Appendix F
Performance of Selected Alternatives on Newlands Project Water Supply Reliability

Newlands Project Planning Study
Special Report

Prepared by

Bureau of Reclamation
Mid-Pacific Region
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U.S. Department of the Interior
Bureau of Reclamation

April 2013

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Abbreviations and Acronyms

cfs	cubic feet per second
OCAP	Operating Criteria and Procedures for the Newlands Project
Project	Newlands Project
Study	Newlands Project Planning Study
TROA	Truckee River Operating Agreement

Appendix F – Performance of Selected Alternatives on Newlands Project Water Supply Reliability

This document provides water supply operations results for alternatives described in Chapter 5 of the Newlands Project Planning Study (Study). The Study alternatives were designed to fulfill two objectives: (1) Newlands Project (Project) safety for Truckee Canal operations, and (2) reliability for Project water rights (Chapter 2). The Study identified seven alternatives that best met these objectives (Chapter 5). The ability of these alternatives to meet the Study objectives and the effects of these alternatives on the environmental are compared against each other and against a Without-Action alternative in Chapter 5.

This appendix is organized into two sections. The first section, on methods, describes the approach for simulating the seven Study alternatives in a water supply and operations model.

The second section provides a summary of results that are used by the Study. Results provided in this appendix are limited to the modeling outputs that characterize each alternative's ability to provide reliability for Project water rights and each alternative's effects on environmental conditions throughout the study area (chapters 1 and 3). Important performance characteristics of the alternatives include the following:

- Water supply deliveries to Newlands Project water rights holders
- Water supply deliveries to agricultural, M&I, and Lahontan Valley wetlands
- Spills from Lahontan Reservoir
- Hydropower generation for Truckee-Carson Irrigation District powerhouses located at Lahontan Reservoir and 26-foot drop
- Deliveries to the City of Fernley
- Flows past Derby Dam to Pyramid Lake

Methods

The Pre-Truckee River Operating Agreement (TROA) Planning Model was selected for use in the Study, as described in Appendix B1. The hydrology of the Pre-TROA Planning Model was updated with more recent version of Truckee and Carson river hydrology data, as described in Appendix B2. The representation of hydropower production at Lahontan Reservoir and on the V-line Canal at 26-foot Drop was developed and implemented in the Pre-TROA Planning Model, as described in Appendix B3. Pre-TROA Planning Model results must be adjusted, as described in Appendix B4, for the outputs that describe the delivery of Project water rights to the City of Fernley and the flows past Derby Dam to Pyramid Lake.

Study alternatives assume a level of demand among water users that is presented as the "estimated future demand" in Appendix C.

The Pre-TROA Planning Model is built in a RiverWare modeling environment, and slots are features of the RiverWare environment that accept inputs. The RiverWare slots used to input demand are listed in Table F-1.

Table F-1. Model Slots Used to Specify Acreages of Water Rights

Division	User	RiverWare Slots Used to Specify Acreages of Water Rights
Carson Division	Project Irrigators	MHEData.CarsonDivisionWRandIrrig
	Paiute-Shoshone Irrigation	MHEData.FallonIndianReservation
	City of Fallon	MHEData.CarsonDivisionWRandIrrig
	Environmental	MHEData.FallonIndianReservationWetlands MHEData.StillwaterNationalWildlifeRegfuge MHEData.CarsonLakeAndPasture
Truckee Division	Project Irrigators	MHEData.TruckeeDivisonWRandIrrig
	City of Fernley	DerbyDamData.DerbyBypassComponents (Fernley C3)
	Environmental	DerbyDamData.DerbyBypassComponents (PLPT_C3)

Representation of Study Alternatives in Water Supply Model

Study alternatives include several features that affect Project water supply reliability and are represented explicitly in the Pre-TROA Planning Model. These features are presented in Table F-2. The approach to representing these features in the Pre-TROA Planning Model are described in the following sub-sections.

Table F-2. Features of Study Alternatives Represented in the Pre-TROA Planning Model

Alternative Name	Truckee Canal Flow Stage (cfs)	Truckee Canal Lining and Seepage Reduction	Project Efficiency Increases	Agricultural Demand Reduction
600	600			
350.a	350			
350.b	350		X	
350.d	350	X		
250.a	250			X
250.b	250		X	
250.d	250	X		X
Without-Action	150			

Key:
cfs – cubic feet per second
TROA = Truckee River Operating Agreement

Truckee Canal Flow Stage

The Study considers a range of potential flow-stages for the Truckee Canal (Chapter 4). Flow-stages are specified as a maximum capacity limitation in the Pre-TROA Planning Model using the slot, TRUCKEECANALDIV.CANALCAPACITYDEFAULT. The flow-stage conditions evaluated include 600, 350, 250, and 150 cubic-feet per second (cfs).

Truckee Canal Lining and Seepage Reduction

The lining option this Study considers is consistent with the recommendation in U.S. Department of the Interior, Bureau of Reclamation's (Reclamation) 2011 *Corrective Action Study Alternatives and Appraisal Level Cost Estimates* (Reclamation 2011e), which is to line 17 miles of the Truckee Canal, including the entire Fernley Reach; this is assumed to reduce seepage losses by 85 percent of their current levels based on delivery data from the last decade provided by Reclamation and the Truckee-Carson Irrigation District. Although evaporation losses would still occur, the proportion of losses attributed to evaporation is expected to be extremely small in comparison to seepage, and evaporation losses are treated as negligible.

To simulate the reduction of Truckee Canal seepage, a factor of 0.85 was applied to the slot TCANALATHAZEN.LOCALINFLOW for each time step within the model run. By doing this, the Truckee Canal seepage losses are held at 85 percent of historical seepage rates.

Project Efficiency Increases

Two study alternatives (350.b and 250.b) consider increases in Project delivery efficiency by implementing measures that reduce losses by lining canals and laterals in the Carson Division. This action was identified by Reclamation in the 1994 *Newlands Project Efficiency Study* (Reclamation 1994) as a method to

help bring the Project to a 75 percent efficiency level. Efficiency rates are entered to the Pre-TROA Planning Model through the slot LAHONTANDATA.USERINPUTCDEFFICIENCYFACTOR. For the analysis, the efficiency factor was changed, increasing from 0.65 to 0.75.

Agricultural Demand Reduction

Two study alternatives (250.a and 250.d) consider agricultural demand reduction programs as a means to meet the Study's water supply objective. For these alternatives, the water rights demands of commercial and non-commercial irrigators were adjusted by reducing acres of demand in slots for MHEDATA.CARSONDIVISIONWRANDIRRIG, and MHEDATA.TRUCKEEDIVISONWRANDIRRIG. Demand for environmental, wetland, tribal, and municipal and industrial water rights holders remained at their full amounts for these alternatives.

The Study identified two measures for reducing demand in the Project: (1) permanent agricultural land retirement and (2) dry-year agricultural land fallowing programs. Both the retirement and fallowing of lands allows water that would have been allocated to those lands to be distributed among the remaining active lands, thereby increasing the reliability of supplies to the remaining active lands.

Despite their similarities, these two measures differ in their performance toward meeting the Study's water supply objective. The permanent retirement measure, as its name suggests, reduces Project demand in all years. A permanent retirement of some lands makes it easier to meet remaining demands in dry years; but, it also results in larger reservoir carry-over storage at the beginning of dry years because demands are also lower during wetter years. Dry-year fallowing programs reduce demand for a given acreage by removing a given acreage of agricultural land from production in "dry-years." For the purpose of this Study, dry-years (sometimes also referred to as "shortage years") are defined as any calendar year (January through December) in which the Project is otherwise unable to deliver more than 95 percent of the total demand. The dry-year fallowing measure has a lower performance in comparison to the permanent retirement measure because it does not provide for additional reservoir carry-over. Thus, for any given alternative to meet the Study's water supply objective, the acreage needed when relying on dry-year fallowing programs will be larger than the acreage needed if the same alternative relied on permanent retirement, instead.

Iterative Approach to Study Alternative Formulation

The analysis presented in this appendix was conducted in support of refinement of Preliminary alternatives into of Study alternatives. This refinement included a final determination of the measures and the extent to which those measures were needed to meet the Study's water supply objective. For the Study alternatives, the ability to meet the water supply objective is affected by some combination of the following measures:

- One of two safety measures:
  - Implementing the safety repair with an HDPE cutoff wall at flow stages of 600, 350 and 250 cfs; and,
  - Implementing the safety repair with a partial Truckee Canal concrete and geomembrane liner at flow stages of 350 and 250 cfs;
- Increasing Project water supply delivery efficiencies to 75% by lining Carson Division canals and laterals; and,
- Reducing Project demand through either permanent retirement or dry-year fallowing.

All of these measures received some representation in the Pre-TROA Planning Model, as described in the previous section. Of these measures, reducing Project demand is the only measure that the Study considered with a variable level of implementation.

Several of the preliminary alternatives that were advanced to be Study alternatives included a potential reliance upon demand reduction (alternatives 350.a, 250.a, and 250.d). For these alternatives, this appendix reports on the analysis conducted to determine the level of demand reduction needed in order to meet the Study's water supply objective. The analysis conducted for these alternatives was also used to inform selection between permanent retirement or dry-year fallowing for the final formulation of the Study alternatives.

