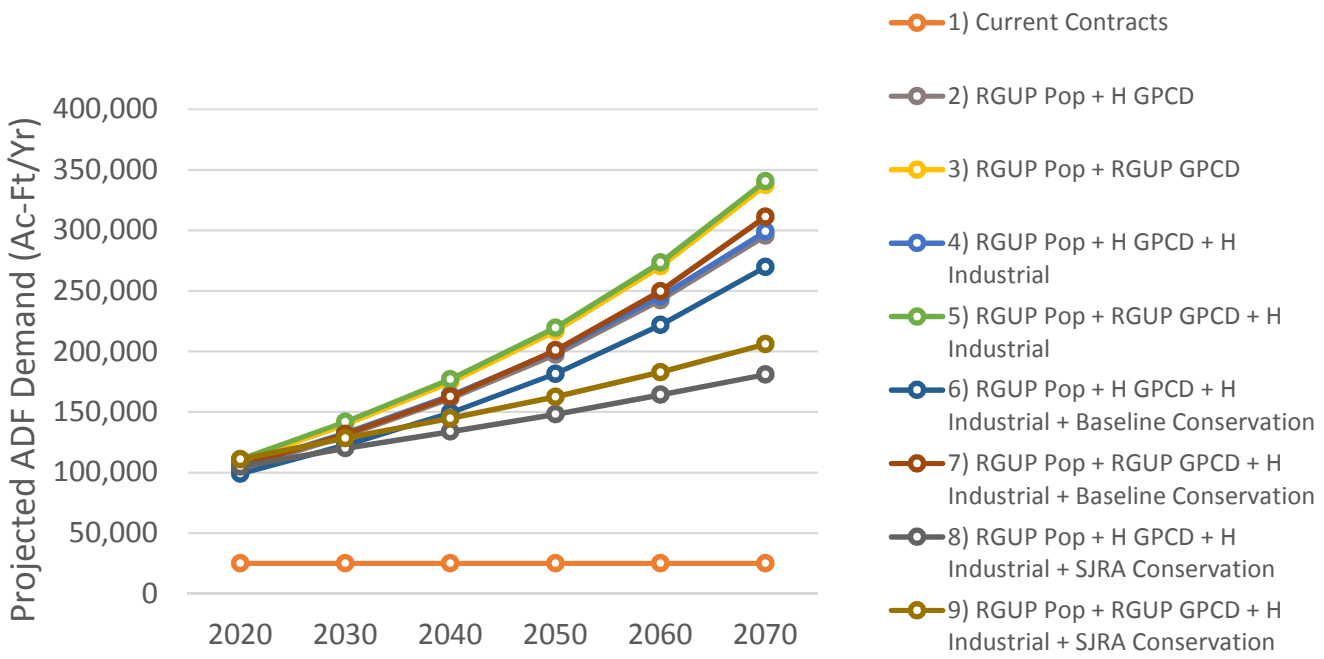


Figure 16 – Average Municipal Demand Projections for Montgomery County

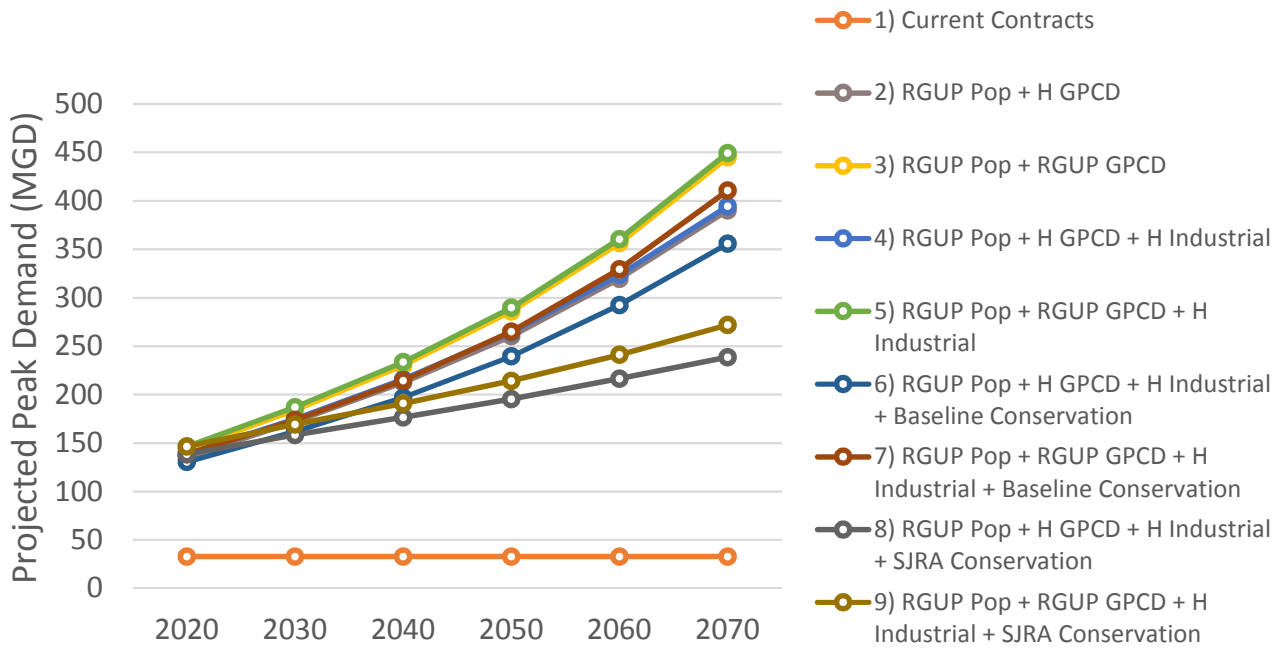


Figure 17 – Peak Municipal Demand Projections for Montgomery County

Recommended Demand Scenarios

The projections described above were presented to SJRA at a workshop on February 26, 2016. Based on discussions during and following the workshop, three scenarios were recommended for further consideration of future demand and needs analysis. These scenarios are described below in *Table 2*.

Table 2 – Recommended Demand Scenarios for Further Study

System	Scenario	Industrial Projection	Irrigation Projection	Municipal Projection
