Nevada Irrigation District

Staff Report

for the Regular Meeting of the Board of Directors, August 26, 2020

TO: Board of Directors

FROM: Doug Roderick, P.E., Interim Engineering Manager
Greg Jones, M.B.A., Interim General Manager

DATE: August 20, 2020

SUBJECT: **Water Planning Projections (FATR# 1041)**

ENGINEERING

RECOMMENDED ACTION:
Receive a presentation from staff and HDR consultants regarding the Water Planning Projections presented in the supply and demand projection technical memorandums and release the technical memorandums for public comment.

BACKGROUND:
It is good practice and stewardship for any water provider to plan ahead for future supply and demand conditions. Projecting future supply and demand conditions is a dynamic process that should be updated on a regular basis to reflect actual conditions, trends, and new constraints. These new supply and demand projections are identified as Water Planning Projections and are used in a number of NID planning documents and other management and policy-setting efforts.

The need to update NIDs Water Planning Projections is driven by a series of requirements and assumptions, including the new Yuba-Bear System FERC regulatory requirements, environmental regulatory flow requirements, state-derived climate change data, and state-mandated planning requirements. Together, these requirements and assumptions constitute significantly new planning assumptions and drive the need to update and revise NID's Water Planning Projections.

NID contracted with consultants HDR to update its Water Planning Projections through new supply and demand forecasts. The resulting methodology, assumptions, and findings are presented in a suite of technical memorandums prepared by HDR consultants, as defined below: Hydraulic Analysis, Water Supply Analysis, and Water Demand Projection.

The suite of memorandums addresses only the methodology and process to create the Water Planning Projections. It is important to note that any alternative management strategies, specific projects, individual policies, and/or other mitigating factors that may derive from the Projections are not a part of the Technical Memorandum described here today. Any and all future mitigating projects and alternatives which may derive from these Projections will be addressed separately through the Plan For Water implementation process, expected to begin in Q3 2021.

Hydrologic Analysis Technical Memorandum
This memorandum projects the unimpaired runoff in NID's watersheds under various climate change scenarios. The historical runoff model was previously developed and approved through the FERC licensing process. The hydrologic projections consider a range of climate scenarios as projected by Global Climate Models (GCMs) that have been combined and downscaled to California by the California Water Commission for public use.

The TM presents a background of NID's watersheds and supply system, modeling and climate dataset downscaling methodologies, and resulting range of unimpaired runoff values under the different climate scenarios.

Water Supply Analysis Technical Memorandum
This memorandum uses the unimpaired runoff results from the Hydrologic Analysis TM to convert to available NID supply. The model developed and approved through the FERC licensing process incorporates all the operational constraints, agreements, water rights, and other rules used to operate the Yuba-Bear system between NID, PGE, and PCWA. An additional carryover storage model is also used to determine NID reservoir storage carryover from year to year.

This TM presents the modeling methodology and results of projected supplies during average and wet years, as well as during a 5-year drought scenario.

Water Demand Projection Model Update Technical Memorandum
This TM builds upon NID's existing canal system demand model to project a range of future treated and raw water demands. The model is built upon NID's mapping system, with a General Plan land use designation overlay to allow determination of all current/future customers, land use types, and water uses in the analysis. On average, customer raw water demands are approximately 85% of the total NID demand, with 10 percent applied to treated water demands and 5% to current environmental flows. As treatment plants are fed by raw water canal systems, the demand model incorporates treatment plant demands through the raw water canal systems.

Calculating demand is a simple process of multiplying the designated land use unit demand factor by parcel size or number of customers. However, there are numerous assumptions that are made to arrive at the simple demand calculation. There are economic and demographic assumptions, regulatory and legal impacts, operational assumptions, and others that effectively assume a state of the NID community in 50 years. The demand projection assumes values for all the variable inputs into the model to create a range of potential future demands.

Next Steps
The technical memorandums and additional Water Planning Projections information will be available to the public on NID's website on August 27, 2020. NID welcomes the public to review the information provided and submit comments. Although these Projections nor the Technical Memoranda are under a regulatory mandated review period, NID understands the public's interest in these documents and would like to receive comments and feedback from the public. NID will be receiving and will collect comments related to this material by COB on October 9, 2020. Comments must be received by email or website per instructions provided on NID's Plan For Water website. It is anticipated that a Board workshop will be held on or about October 28, 2020, to present and review the public's comments for discussion.

The Water Planning Projections are required for the State-mandated Agricultural Water Management Plan and the Urban Water Management Plan, due to the State Department of Water Resources in April 2021, and June 2021, respectively.

This item supports Goal No. 2 of the District's Strategic Plan by developing a collaborative and responsive relationship with our local and regional community, and Goal No. 3 by developing and managing our resources that protects and provides for local control of our community's most valuable assets – a fairly priced and available water supply.

BUDGETARY IMPACT:
The budgetary impact of additional analysis or other planning efforts, if directed by the Board, will be determined once the public review period has concluded, and a summary of potential next efforts can be developed and presented to the Board.