The extent of demand reduction needed to meet the Study's water supply objective was estimated through a process of running several simulations, each with an incrementally greater fraction of agricultural demand reduction. Each iterative step considered 5 percent greater reductions in demand until water supplies met or exceeded the performance of the Desired Reliability scenario. Briefly, the Desired Reliability scenario provides a benchmark for water supply deliveries to the Project that are used as the basis for meeting the Study water supply objective. The simulated Desired Reliability relies heavily upon three factors: (1) historical hydrologic conditions, (2) the current pre-TROA regulatory conditions, and (3) a 900 cfs operating capacity for the Truckee Canal. Appendix D1 provides a more detailed description of the Desired Reliability scenario.

The water supply objective was considered to have been met or exceeded when (1) the alternative's long-term average Project delivery equals or exceeds that of the Desired Reliability, and (2) the largest negative difference in supply relative to the Desired Reliability scenario for any of the 100 years simulated was less than 10,000 acre-feet.

Alternatives were first simulated with the permanent land retirement method. For alternatives that required 5 percent or more land retirement to meet the water supply objective, an additional series of analyses were performed to determine the extent of dry-year demand reduction needed to meet the water supply objective.

Table F-3 shows the total demand in acre-feet for each category of water user considered by the Study for each fraction of demand reduction considered in this appendix. The column of "Estimated Future Demand" refers to the total anticipated amount of Project demand, and reflects the historical cultural practice of agricultural rights users calling upon less than the full water righted amount. A more detailed description of demand is provided in Appendix C and Chapter 3 of this Special Report. The following columns adjust the estimated future demand consistent with the percent-reductions in agricultural demand indicated across the second row in the header.

Table F-3. Anticipated Future Potentially Active Newlands Project Water Rights, Adjusted for Cultural Practices and Reduced by Given Fractions of Agricultural Demand

Carson Division Rights		Estimated Future Demand (acre-feet)	Future Demand, if Measures are Implemented to Reduce Agricultural Demand (percent reduction in demand; acre-feet)				
			5%	10%	15%	20%	25%
Ag	Commercial and Noncommercial Farms	105,560	100,282	95,004	89,726	84,448	79,170
	Fallon Paiute-Shoshone Irrigated Lands	10,588	10,588	10,588	10,588	10,588	10,588
M&I	City of Fallon & Churchill County	2,799	2,799	2,799	2,799	2,799	2,799
Env	USFWS Water Rights	61,844	61,844	61,844	61,844	61,844	61,844
	Carson Lake and Pasture	7,183	7,183	7,183	7,183	7,183	7,183
	Fallon Paiute-Shoshone Tribal Wetlands	1,400	1,400	1,400	1,400	1,400	1,400
	Carson Division Subtotal	189,374	184,096	178,818	173,540	168,262	162,984
Truckee Division Rights		**Estimate Future Demand (acre-feet)**	**Future Demand, if Measures are Implemented to Reduce Agricultural Demand (percent reduction in demand; acre-feet)**				
			5%	**10%**	**15%**	**20%**	**25%**
Ag	Commercial and Noncommercial Farms	6,204	5,893	5,583	5,273	4,963	4,653
M&I	City of Fernley & Lyon County	11,249	11,249	11,249	11,249	11,249	11,249
	Truckee Division Subtotal	17,453	17,142	16,832	16,522	16,212	15,902
TOTAL Potentially Active Newlands Project Rights		**206,826**	**201,238**	**195,650**	**190,062**	**184,474**	**178,886**

Notes:
[1] Figures have been rounded to their whole-number equivalents; as a result, some rounding errors may exist.

Key:
Ag = Agricultural
Env = Environmental
M&I = municipal and industrial
USFWS = U.S. Fish and Wildlife Service

Modeling Outputs Considered

Table F-4 presents the RIVERWARE output slots of the Pre-TROA Planning Model considered in the analyses in this appendix. Data from these outputs are compiled for analyses in the "Results and Conclusions" section. Data on hydropower generation and environmental flows are used by this Study to estimate environmental effects (see Chapter 5).

Table F-4. Model Output Slots Used in Subsequent Analyses

Description	RiverWare Output Slot Name
Newlands Project annual deliveries (AF)	NPPS.DeliveryNewlands
Newlands Project annual deliveries (%)	NPPS.PercentTotalNewlandsDelivered
Percent of the Annual Truckee Division Demand that was Delivered (%)	NPPS.PercentTotalTDDDelivered
Volume of Annual Deliveries to the Carson Division Agricultural Irrigation Water Users (AF)	NPPS.DeliveryCarsonIrrig
Volume of Annual Deliveries to the EntireTruckee Division (AF)	NPPS.DeliveryTD
Volume of Annual Deliveries to the Carson Division Municipal and Industrial Water Users (AF)	NPPS.DeliveryCarsonMandI
Volume of Annual Deliveries to Carson Lake and Pasture (AF)	NPPS.DeliveryCLP
Volume of Annual Deliveries to the Fallon Tribe's Wetlands (AF)	NPPS.DeliveryFallonTribeWetlands
Volume of Annual Deliveries to Stillwater National Wildlife Refuge (AF)	NPPS.DeliveryStillwater
Annual Spills from Lahontan reservoir to Stillwater National Wildlife Refuge (TAF)	NPPS.SpillsToStillwater
Average monthly power generated down the V canal in the Carson Division (MW)	NPPS.26FtDropAvgMonthlyPower
Average monthly power generated at the Lahontan Reservoir (MW)	NPPS.LahontanAvgMonthlyPower
Annual flow into Pyramid Lake (TAF)	NPPS.PyramidAnnualInflow

Key:
AF = acre-foot
MW = megawatt
TAF = thousand acre-foot

Results and Conclusions

This appendix does not present water supply reliability in terms of a singular number. Reliability includes two features: (1) the frequency of shortfall, and (2) the magnitude of shortfall. As such, reliability must be presented in a two-dimensional context that allows for the evaluation of both frequency and magnitude.

For this analysis, each alternative was simulated over the full 100-year hydrologic record. Exceedence plots, such as the plot shown in Figure F-1, provide a direct depiction of shortfall frequencies and magnitudes. In these plots, the annual proportion of demand met is ranked from lowest to highest and plotted on a chart in that order. Because the data set the Study used includes exactly 100 years, this plot can simultaneously represent the proportion of years a certain level of demand is met. For example, in the Desired Reliability scenario, at least 80 percent of demand is met 9 out of 10 years. Such a representation allows the reader to make quick assessments about the likelihood and magnitude of shortfalls for a given alternative.

The bottom half of Figure F-1 compares the Desired Reliability with the Without-Action Alternative in terms of the difference of annual deliveries in thousands of acre-feet (TAF). A difference in delivery of zero TAF represents the Desired Reliability; a volume above zero is shown when the alternative's performance surpasses the Desired Reliability, and below zero when the performance falls short of the Desired Reliability. The summation of these delivery differences, or net difference, is calculated from the sum of positive and negative volumes depicted in the lower plots shown in each alternative figure. Negative net differences indicate that a deficit exists between the Desired Reliability and the long-term average water supply for the given alternative. Positive, or net zero conditions, indicate that the long-term average delivery appears equal to or better than the Desired Reliability condition.

Several observations can be made from comparing the performances of the various alternatives plotted in figures in this appendix. The following subsections summarize each of the alternatives considered and compare the performance of each alternative to the Desired Reliability condition and the Without Action Alternative. The assessments help the Study explore the various means to meet the Study's safety and water supply objectives.

Without-Action Alternative

The Without-Action Alternative is characterized by a reduced flow of150 cfs in the Truckee Canal, without any actions to meet the safety and water supply objectives of the Study beyond those currently planned and funded. As demonstrated in the following analysis, the Without-Action Alternative fails to meet the Study's water supply objective.

Results from the Without Action Alternative are summarized below and on the following two pages of this appendix. Table F-5 compares the simulated conditions of the Without-Action Alternative and the Desired Reliability condition for a variety of conditions in the Newlands Project that the Study uses to assess the performance of alternatives with respect to: water supply reliability, economic and financial conditions of the Project, and environmental conditions within the study area. Figure F-1 displays the Project water supply performance of the Without-Action Alternative relative to the Desired Reliability.

Summary of Without-Action Alternative

The Without-Action Alternative does not meet either of the two conditions needed to achieve the Study's water supply objective: (1) as shown in Table F-5, the long-term average delivery of Project water (90.5 percent) is less than the desired reliability (94.6 percent); (2) as shown in Figure F-1, the largest annual difference in supply relative to the Desired Reliability scenario is approximately negative-48,000 acre-feet, which exceeds the desired negative-10,000 acre-foot threshold.

The data summarized in Table F-5 were used to assess economic and financial conditions of the Project (Chapter 5 and Appendix G) and environmental conditions within the study area (Chapter 5) under the Without-Action Alternative.

Table F-5. Performance Summary of the Without-Action Alternative

	Without-Action Alternative	Desired Reliability Scenario
Average Demand Met[1] (%)	90.5%	94.6%
Number of Years where >95% of Demand is Met	68 years	86 years
Number of Years where <50% of Demand Met	7 years	3 years
Percent of Demand Met in Driest Year (%)	38.4%	40.0%
Average Annual Deliveries to Ag/Irrigation (TAF)	111.2	NA
Average Annual Deliveries to M&I (TAF)	13.2	NA
City of Fernley Demand Met[2] (%)	99%	121%
Average Annual Deliveries to Lahontan Valley Wetlands (TAF)	63.6	NA
Deliveries to Stillwater NWR (TAF)	*55.8*	*NA*
Deliveries to other Lahontan Valley Wetlands (TAF)	*7.8*	*NA*
Average Annual Hydropower Generation (MWh)	18,467	NA
Avg. Annual Spill from Lahontan Dam (TAF)	11.0	12.5
Annual Flow to Pyramid Lake[3] (TAF)	516	460

Notes:

[1] The 100 year average of Project deliveries, as a percent of total demand met.