Montgomery	1	2) Expanded Contracts	(1) Current Contracts	(4) RGUP Pop + Region H GPCD + Region H Manufacturing
Montgomery	2	2) Expanded Contracts	(1) Current Contracts	(6) RGUP Pop + Region H GPCD + Region H Manufacturing + Baseline Conservation
Montgomery	3	2) Expanded Contracts	(1) Current Contracts	(8) RGUP Pop + Region H GPCD + Region H Manufacturing + SJRA Conservation

The resulting projections are detailed below in *Figure 18* and *Figure 19*. The projected increase in demand ranges from approximately 62 percent to almost 159 percent from 2020 through 2070.

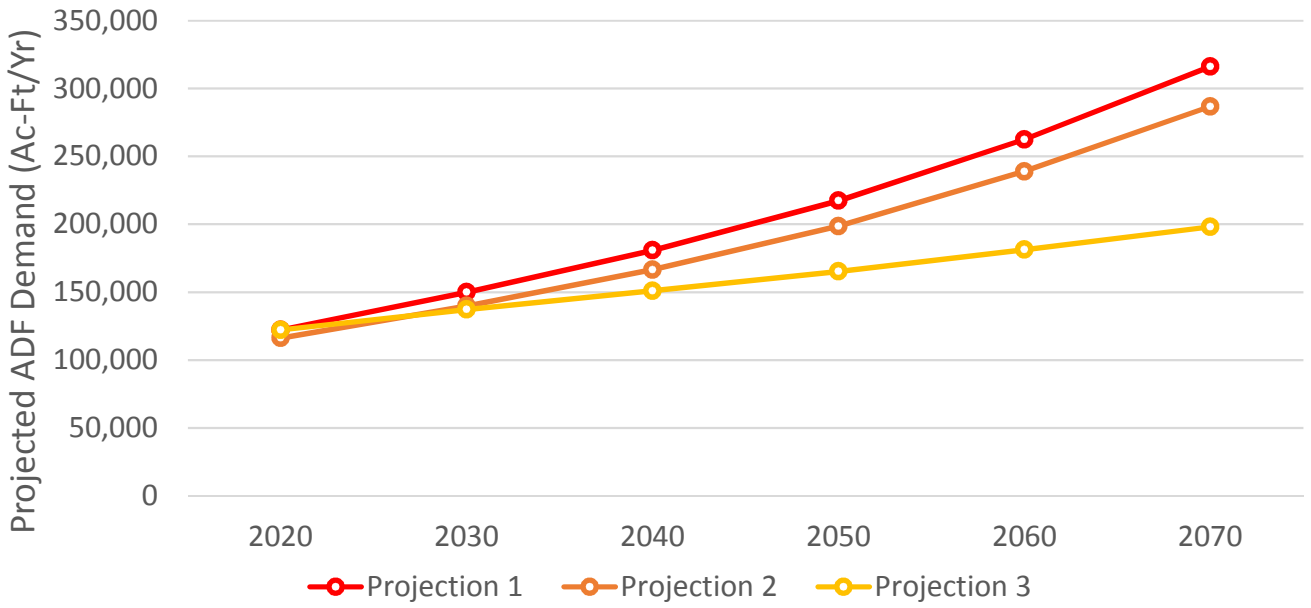


Figure 18 – Recommended Average Demand Projection Scenarios for Montgomery County