ATTACHMENT:
- HDR Water Planning Projection Technical Memorandum Presentation

DR

Water Planning Analyses

Prepared for
NID Board of Directors Meeting, August 26, 2020

8/19/2020

Presentation of Water Planning Analyses

- Water Demand Model Update TM
- Hydrologic Analysis TM
- Supply Analysis TM

Water Demand Model Update Technical Memorandum (TM)

01 2020 Demand Model Update: Goals and Objectives

02 NID’s Previous Demand Model

- Approach
- Model Framework

03 2020 Demand Model

- Updates
- Model Results

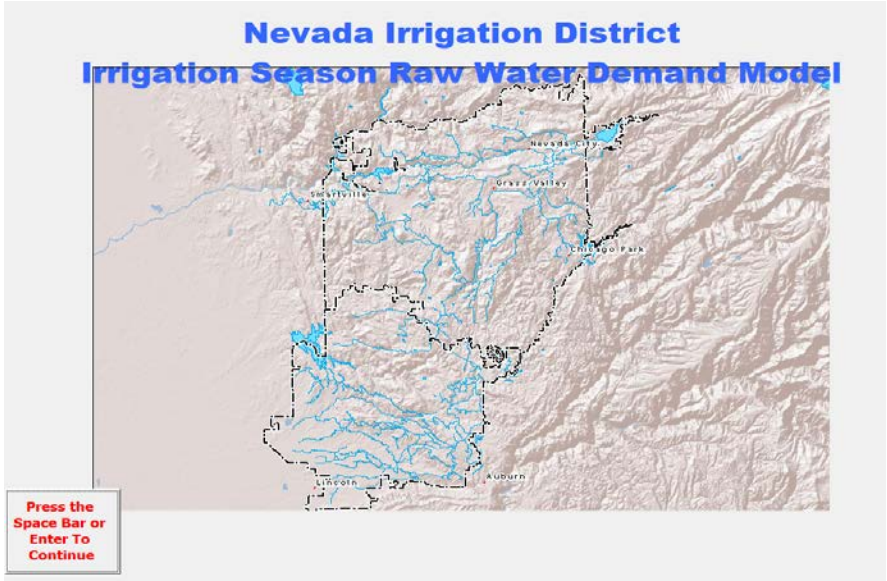
04 Conclusions

01 2020 Demand Model Update: Goals and Objectives

- Looking Back: Historical analysis of NID’s demands
- Looking Forward: Projections for future water usage based on historical data
- 40 Year planning period (2020 - 2060) to align with DOF datasets
- Multiple demand scenarios for future planning
- Analysis based on already adopted methodology by District
- Stand-alone Technical Memo

02 NID's Previous Demand Models

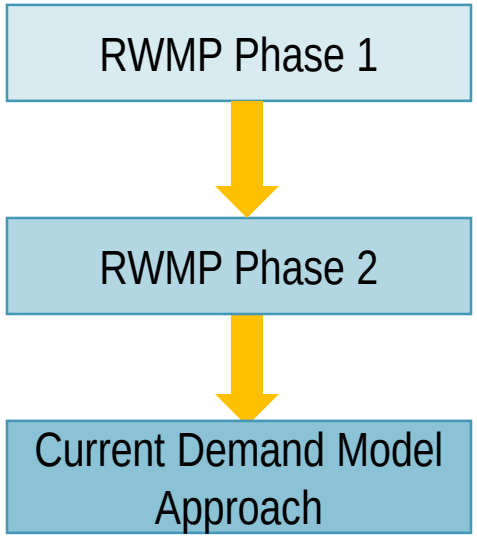
- Original Model built by Kleinschmidt Associates as part of Raw Water Master Plan



- **Phase 1 (2005)**
  - Built in 2005
  - Based on data through 2002
  - Projections timeframe 2002-2027
  - Simple excel based model
- **Phase 2 (2011)**
  - Update of the prior model by Kleinschmidt Associates (same approach as Phase 1)
  - Projections based on data through 2007
  - Projection through 2032
  - Migration to database model for added functionality