[2] Where average Truckee Division demand met was 94.5%. Refer to Appendix B4 for methods.

[3] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

Key:

Ag = agriculture

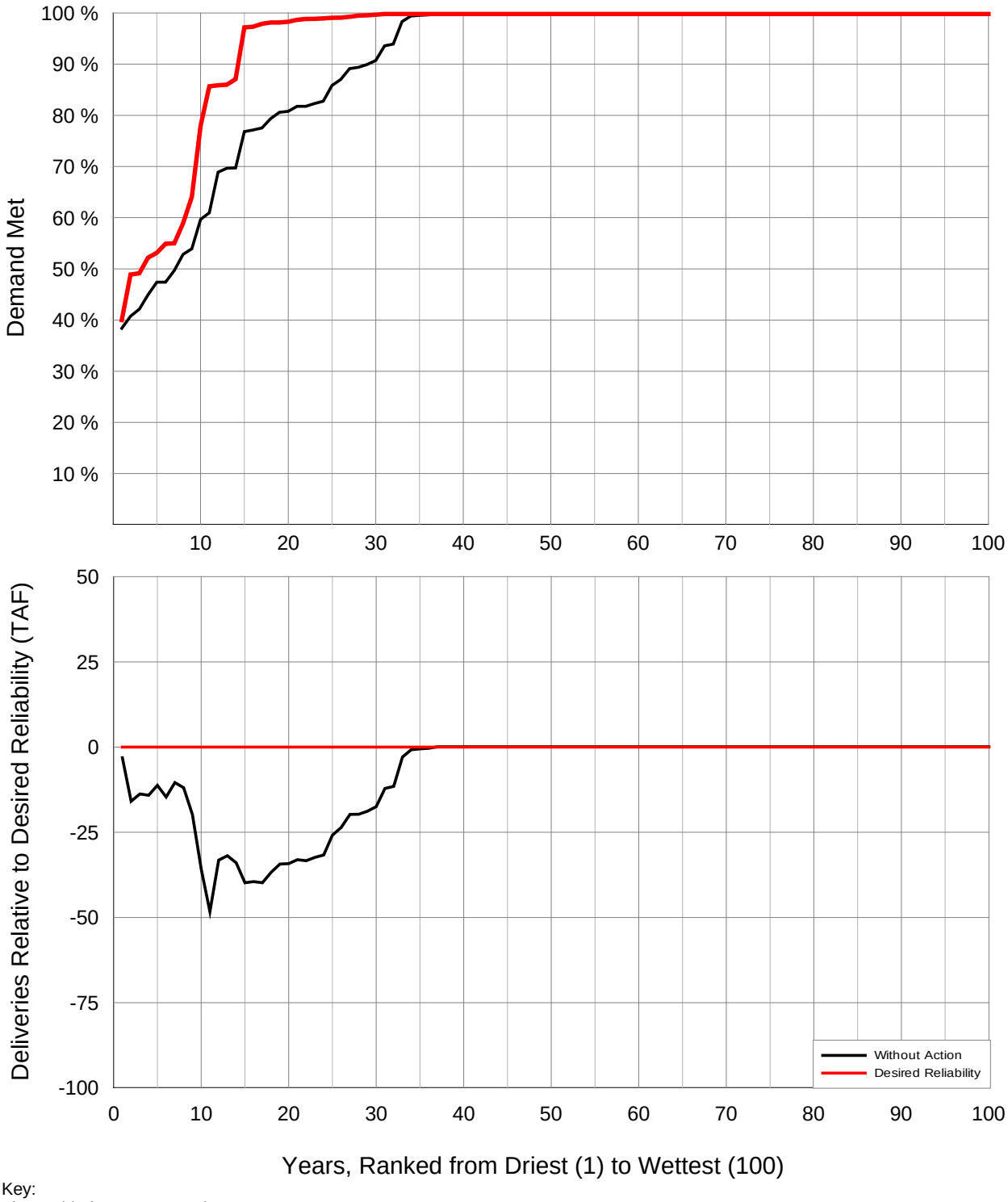
M&I = municipal and industrial

MWh = megawatt-hours

NA = not applicable

NWR = national wildlife refuge

TAF = thousand acre-feet



Key:
cfs = cubic feet per second

Figure F-1. Relative Performance of the Without-Action Alternative on Annual Newlands Project Deliveries

Alternative 600

Alternative 600 is characterized by a Truckee Canal that has been improved with the addition of a cutoff wall, allowing for a conveyance capacity of up to 600 cfs. As demonstrated in the following analysis, Alternative 600 meets the Study's water supply objective.

Results from Alternative 600 are summarized below and on the following two pages of this appendix. Table F-6 compares the simulated conditions of Alternative 600 to the Without-Action Alternative and the Desired Reliability condition for a variety of conditions in the Newlands Project that the Study uses to assess the performance of alternatives with respect to water supply reliability, economic and financial conditions of the Project, and environmental conditions within the study area. Figure F-2 displays the Project water supply performance under Alternative 600 relative to the Without-Action Alternative and the Desired Reliability.

Summary of Alternative 600

Alternative 600 meets or exceeds both of the conditions needed to achieve the Study's water supply objective: (1) as shown in Table F-6, the long-term average delivery of Project water (96.5 percent) exceeds that of the Desired Reliability scenario (94.6 percent); and (2) as shown in Figure F-2, deliveries for Alternative 600 exceed those for the Desired Reliability for each of the 100 years evaluated.

The data summarized in Table F-6 were used to assess economic and financial conditions of the Project (Chapter 5 and Appendix G) and environmental conditions within the study area (Chapter 5) under the Alternative 600.

Table F-6. Performance Summary of Alternative 600

	Alternative 600	Without-Action Alternative	Desired Reliability Scenario
Average Demand Met[1] (%)	96.5%	90.5%	94.6%
Number of Years where >95% of Demand is Met	88 years	68 years	86 years
Number of Years where <50% of Demand Met	0 years	7 years	3 years
Percent of Demand Met in Driest Year (%)	51.8%	38.4%	40.0%
Average Annual Deliveries to Ag/Irrigation (TAF)	118.3	111.2	NA[4]
Average Annual Deliveries to M&I (TAF)	13.3	13.2	NA[4]
City of Fernley Demand Met[2] (%)	115%	99%	121%
Average Annual Deliveries to Lahontan Valley Wetlands (TAF)	68.0	63.6	NA[4]
Deliveries to Stillwater NWR (TAF)	*60.0*	*55.8*	*NA[4]*
Deliveries to other LV Wetlands (TAF)	*8.0*	*7.8*	*NA[4]*
Average Annual Hydropower Generation (MWh)	21,147	18,467	NA[4]
Avg. Annual Spill from Lahontan Dam (TAF)	12.6	11.0	12.5
Annual Flow to Pyramid Lake[3] (TAF)	480	516	460

Notes:

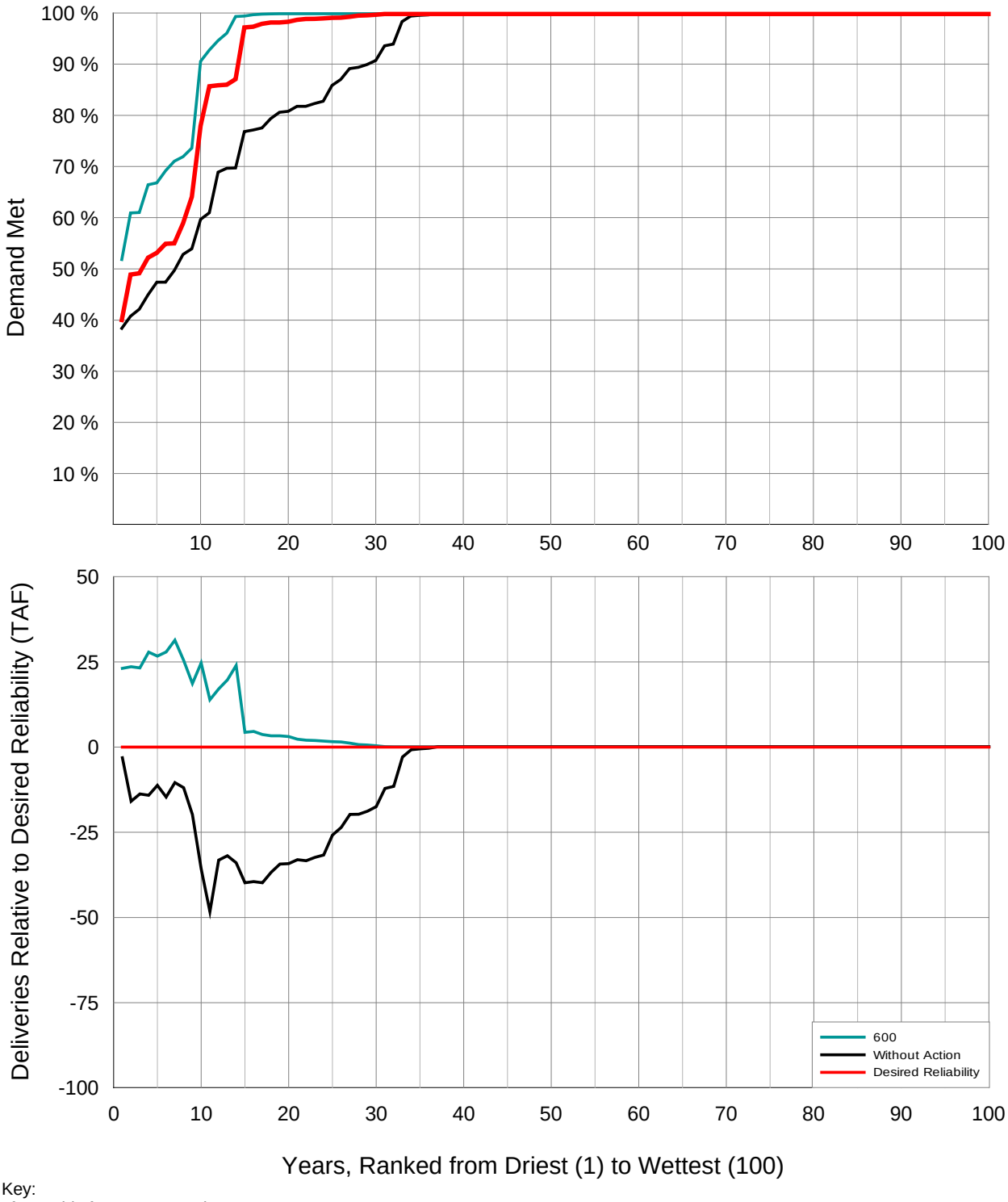
[1] The 100 year average of Project deliveries, as a percent of total demand met.