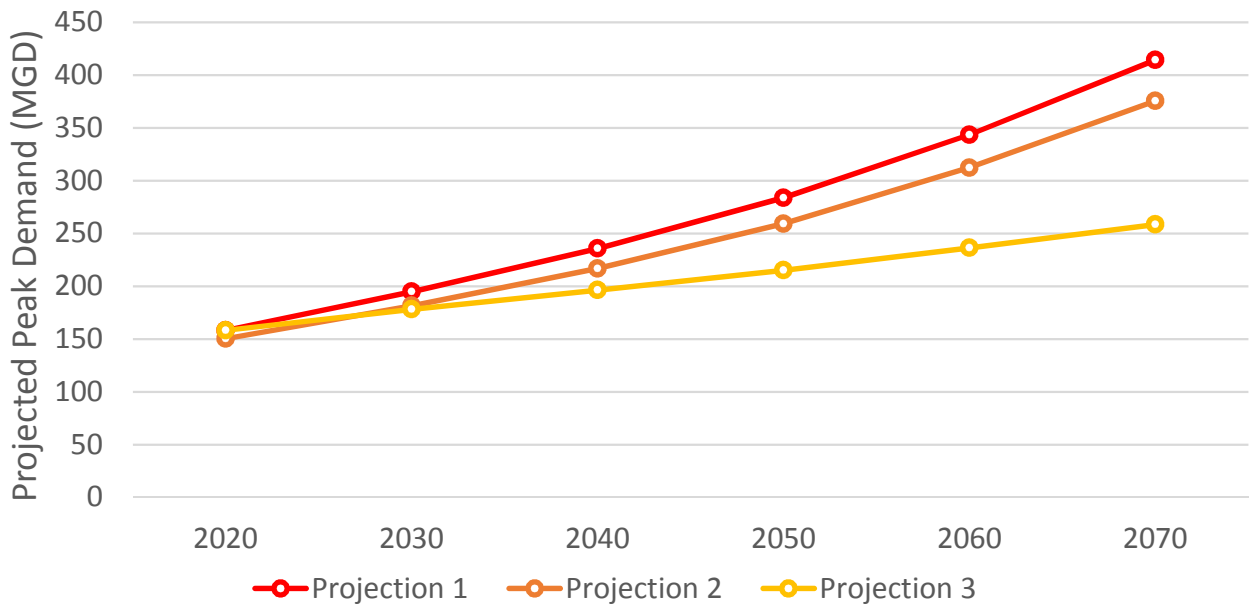


Figure 19 – Recommended Peak Demand Projection Scenarios for Montgomery County

Scenarios for Supplies from Other Sources

The municipal demands presented above provide an aggregate demand for the entirety of Montgomery County which will include demands that will not be served by surface water supplies from SJRA. These other supplies include the following:

- Allowable groundwater pumpage under the Lone Star Groundwater Conservation District (LSGCD) regulatory plan,
- Exempt pumpage under the LSGCD regulatory plan,
- Water provided by other GRPs in Montgomery County.

In order to represent the true level of demand for SJRA, adjustments to the final projection scenarios were adjusted to account for the following supplies:

- SJRA does not supply water for demands served by other existing GRPs within the county,
- SJRA makes use of the 70 percent of TQD assigned to its GRP members, and
- The domestic exempt pumpage projected for the county is utilized by municipal demands that are currently unassigned to a GRP and may participate with SJRA in the future as a Safe Harbor GRP customers.

The resulting demands projected to be served by SJRA based on these assumptions are shown below in *Figure 20* and *Figure 21*.