03 2020 Demand Model Approach

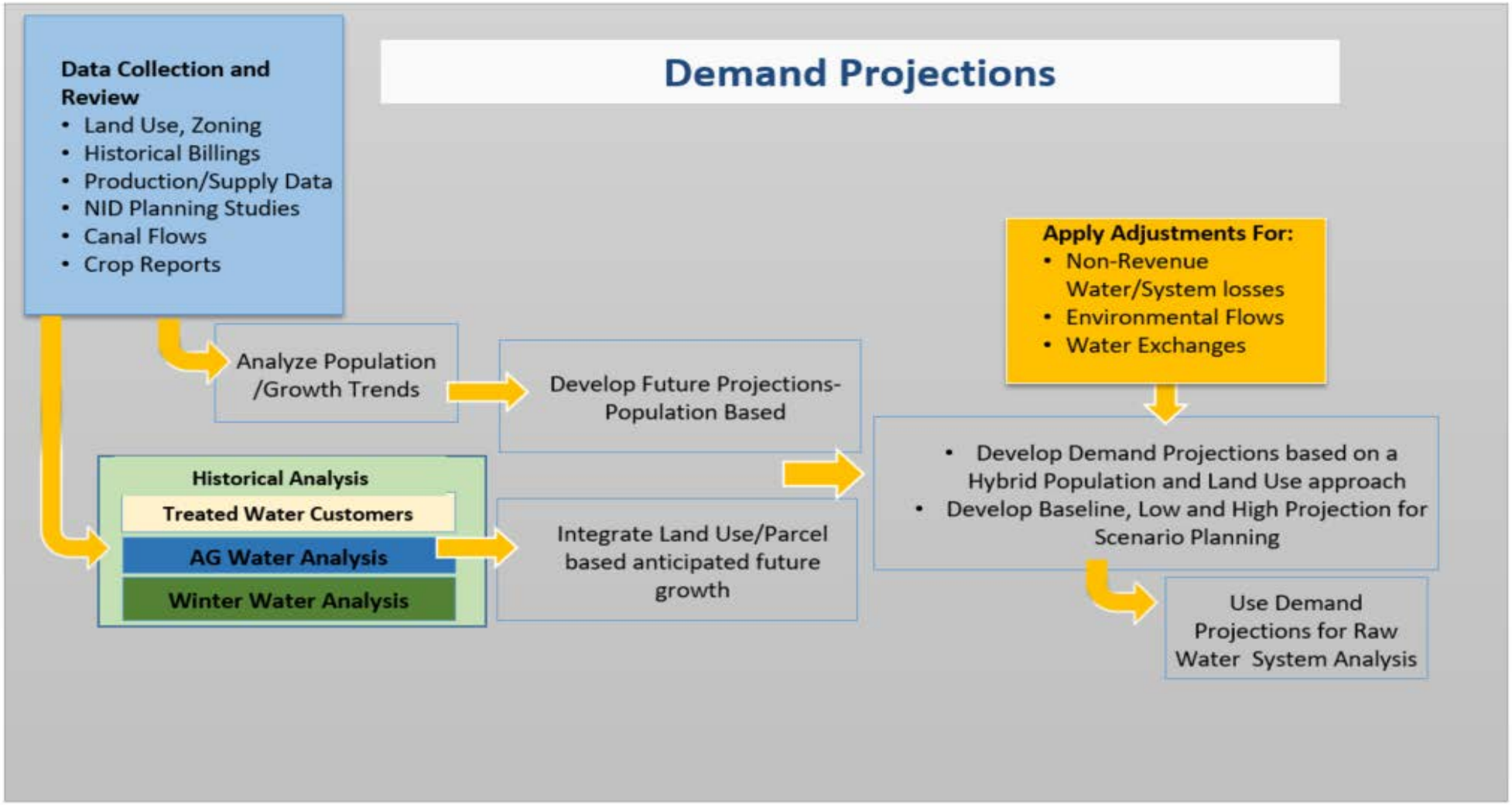
- Consistent with previous demand models (Phase 1 and Phase 2)
- Maximize the use of previous efforts and available data
- Update prior models/analyses rather than adopt new analysis approach
- Builds on analysis that has been reviewed and adopted by the District and Public



03 2020 Demand Model: Updates

- Migration to MS Access platform and GIS integration
- Include model data through 2017
- Incorporate updated growth patterns based on DOF data
- Update historical water use analysis
- Update environmental flows per new FERC licensing agreement
- Update mutual water company components

03 2020 Demand Model: Overview



03 2020 Demand Model: Data and Sources

Actual Historical and Current Data Sets

- Land Use/Zoning- APN Parcel level data
- Historical Billings – NID water customer data (2009 - 2017) both Treated and Agricultural customers
- Production/Supply Data – NID treatment plant data
- Planning Studies: UWMPs, Agriculture Water Management Plan 2015, 2011census (DOF), regional studies for population and LU trends
- Previous Raw Water Master Plan Data 2011
- Canal flows – 168 gages
- Crop reports