[2] Where average Truckee Division demand met was 94.5%. Refer to Appendix B4 for methods.

[3] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

[4] Study alternatives and the Desired Reliability scenario differ substantially in the distribution of water rights among user groups, which prevents appropriate comparison of average annual deliveries to specific water user groups.

Key:
Ag = agriculture
LV = Lahontan Valley
M&I = municipal and industrial
MWh = megawatt-hours
NA = not applicable
NWR = national wildlife refuge
TAF = thousand acre-feet



Key:
cfs = cubic feet per second

Figure F-2. Relative Performance of Alternative 600 on Annual Newlands Project Deliveries

Alternative 350.a

Alternative 350.a is characterized by a 350 cfs flow stage in the Truckee Canal that has been improved with the addition of a cutoff wall. Neither permanent agricultural land retirement nor a dry-year land fallowing program to decrease Project demand was found to be necessary for Alternative 350.a to meet the Desired Reliability level. As demonstrated in the following analysis, Alternative 350.a meets the Study's water supply objective.

Results from Alternative 350.a are summarized below and on the following two pages of this appendix. Table F-7 compares the simulated conditions of Alternative 350.a to the Without-Action Alternative and the Desired Reliability condition for a variety of conditions in the Newlands Project that the Study uses to assess the performance of alternatives with respect to: water supply reliability, economic and financial conditions of the Project, and environmental conditions within the study area. Figure F-3 displays the Project water supply performance under Alternative 350.a relative to the Without-Action Alternative and the Desired Reliability.

Summary of Alternative 350.a

Alternative 350.a meets or exceeds both of the conditions needed to achieve the Study's water supply objective: (1) as shown in Table F-7, the long-term average delivery of Project water (95.6 percent) exceeds that of the Desired Reliability scenario (94.6 percent); and (2) as shown in Figure F-3, the largest annual difference in supply relative to the Desired Reliability scenario is approximately negative-8,000 acre-feet, which is below the desired negative-10,000 acre-foot threshold.

The data summarized in Table F-7 were used to assess economic and financial conditions of the Project (Chapter 5 and Appendix G) and environmental conditions within the study area (Chapter 5) under Alternative 350.a.

Table F-7. Performance Summary of Alternative 350.a

	Alternative 350.a	Without-Action Alternative	Desired Reliability Scenario
Average Demand Met[1] (%)	95.6%	90.5%	94.6%
Number of Years where >95% of Demand is Met	85 years	68 years	86 years
Number of Years where <50% of Demand Met	0 years	7 years	3 years
Percent of Demand Met in Driest Year (%)	50.6%	38.4%	40.0%
Average Annual Deliveries to Ag/Irrigation (TAF)	117.2	111.2	NA[4]
Average Annual Deliveries to M&I (TAF)	13.3	13.2	NA[4]
City of Fernley Demand Met[2] (%)	108%	99%	121%
Average Annual Deliveries to Lahontan Valley Wetlands (TAF)	67.3	63.6	NA[4]
Deliveries to Stillwater NWR (TAF)	*59.1*	*55.8*	*NA[4]*
Deliveries to other LV Wetlands (TAF)	*8.2*	*7.8*	*NA[4]*
Average Annual Hydropower Generation (MWh)	20,510	18,467	NA[4]
Avg. Annual Spill from Lahontan Dam (TAF)	12.1	11.0	12.5
Annual Flow to Pyramid Lake[3] (TAF)	487	516	460

Notes:

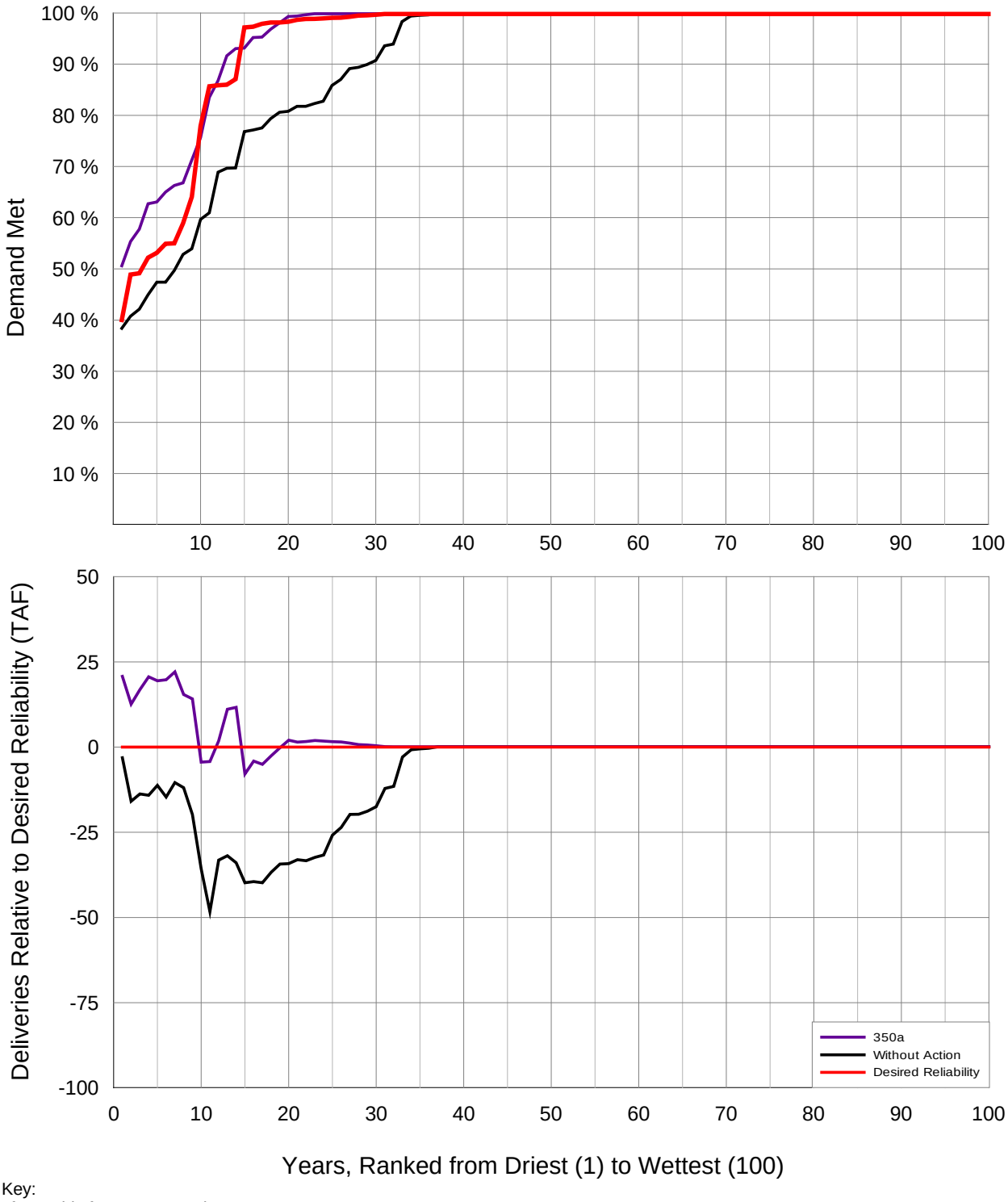
[1] The 100 year average of Project deliveries, as a percent of total demand met.

[2] Where average Truckee Division demand met was 94.5%. Refer to Appendix B4 for methods.

[3] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

[4] Study alternatives and the Desired Reliability scenario differ substantially in the distribution of water rights among user groups, which prevents appropriate comparison of average annual deliveries to specific water user groups.

Key:
Ag = agriculture
LV = Lahontan Valley
M&I = municipal and industrial
MWh = megawatt-hours
NA = not applicable
NWR = national wildlife refuge
TAF = thousand acre-feet



Key:
cfs = cubic feet per second

Figure F-3. Relative Performance of Alternative 350.a on Annual Newlands Project Deliveries

Alternative 350.b

Alternative 350.b is characterized by: (1) a 350 cfs flow stage in the Truckee Canal that has been improved with the addition of a cutoff wall and (2) lining of Carson Division canals. As demonstrated in the following analysis, Alternative 350.b meets the Study's water supply objective.