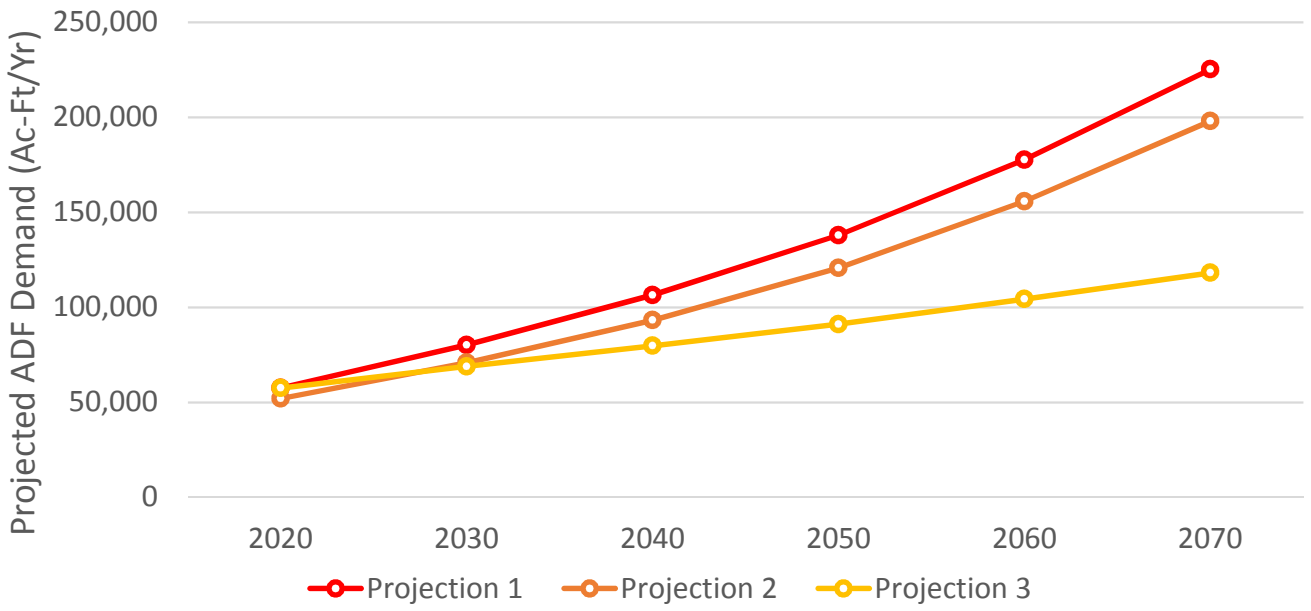


Figure 20 – Recommended Average Demand Projection Scenarios for SJRA Service Area in Montgomery County