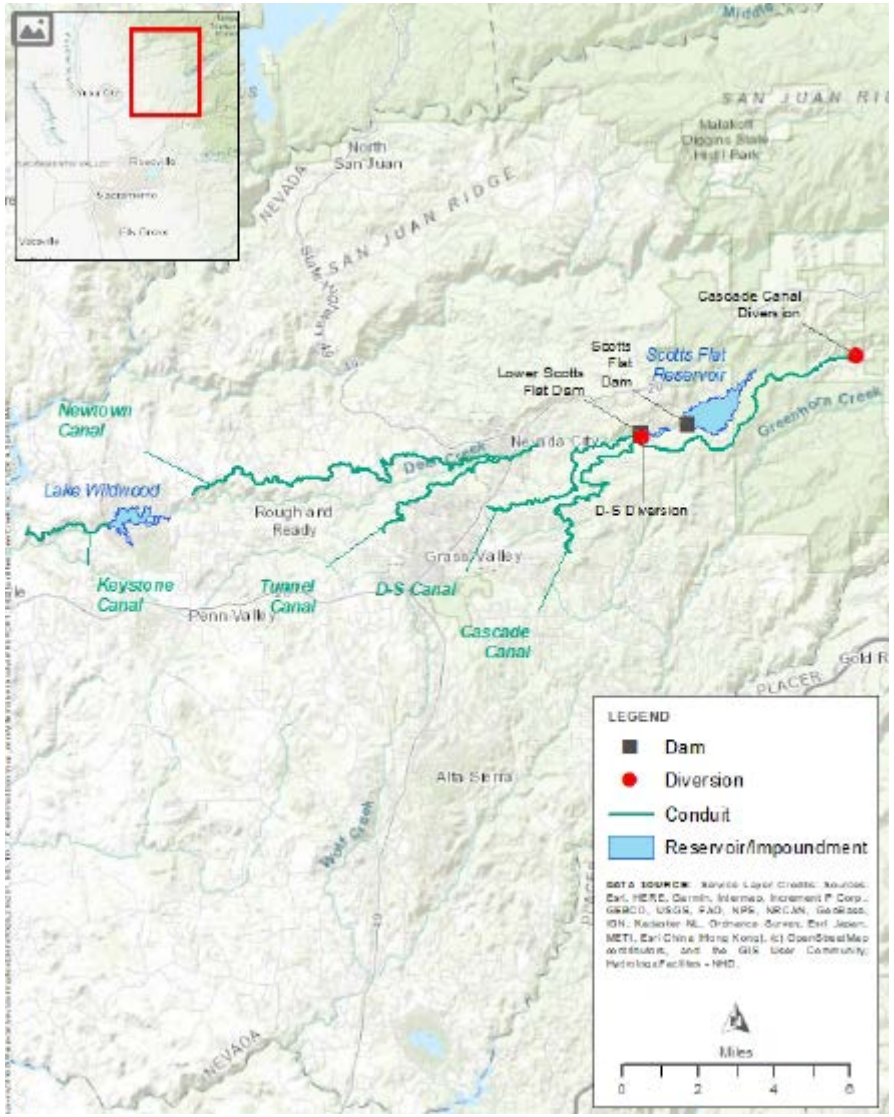
Assumed Data Sets

- Unimpaired Hydrology Model

03 2020 Demand Model: Output and Reporting

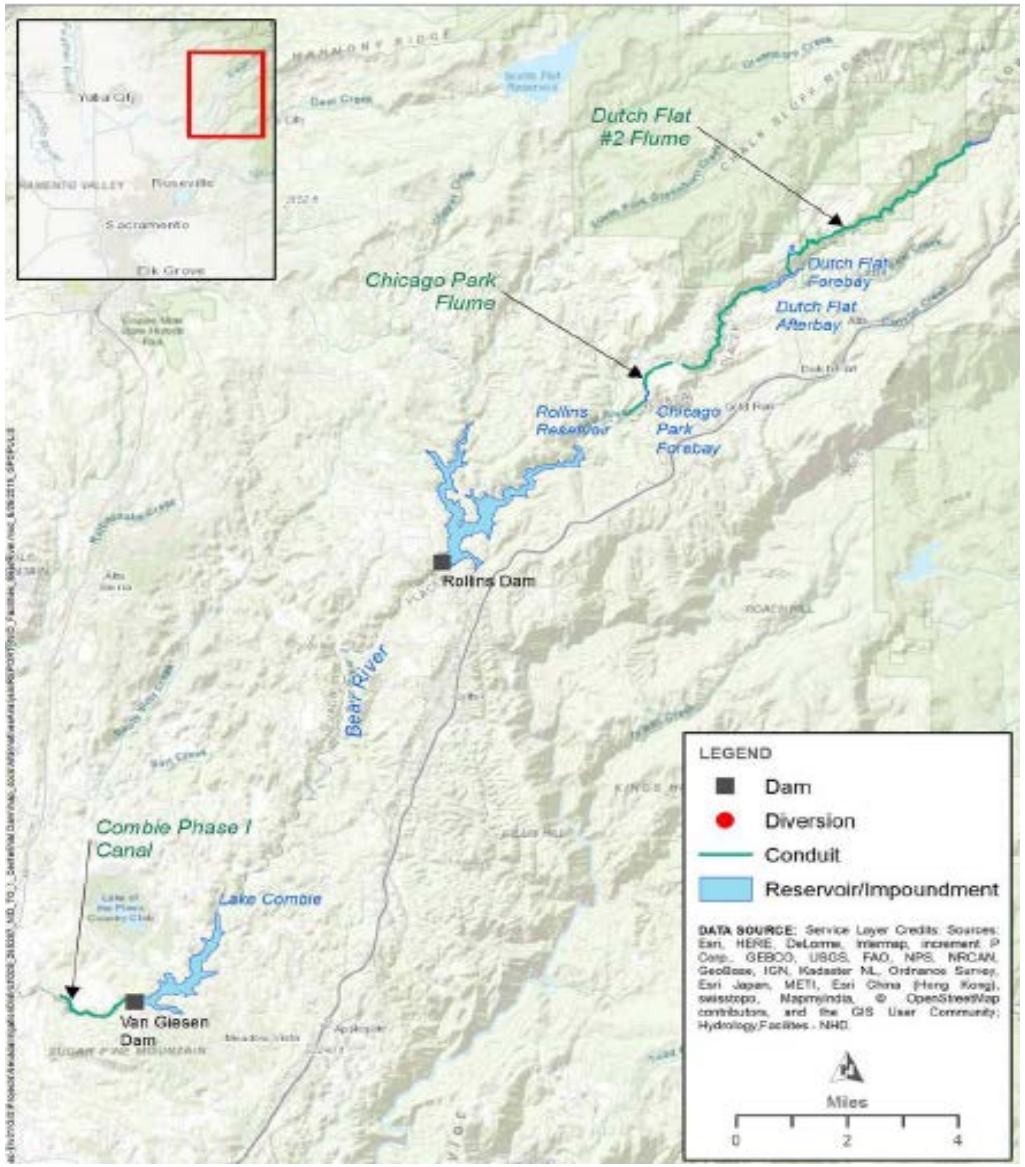
- Model provides 40 -Year planning period projections
- Projections by system (Deer Creek and Bear River)
- Projections can be queried by canal and segments
- Total District estimates
- Winter water use estimates