Results from Alternative 350.b are summarized below and on the following two pages of this appendix. Table F-8 compares the simulated conditions of Alternative 350.b to the Without-Action Alternative and the Desired Reliability condition for a variety of conditions in the Newlands Project that the Study uses to assess the performance of alternatives with respect to: water supply reliability, economic and financial conditions of the Project, and environmental conditions within the study area. Figure F-4 displays the Project water supply performance under Alternative 350.b relative to the Without-Action Alternative and the Desired Reliability.

Summary of Alternative 350.b

Alternative 350.b meets or exceeds both of the conditions needed to achieve the Study's water supply objective: (1) as shown in Table F-8, the long-term average delivery of Project water (97.3 percent) exceeds that of the Desired Reliability scenario (94.6 percent); and (2) as shown in Figure F-4, deliveries for Alternative 350.b exceed those for the Desired Reliability for each of the 100 years evaluated.

The data summarized in Table F-8 was used to assess economic and financial conditions of the Project (Chapter 5 and Appendix G) and environmental conditions within the study area (Chapter 5) under Alternative 350.b.

Table F-8. Performance Summary of Alternative 350.b

	Alternative 350.b	Without-Action Alternative	Desired Reliability Scenario
Average Demand Met[1] (%)	97.3%	90.5%	94.6%
Number of Years where >95% of Demand is Met	90 years	68 years	86 years
Number of Years where <50% of Demand Met	0 years	7 years	3 years
Percent of Demand Met in Driest Year (%)	57.7%	38.4%	40.0%
Average Annual Deliveries to Ag/Irrigation (TAF)	119.2	111.2	NA[4]
Average Annual Deliveries to M&I (TAF)	13.4	13.2	NA[4]
City of Fernley Demand Met[2] (%)	108%	99%	121%
Average Annual Deliveries to Lahontan Valley Wetlands (TAF)	68.6	63.6	NA[4]
Deliveries to Stillwater NWR (TAF)	*60.2*	*55.8*	*NA[4]*
Deliveries to other LV Wetlands (TAF)	*8.4*	*7.8*	*NA[4]*
Average Annual Hydropower Generation (MWh)	19,510	18,467	NA[4]
Avg. Annual Spill from Lahontan Dam (TAF)	14.3	11.0	12.5
Annual Flow to Pyramid Lake[3] (TAF)	505	516	460

Notes:

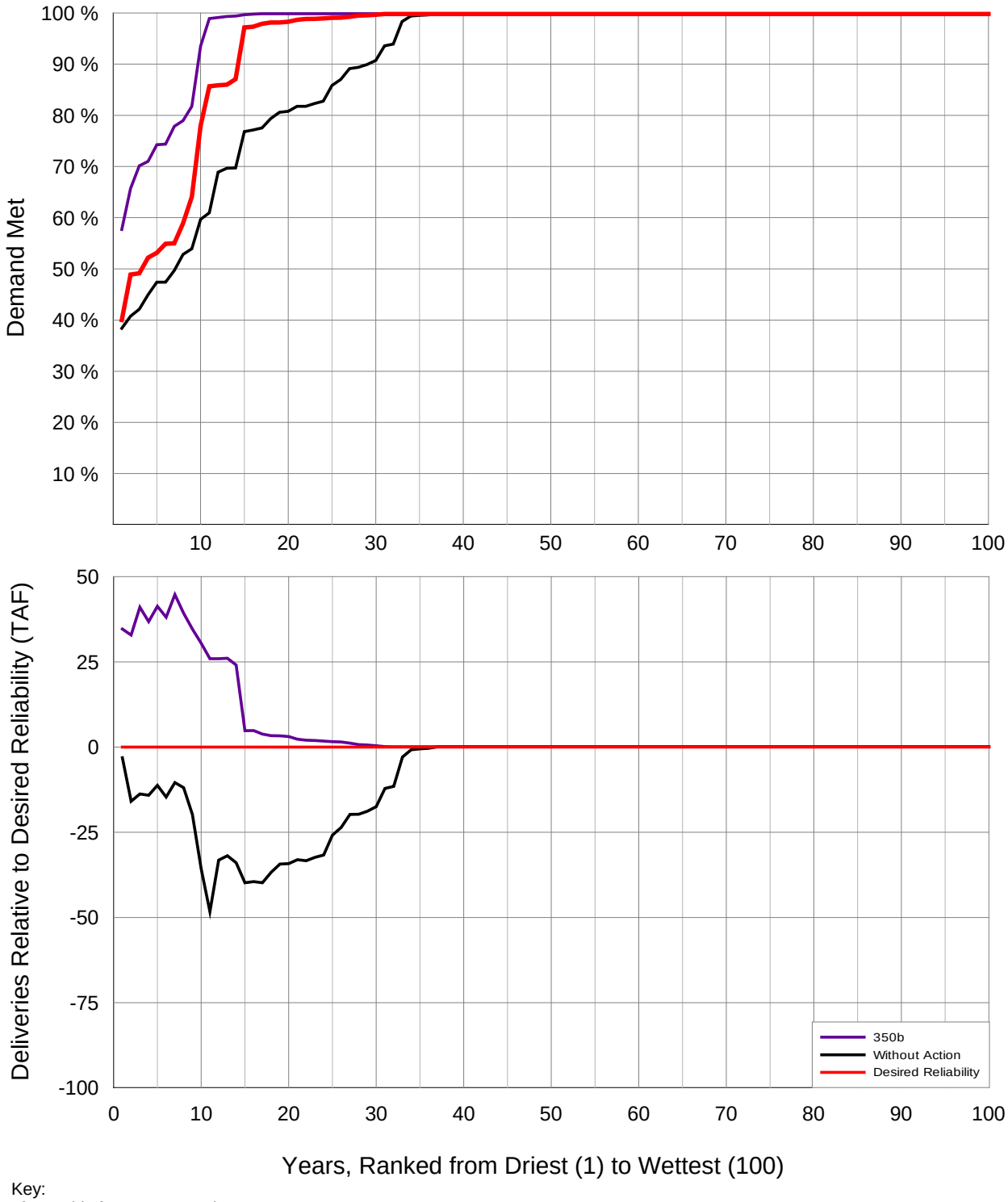
[1] The 100 year average of Project deliveries, as a percent of total demand met.

[2] Where average Truckee Division demand met was 94.5%. Refer to Appendix B4 for methods.

[3] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

[4] Study alternatives and the Desired Reliability scenario differ substantially in the distribution of water rights among user groups, which prevents appropriate comparison of average annual deliveries to specific water user groups.

Key:
Ag = agriculture
LV = Lahontan Valley
M&I = municipal and industrial
MWh = megawatt-hours
NA = not applicable
NWR = national wildlife refuge
TAF = thousand acre-feet



Key:
cfs = cubic feet per second

Figure F-4. Relative Performance of Alternative 350.b on Annual Newlands Project Deliveries

Alternative 350.d

Alternative 350.d is characterized by a 350 cfs flow stage in the Truckee Canal that has been improved with a concrete/geomembrane lining. As demonstrated in the following analysis, Alternative 350.d meets the Study's water supply objective.

Results from Alternative 350.d are summarized below and on the following two pages of this appendix. Table F-9 compares the simulated conditions of Alternative 350.d to the Without-Action Alternative and the Desired Reliability condition for a variety of conditions in the Newlands Project that the Study uses to assess the performance of alternatives with respect to: water supply reliability, economic and financial conditions of the Project, and environmental conditions within the study area. Figure F-5 displays the Project water supply performance under Alternative 350.d relative to the Without-Action Alternative and the Desired Reliability.

Summary of Alternative 350.d

Alternative 350.d meets or exceeds both of the conditions needed to achieve the Study's water supply objective: (1) as shown in Table F-9, the long-term average delivery of Project water (96.3 percent) exceeds that of the Desired Reliability scenario (94.6 percent); and (2) as shown in Figure F-5, deliveries for Alternative 350.d exceed those for the Desired Reliability for each of the 100 years evaluated.

The data summarized in Table F-9 were used to assess economic and financial conditions of the Project (Chapter 5 and Appendix G) and environmental conditions within the study area (Chapter 5) under Alternative 350.d.

Table F-9. Performance Summary of Alternative 350.d

	Alternative 350.d	Without-Action Alternative	Desired Reliability Scenario
Average Demand Met[1] (%)	96.3%	90.5%	94.6%
Number of Years where >95% of Demand is Met	88 years	68 years	86 years
Number of Years where <50% of Demand Met	0 years	7 years	3 years
Percent of Demand Met in Driest Year (%)	52.9%	38.4%	40.0%
Average Annual Deliveries to Ag/Irrigation (TAF)	118.0	111.2	NA[4]
Average Annual Deliveries to M&I (TAF)	13.3	13.2	NA[4]
City of Fernley Demand Met[2] (%)	56%	99%	121%
Average Annual Deliveries to Lahontan Valley Wetlands (TAF)	67.8	63.6	NA[4]
Deliveries to Stillwater NWR (TAF)	*59.4*	*55.8*	*NA[4]*
Deliveries to other LV Wetlands (TAF)	*8.4*	*7.8*	*NA[4]*
Average Annual Hydropower Generation (MWh)	20,928	18,467	NA[4]
Avg. Annual Spill from Lahontan Dam (TAF)	13.2	11.0	12.5
Annual Flow to Pyramid Lake[3] (TAF)	491	516	460

Notes:

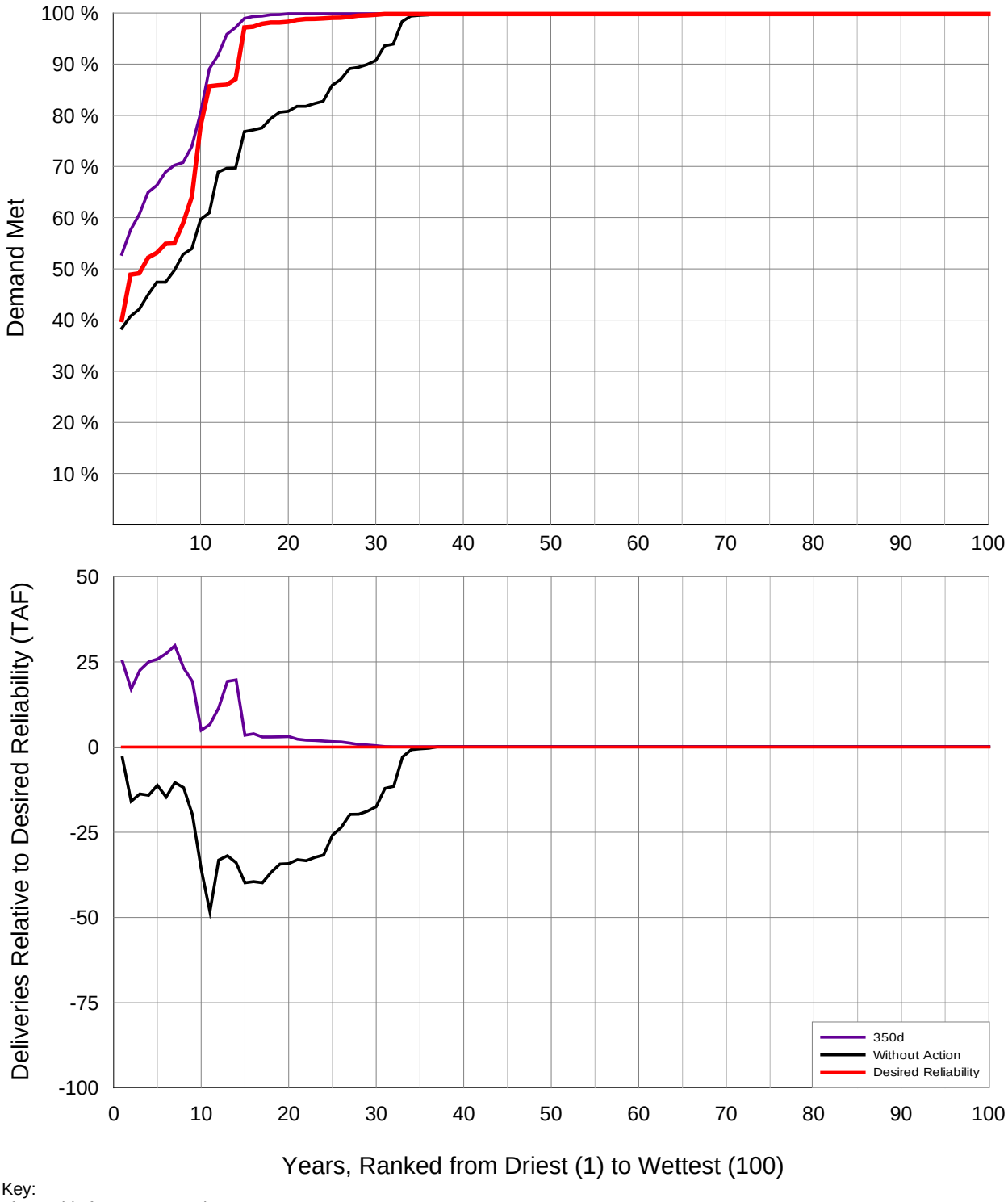
[1] The 100 year average of Project deliveries, as a percent of total demand met.

[2] Where average Truckee Division demand met was 94.5%. Refer to Appendix B4 for methods.

[3] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

[4] Study alternatives and the Desired Reliability scenario differ substantially in the distribution of water rights among user groups, which prevents appropriate comparison of average annual deliveries to specific water user groups.

Key:
Ag = agriculture
LV = Lahontan Valley
M&I = municipal and industrial
MWh = megawatt-hours
NA = not applicable
NWR = national wildlife refuge
TAF = thousand acre-feet



Key:
cfs = cubic feet per second

Figure F-5. Relative Performance of Alternative 350.d on Annual Newlands Project Deliveries

Alternative 250.a

Alternative 250.a is characterized by: (1) a 250 cfs flow in the Truckee Canal that has been improved with the addition of a cutoff wall, and (2) a program to reduce agricultural demand to meet Desired Reliability.

Project agricultural demand reduction could be accomplished using either of two measures identified by the Study: permanent retirement of water-righted land or dry-year fallowing. For Alternative 250.a, 22 of the 100 years simulated were identified as dry-years, meaning that total water delivery to the Project fell below 95-percent of demand for those years. Because demand reduction is scalable, the following analysis was conducted to determine the extent of either measure needed to achieve the Study's water supply objective under Alternative 250.a.

The following four figures and tables summarize results of an iterative analysis, conducted to determine the extent of (1) permanent retirement or (2) dry-year demand reduction required to meet the Study's water supply objective under Alternative 250.a. Figure F-6 shows the results from the first set of analysis, which assesses the effects of permanent water-righted land retirement on the water supply reliability of Alternative 250.a, in 5-percent increments from 0 through 15 percent retirement. Figure F-7 shows the results from the second set of analysis, which assesses the effects of dry-year fallowing on the water supply reliability of Alternative 250.a, in 5-percent increments from 20 through 25-percent dry-year fallowing (see Table F-3). Because dry-year fallowing programs are relatively less effective per acre than permanent retirement, a greater extent of temporary fallowing was assumed to be required to achieve equivalent levels of performance as permanent retirement. The starting point for the dry-year analysis was 20 percent fallowing during dry years, and continued in 5-percent increments to 25 percent fallowing during dry years.

Table F-10 compares the simulated conditions of a 250-cfs Truckee Canal and 15 percent permanent retirement with the Without-Action Alternative and the Desired Reliability condition. Table F-11 compares the simulated conditions of a 250-cfs Truckee Canal and 25 percent dry-year fallowing with the Without-Action Alternative and the Desired Reliability condition. Comparisons in these two tables repot on a variety of conditions in the Newlands Project that the Study uses to assess the performance of alternatives with respect to: water supply reliability, economic and financial conditions of the Project, and environmental conditions within the study area.

Summary of Alternative 250.a

Alternative 250.a meets or exceeds both of the conditions needed to achieve the Study's water supply objective, either with 15 percent permanent retirement or 25 percent dry-year fallowing.

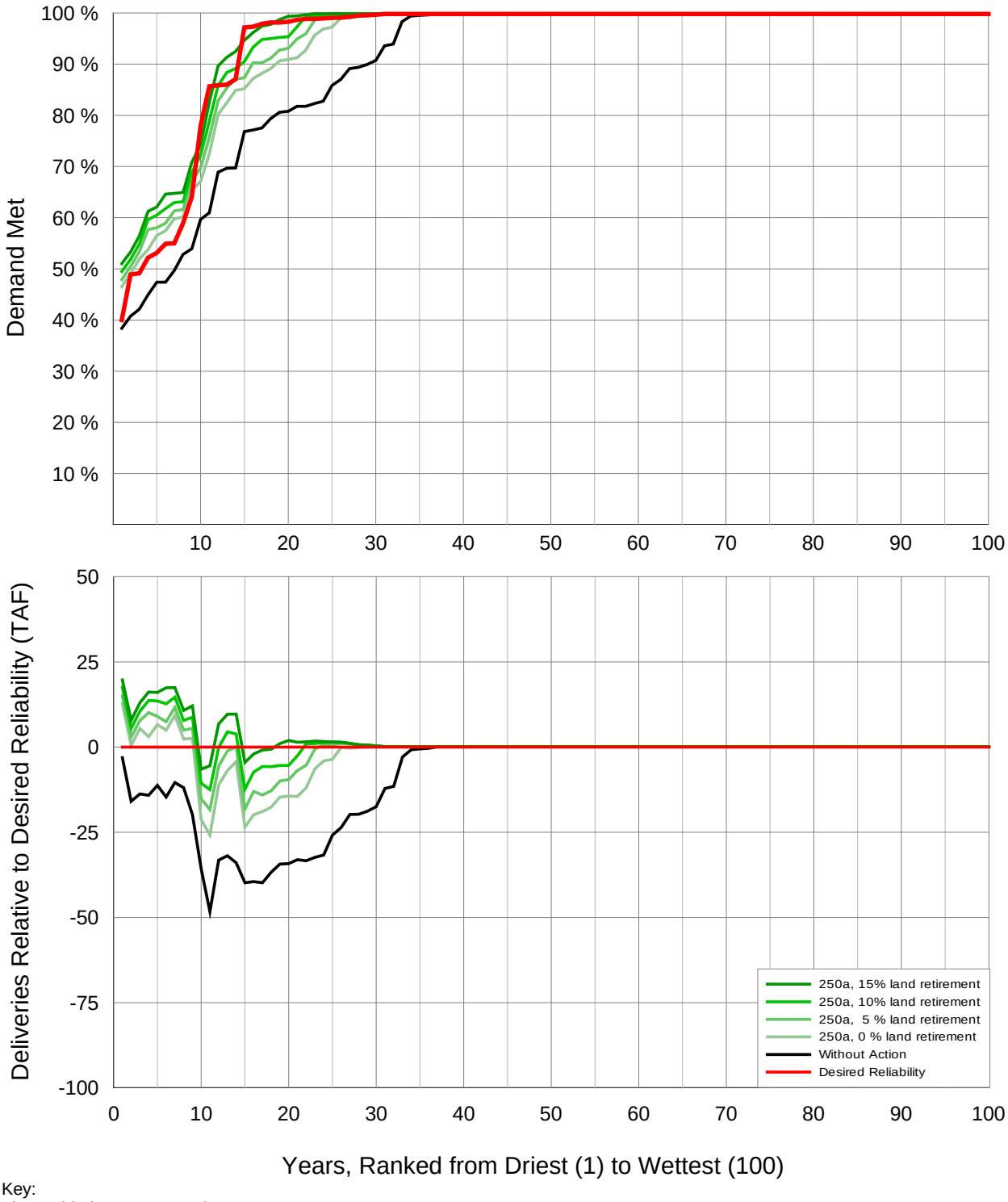
For Alternative 250.a with 15 percent permanent retirement, the long-term average delivery of Project water (95.5 percent) exceeds that of the Desired

Reliability scenario (94.6 percent) (see Table F-10). Additionally, the largest annual difference in supply relative to the Desired Reliability scenario is approximately negative-6,000 acre-feet, which is below the desired negative-10,000 acre-foot threshold (see Figure F-6).