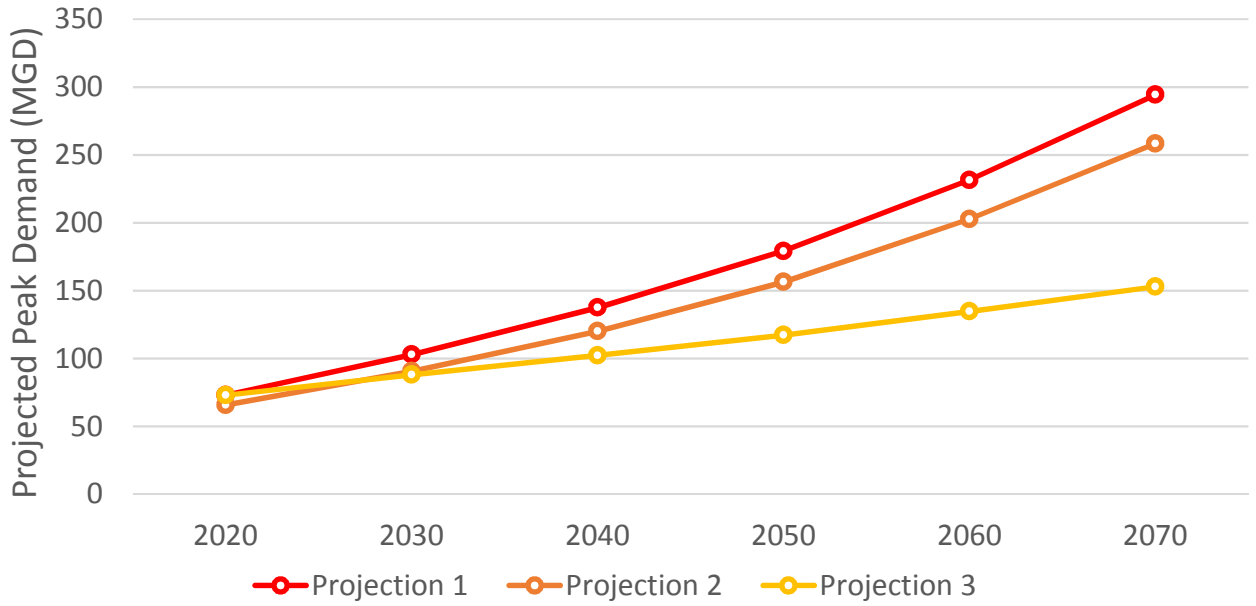
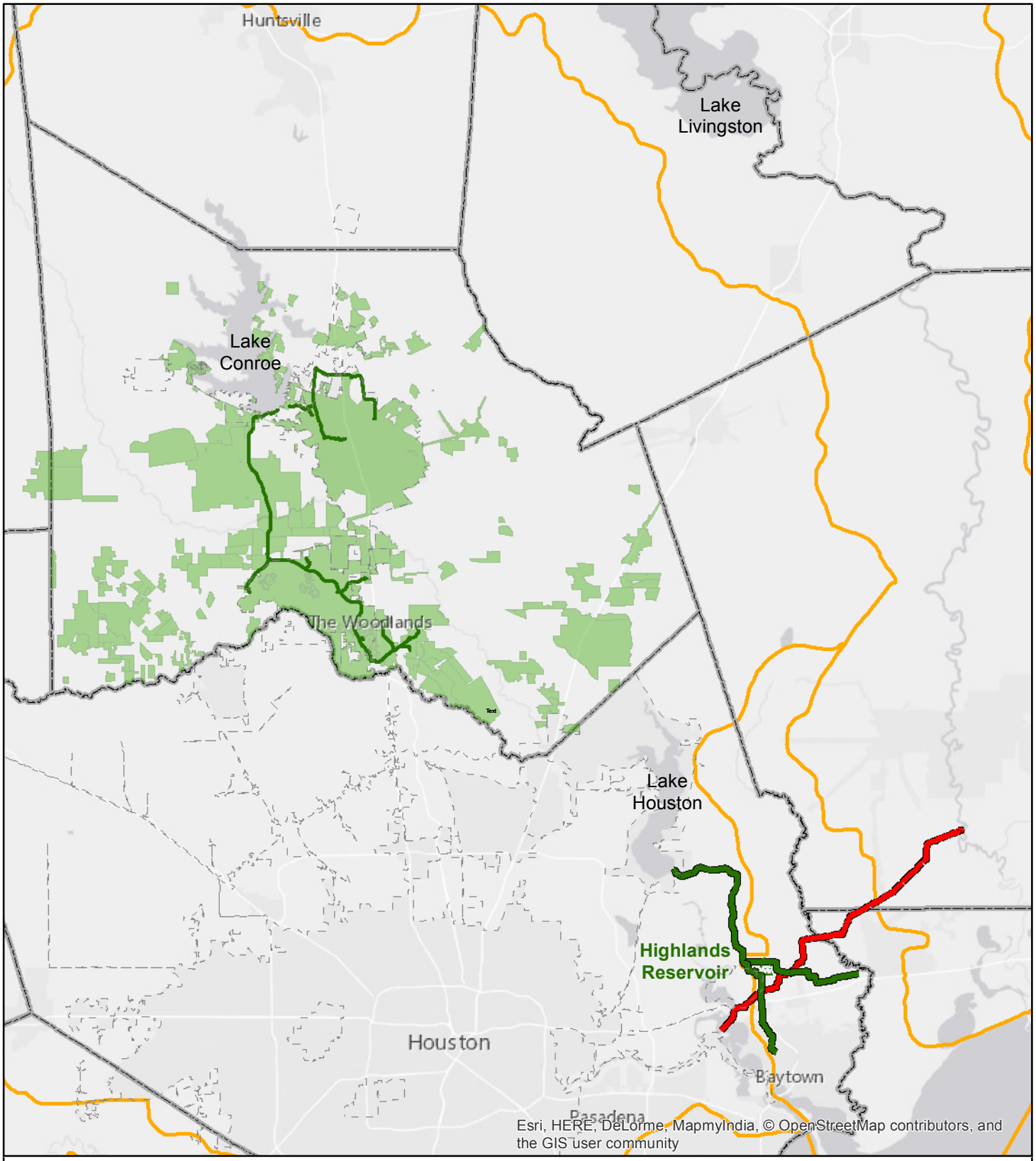


Figure 21 – Recommended Peak Demand Projection Scenarios for SJRA Service Area in Montgomery County



SJRA Canals

SJRA GRP Pipelines

SJRA GRP Participants

CWA Main Canal

City Limits

Basins

Exhibit 1

Location Map

N
W E
S

0 2.5 5 10 15 Miles

FREESE AND NICHOLS