03 2020 Demand Model: Deer Creek System Results



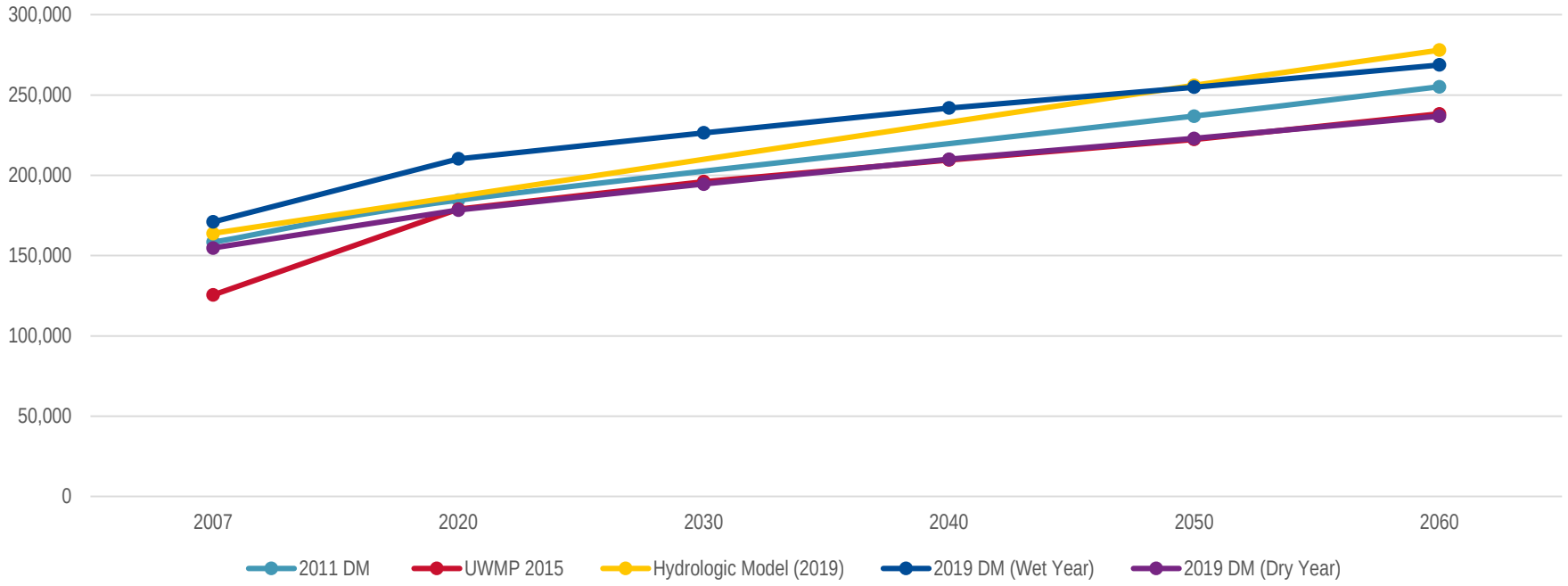
Year	Irrigation Season Demand (Acre-Feet)	Winter Season Demand (Acre-Feet)	Total System Demand (Acre-Feet)
2020	37,245	15,023	52,268
2030	43,034	15,023	58,057
2040	48,252	15,023	63,275
2050	53,822	15,023	68,845
2060	60,134	15,023	75,157

03 2020 Demand Model: Bear River System Results



Year	Irrigation Season Demand (Acre-Feet)	Winter Season Demand (Acre-Feet)	Total System Demand (Acre-Feet)
2020	72,839	25,355	98,194
2030	83,244	25,355	108,599
2040	93,455	25,355	118,810
2050	100,910	25,355	126,265
2060	108,424	25,355	133,779