For Alternative 250.a with 25 percent dry year fallowing, the long-term average delivery of Project water (95.7 percent) exceeds that of the Desired Reliability scenario (94.6 percent) (see Table F-11). Additionally, the largest annual difference in supply relative to the Desired Reliability scenario is approximately negative-9,000 acre-feet, which meets the desired negative-10,000 acre-foot threshold (see Figure F-7).

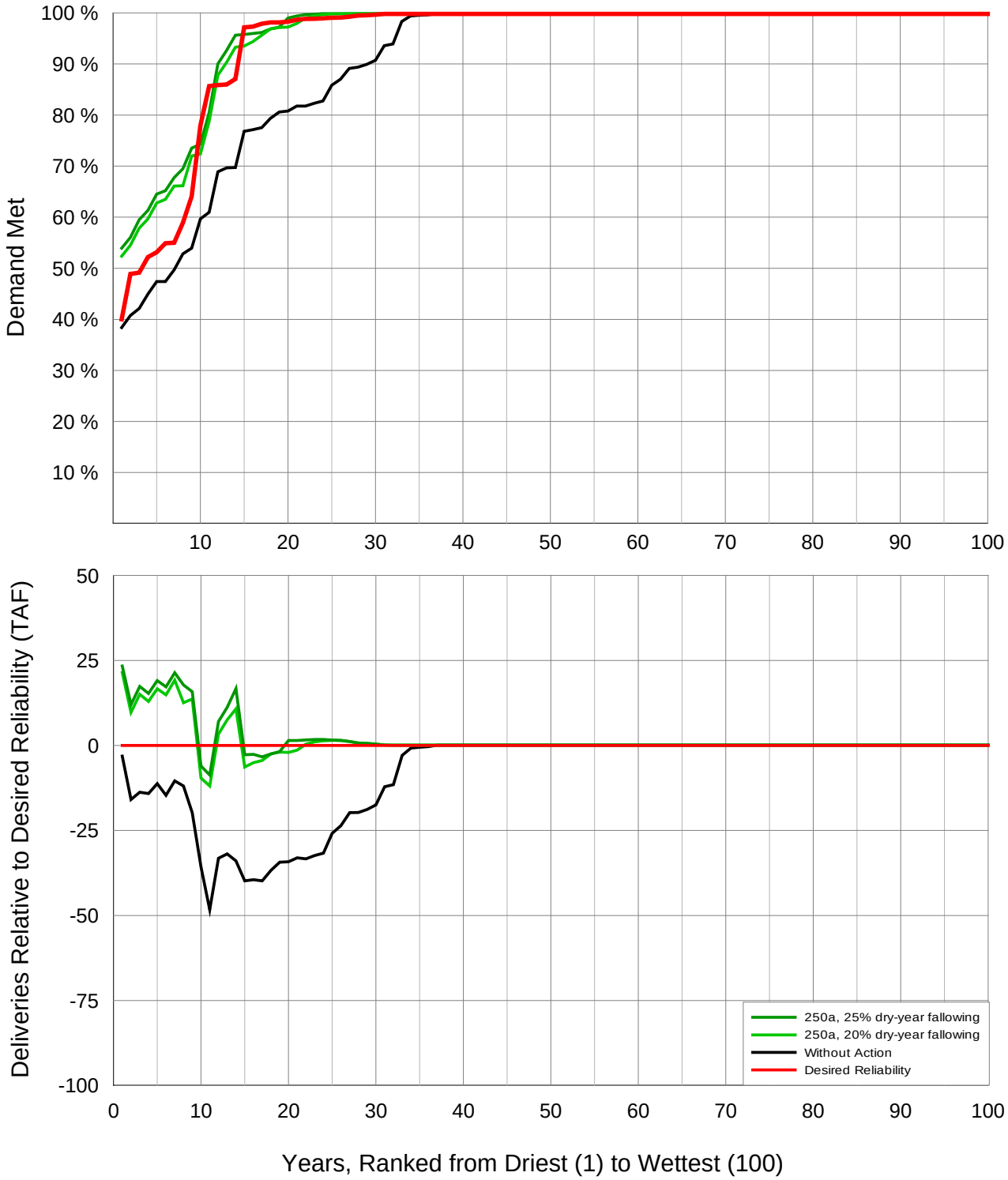
For Alternative 250.a, the Study selected the dry-year fallowing measure as the most appropriate option for demand reduction in this alternative. While the fallowing option is more expensive than the retirement, its selection was made with regard to completeness and acceptability considerations identified by Project water rights holders. This selection was made during the screening and selection of Study Alternatives, as described in Chapter 4.

The data summarized in Table F-11 were used to assess economic and financial conditions of the Project (Chapter 5 and Appendix G) and environmental conditions within the study area (Chapter 5) under Alternative 250.a.



Key:
cfs = cubic feet per second

Figure F-6. Relative Performance of Alternative 250.a with Permanent Retirement on Annual Newlands Project Deliveries



Key:
cfs = cubic feet per second

Figure F-7. Relative Performance of Alternative 250.a with Dry-Year Land Fallowing on Annual Newlands Project Deliveries

Table F-10. Performance Summary of Alternative 250.a, 15% Permanent Retirement

	Alternative 250.a, 15% Permanent Retirement	Without-Action Alternative	Desired Reliability Scenario
Average Demand Met[1] (%)	95.5%	90.5%	94.6%
Number of Years where >95% of Demand is Met	85 years	68 years	86 years
Number of Years where <50% of Demand Met	0 years	7 years	3 years
Percent of Demand Met in Driest Year (%)	51.0%	38.4%	40.0%
Average Annual Deliveries to Ag/Irrigation (TAF)	90.6	111.2	NA[4]
Average Annual Deliveries to M&I (TAF)	13.3	13.2	NA[4]
City of Fernley Demand Met[2] (%)	105%	99%	121%
Average Annual Deliveries to Lahontan Valley Wetlands (TAF)	67.2	63.6	NA[4]
Deliveries to Stillwater NWR (TAF)	*59.0*	*55.8*	*NA[4]*
Deliveries to other LV Wetlands (TAF)	*8.2*	*7.8*	*NA[4]*
Average Annual Hydropower Generation (MWh)	19,449	18,467	NA[4]
Avg. Annual Spill from Lahontan Dam (TAF)	13.0	11.0	12.5
Annual Flow to Pyramid Lake[3] (TAF)	507	516	460

Notes:

[1] The 100 year average of Project deliveries, as a percent of total demand met.

[2] Where average Truckee Division demand met was 94.5%. Refer to Appendix B4 for methods.

[3] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

[4] Study alternatives and the Desired Reliability scenario differ substantially in the distribution of water rights among user groups, which prevents appropriate comparison of average annual deliveries to specific water user groups.

Key:
Ag = agriculture
LV = Lahontan Valley
M&I = municipal and industrial
MWh = megawatt-hours
NA = not applicable
NWR = national wildlife refuge
TAF = thousand acre-feet

Table F-11. Performance Summary of Alternative 250.a, 25% Dry-Year Fallowing

	Alternative 250.a, 25% Dry-Year Fallowing	Without-Action Alternative	Desired Reliability Scenario
Average Demand Met[1] (%)	95.7%	90.5%	94.6%
Number of Years where >95% of Demand is Met	87 years	68 years	86 years
Number of Years where <50% of Demand Met	0 years	7 years	3 years
Percent of Demand Met in Driest Year (%)	53.9%	38.4%	40.0%
Average Annual Deliveries to Ag/Irrigation (TAF)	112.4	111.2	NA[4]
Average Annual Deliveries to M&I (TAF)	13.3	13.2	NA[4]
City of Fernley Demand Met[2] (%)	105%	99%	121%
Average Annual Deliveries to Lahontan Valley Wetlands (TAF)	67.4	63.6	NA[4]
Deliveries to Stillwater NWR (TAF)	*59.2*	*55.8*	*NA[4]*
Deliveries to other LV Wetlands (TAF)	*8.2*	*7.8*	*NA[4]*
Average Annual Hydropower Generation (MWh)	19,787	18,467	NA[4]
Avg. Annual Spill from Lahontan Dam (TAF)	11.6	11.0	12.5
Annual Flow to Pyramid Lake[3] (TAF)	498	516	460

Notes:

[1] The 100 year average of Project deliveries, as a percent of total demand met.

[2] Where average Truckee Division demand met was 94.5%. Refer to Appendix B4 for methods.

[3] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

[4] Study alternatives and the Desired Reliability scenario differ substantially in the distribution of water rights among user groups, which prevents appropriate comparison of average annual deliveries to specific water user groups.