03 2020 Demand Model: Overall System Results



Year	Total System Demand Dry Year (Acre-Feet)	Total System Demand Wet Year (Acre-Feet)
2020	178,362	210,262
2030	194,557	226,457
2040	209,985	241,885
2050	223,010	254,910
2060	236,836	268,736

04 Conclusion

- 2020 Demand model is based on (and consistent with) updates to Phase 1 and Phase 2 of the District’s Raw Water Master Plan
- Model provides demand projection estimates for a 40-Year planning horizon based on historical data
- Analysis based on already adopted methodology

Hydrologic Analysis Technical Memorandum (TM)

01 Hydrologic Analysis Study Objectives
02 Projection of Climate Change on Runoff
03 Unimpaired Hydrology
04 2070 Drought Projection
05 Reservoir Operations Model
06 Conclusions

01 Hydrologic Analysis Study Objectives

- Develop Hydrologic tools to help assess the adequacy to meet future water demands within the district
- Expand the planning horizon from 20 to 50 years (~2070)

02 Climate Change Impacts on Watershed Runoff

- California Climate Change Assessment (Thorne 2018):
  - More intense precipitation events (atmospheric rivers)
  - More droughts
- By the year 2100 In the Sierra Nevada (Dettinger et al 2018):
  - Air temperatures are projected to increase on average by 6 to 10°F
  - Rain to snow transitional elevation will increase by 1,500 to 3,000 ft during winter snow storms
  - Snowpack will be eliminated below about 6,000 feet
  - Snowmelt runoff will occur earlier in the Water Year
  - Increased winter runoff, and reductions in spring runoff

03 Unimpaired Hydrology

- Hydrologic response of watershed basins with no influence (i.e., regulation) of stream flow by man-made structures such as dams or diversions
- Unimpaired hydrology must be synthesized because watersheds that contribute runoff to NID's water supply are either ungaged or highly regulated
- Two unimpaired hydrology scenarios
  - Historical unimpaired hydrology
  - Climate change projected unimpaired hydrology (2070)
- Used to quantify watershed runoff
  - How will runoff change under climate change?
  - Will NID be able to meet future customer demand?

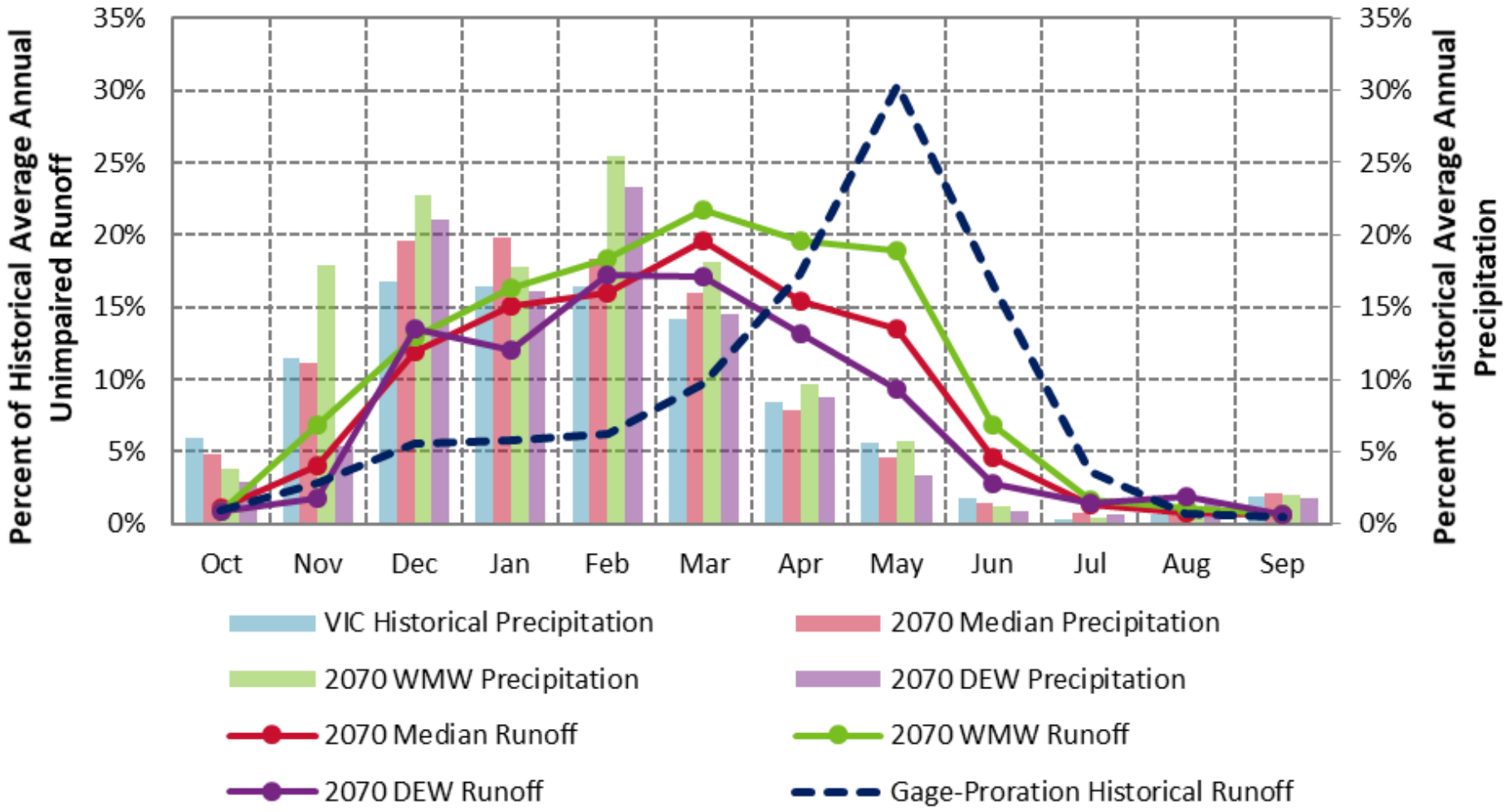
03 Historical Unimpaired Hydrology

- FERC Relicensing unimpaired hydrology
  - Water Years 1976 through 2008
  - Included portions of the Middle Yuba, South Yuba and Bear river watersheds
  - Public process and peer reviewed
- Post-Relicensing updates
  - Expanded the dataset to include portions of Deer Creek, Coon Creek, and Auburn Ravine
  - Redeveloped Bear River unimpaired hydrology
  - Period of record was extended through Water Year 2011
  - Documented in Appendix B of the TM

03 Climate Change Unimpaired Hydrology

- Three 2070 projections of climate change:
  - Drier/extreme-warming (DEW) conditions, pessimistic trajectory of GHG emissions
  - Wetter/moderate-warming (WMW) conditions, optimistic trajectory of GHG emissions
  - Median conditions, between DEW and WMW.
- Water Years 1976 through 2011
- Used State of California climate change model output to translate historical unimpaired hydrology
- Documented in Appendix C of the TM

03 Monthly Percent of Historical Annual Average Unimpaired Runoff at Milton Diversion Dam

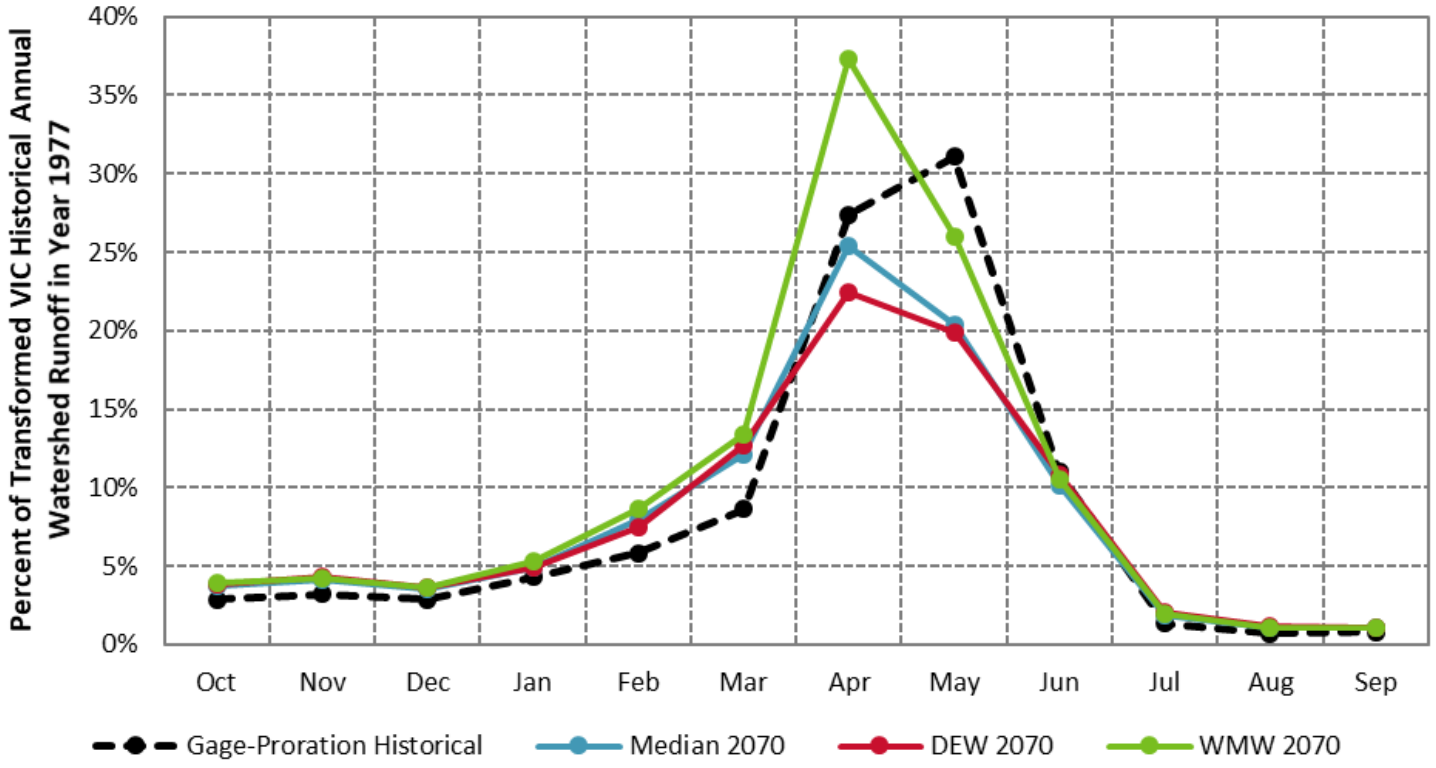


03 Climate Change Unimpaired Hydrology

- In historically snowfall dominant watersheds, 2070 peak runoff months occur earlier in the Water Year and are more distributed during the rainy season
- In historically rainfall dominant watersheds, December through March flows are higher for WMW scenario, similar for the Median scenario and lower for the drier DEW
- Each scenario exhibits a similar temporal pattern and relative distribution of water year types as the historical record
- This method does not account for potential changes in inter-annual variability, such as prolonged drought sequences

04 2070 Drought Projections

- 1977 – The driest year in the historical period of Record



Unimpaired Hydrology Scenario	Percent of Historical WY 1977 Runoff
Historical	100%
DEW 2070	94%
Median 2070	96%
WMW 2070	117%

- The prevalence of droughts in California is expected to increase under climate change (Thorne 2018)

05 Reservoir Operations Model

- Developed for use in the FERC Relicensings of the Yuba-Bear and Drum-Spaulding Projects
  - Public process, peer reviewed
- Simulates reservoir operations based release rules and operational priorities
- Primary input data:
  - Unimpaired hydrology
  - Customer water demand
- Primary output data:
  - Reservoir releases
  - Water supply deliveries/shortages
  - Reservoir carryover storage

05 Reservoir Operations Model

- Post-Relicensing updates
  - Simulation period of record through Water Year 2011
  - Bear River watershed extension
  - Deer Creek watershed extension
  - Projected 2070 conditions

06 Conclusion

- Results of the Hydrologic Analysis TM were used in the Water Supply TM:
  - Quantify watershed runoff under climate change conditions
  - Quantify average annual carryover storage using the Reservoir Operations Model

Supply Analysis Technical Memorandum (TM)

01 Supply Analysis Objectives
02 Watershed Runoff
03 Carryover Storage
04 Contract Purchases
05 Recycled Water
06 Conclusions

01 Supply Analysis Objectives

- Update previous water supply projections
- Update critical drought scenarios (5-year)
- Expand the planning horizon from 20 to 50 years (~2070)

02 Watershed Runoff

- Unimpaired Hydrology TM
- Runoff quantified based on water rights

03 Carryover Storage

- Determine Annual Average Carryover Storage
  - Planning Horizon Unimpaired Hydrology and Demands.
- Determine subsequent years of theoretical 5-year drought.
  - Previous Year carryover storage + previous year inflow
    - + Watershed runoff
    - + PG&E Purchases
    - + Recycled water
    - - Demand
    - - Environmental flows

04 Contract Purchases

- Estimated based on Appendix B of the Coordinated Operations Agreement.
- Based on 5-year drought conditions and the COA
- Assumed water is available

05 Recycled Water

- Projected municipal recycled water supply from 2015 Urban Water Master Plan
  - 5-year projections from 2015 to 2040

2015	2020	2025	2030	2035	2040
1,956	2,321	2,574	2,852	3,157	3,498

  - Linear Extrapolation to 2070: 5,275 ac-ft

06 Conclusion

- Summary of 2070 5-Year Drought Water Supply

Analysis Variable	Avg. Year	Hypothetical 5-Year Drought				
		1994	1987	1988	1976	1977
Watershed Runoff (ac-ft)	383,500	101,350	97,200	95,250	85,500	38,300
Available Carryover Storage (ac-ft)	87,500	87,500	25,126	1,289	0	0
Contract Purchases from PG&E (ac-ft)	7,500	37,300	31,800	30,300	27,500	26,200
Recycled Water (ac-ft)	5,300	5,300	5,300	5,300	5,300	5,300
Total Supply (ac-ft)	483,800	231,450	159,426	132,139	118,300	69,800
Environmental Flow Requirement (ac-ft)	46,200	31,100	24,700	24,000	23,200	16,400
Total Demand Before Drought Demand Reduction (ac-ft)	255,136	240,036	233,636	232,936	232,136	225,336
Drought Action Stage	-	I	IV	IV	IV	IV
Drought Demand Reduction	0%	20%	40%	50%	50%	50%
Total Demand with Drought Demand Reduction (ac-ft)	255,136	206,324	158,137	132,506	127,668	120,868
Shortage With Reductions and Contract Purchases (ac-ft)	0	0	0	-367	-9,368	-51,068