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LV = Lahontan Valley
M&I = municipal and industrial
MWh = megawatt-hours
NA = not applicable
NWR = national wildlife refuge
TAF = thousand acre-feet

Alternative 250.b

Alternative 250.b is characterized by: (1) a 250 cfs flow in the Truckee Canal that has been improved with the addition of a cutoff wall and (2) lining of Carson Division canals. As demonstrated in the following analysis, Alternative 250.b meets the Study's water supply objective.

Results from Alternative 250.b are summarized below and on the following two pages of this appendix. Table F-12 compares the simulated conditions of Alternative 250.b to the Without-Action Alternative and the Desired Reliability condition for a variety of conditions in the Newlands Project that the Study uses to assess the performance of alternatives with respect to: water supply reliability, economic and financial conditions of the Project, and environmental conditions within the study area. Figure F-8 displays the Project water supply performance under Alternative 250.b relative to the Without-Action Alternative and the Desired Reliability.

Summary of Alternative 250.b

Alternative 250.b meets or exceeds both of the conditions needed to achieve the Study's water supply objective: (1) as shown in Table F-12, the long-term average delivery of Project water (96.2 percent) exceeds that of the Desired Reliability scenario (94.6 percent); and (2) as shown in Figure F-8, deliveries for Alternative 250.b exceed those for the Desired Reliability for each of the 100 years evaluated.

The data summarized in Table F-12 was used to assess economic and financial conditions of the Project (Chapter 5 and Appendix G) and environmental conditions within the study area (Chapter 5) under the Without-Action Alternative.

Table F-12. Performance Summary of Alternative 250.b

	Alternative 250.b	Without-Action Alternative	Desired Reliability Scenario
Average Demand Met[1] (%)	96.2%	90.5%	94.6%
Number of Years where >95% of Demand is Met	89 years	68 years	86 years
Number of Years where <50% of Demand Met	0 years	7 years	3 years
Percent of Demand Met in Driest Year (%)	53.4%	38.4%	40.0%
Average Annual Deliveries to Ag/Irrigation (TAF)	118.0	111.2	NA[4]
Average Annual Deliveries to M&I (TAF)	13.3	13.2	NA[4]
City of Fernley Demand Met[2] (%)	105%	99%	121%
Average Annual Deliveries to Lahontan Valley Wetlands (TAF)	67.2	63.6	NA[4]
Deliveries to Stillwater NWR (TAF)	*59.5*	*55.8*	*NA[4]*
Deliveries to other LV Wetlands (TAF)	*7.7*	*7.8*	*NA[4]*
Average Annual Hydropower Generation (MWh)	18,972	18,467	NA[4]
Avg. Annual Spill from Lahontan Dam (TAF)	13.9	11	12.5
Annual Flow to Pyramid Lake[3] (TAF)	512	516	460

Notes:

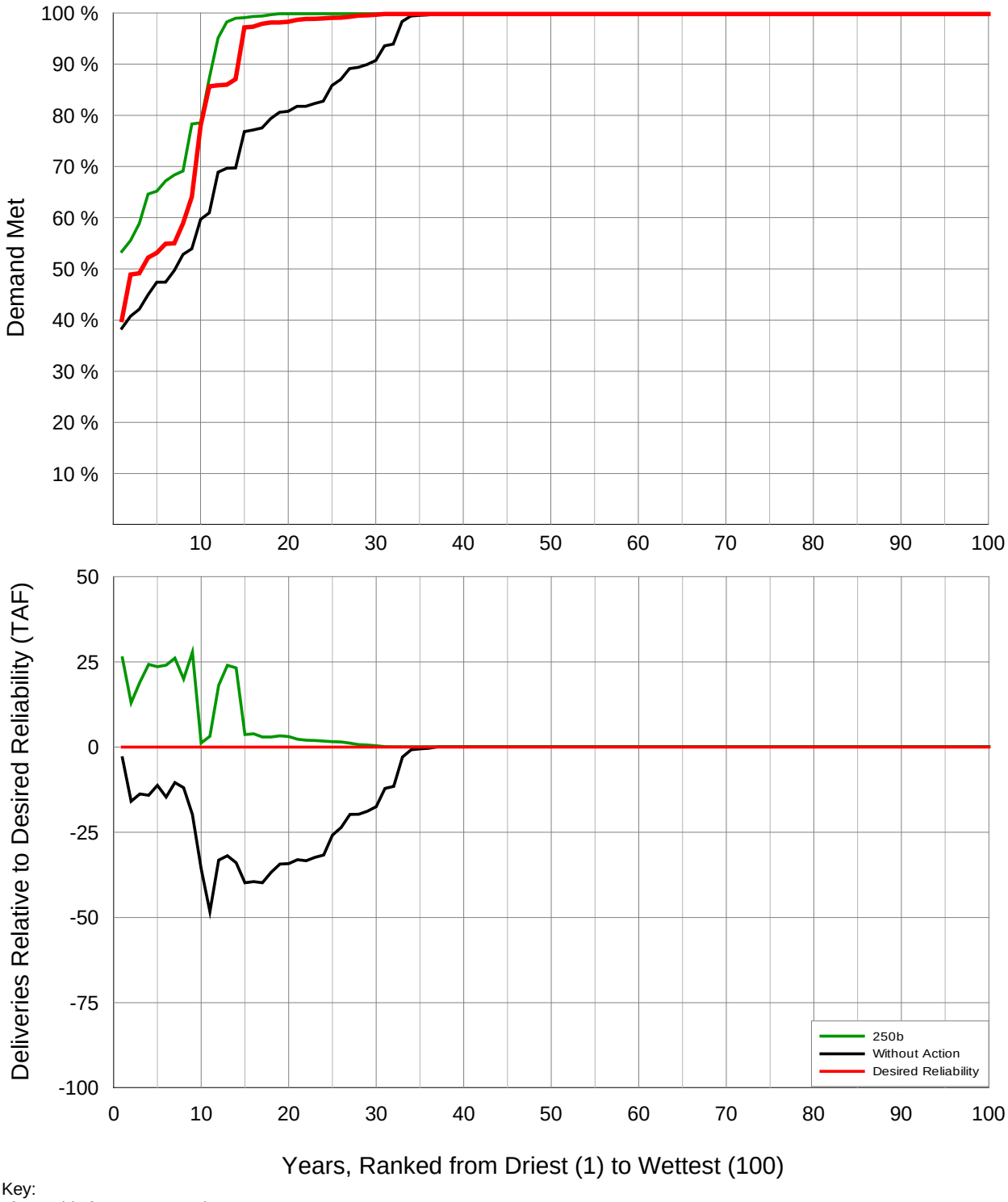
[1] The 100 year average of Project deliveries, as a percent of total demand met.

[2] Where average Truckee Division demand met was 94.5%. Refer to Appendix B4 for methods.

[3] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

[4] Study alternatives and the Desired Reliability scenario differ substantially in the distribution of water rights among user groups, which prevents appropriate comparison of average annual deliveries to specific water user groups.

Key:
Ag = agriculture
LV = Lahontan Valley
M&I = municipal and industrial
MWh = megawatt-hours
NA = not applicable
NWR = national wildlife refuge
TAF = thousand acre-feet



Key:
cfs = cubic feet per second

Figure F-8. Relative Performance of Alternative 250.b on Annual Newlands Project Deliveries

Alternative 250.d

Alternative 250.d is characterized by: (1) a 250 cfs flow in the Truckee Canal that has been improved with a concrete/geomembrane lining, and (2) a program to reduce agricultural demand and to meet Desired Reliability.

Project agricultural demand reduction could be accomplished using either of two measures identified by the Study: permanent retirement of water-righted land or dry-year fallowing. For Alternative 250.d, 22 of the 100 years simulated were identified as dry-years, meaning that total water delivery to the Project fell below 95-percent of demand for those years. Because demand reduction is scalable, the following analysis was conducted to determine the extent of either measure needed to achieve the Study's water supply objective under Alternative 250.d.

The following four figures and tables summarize results of an iterative analysis, conducted to determine the extent of (1) permanent retirement or (2) dry-year demand reduction required to meet the Study's water supply objective under Alternative 250.d. Figure F-9 shows the results from the first set of analysis, which assesses the effects of permanent water-righted land retirement on the water supply reliability of Alternative 250.d, in 5-percent increments from 0 through 5 percent retirement. Figure F-10 shows the results from the second set of analysis, which assesses the effects of dry-year fallowing on the water supply reliability of Alternative 250.d, in 5-percent increments from 5 through 10-percent dry-year fallowing (see Table F-3). Because dry-year fallowing programs are relatively less effective per acre than permanent retirement, a greater extent of temporary fallowing was assumed to be required to achieve equivalent levels of performance as permanent retirement. The starting point for the dry-year analysis was 5 percent fallowing during dry years, and continued in 5-percent increments to 10 percent fallowing during dry years.

Table F-13 compares the simulated conditions of a 250-cfs Truckee Canal and 5 percent permanent retirement with the Without-Action Alternative and the Desired Reliability condition. Table F-14 compares the simulated conditions of a 250-cfs Truckee Canal and 10 percent dry-year fallowing with the Without-Action Alternative and the Desired Reliability condition. Comparisons in these two tables repot on a variety of conditions in the Newlands Project that the Study uses to assess the performance of alternatives with respect to: water supply reliability, economic and financial conditions of the Project, and environmental conditions within the study area.

Summary of Alternative 250.d

Alternative 250.d meets or exceeds both of the conditions needed to achieve the Study's water supply objective, either with 5 percent permanent retirement or 10 percent dry-year fallowing.

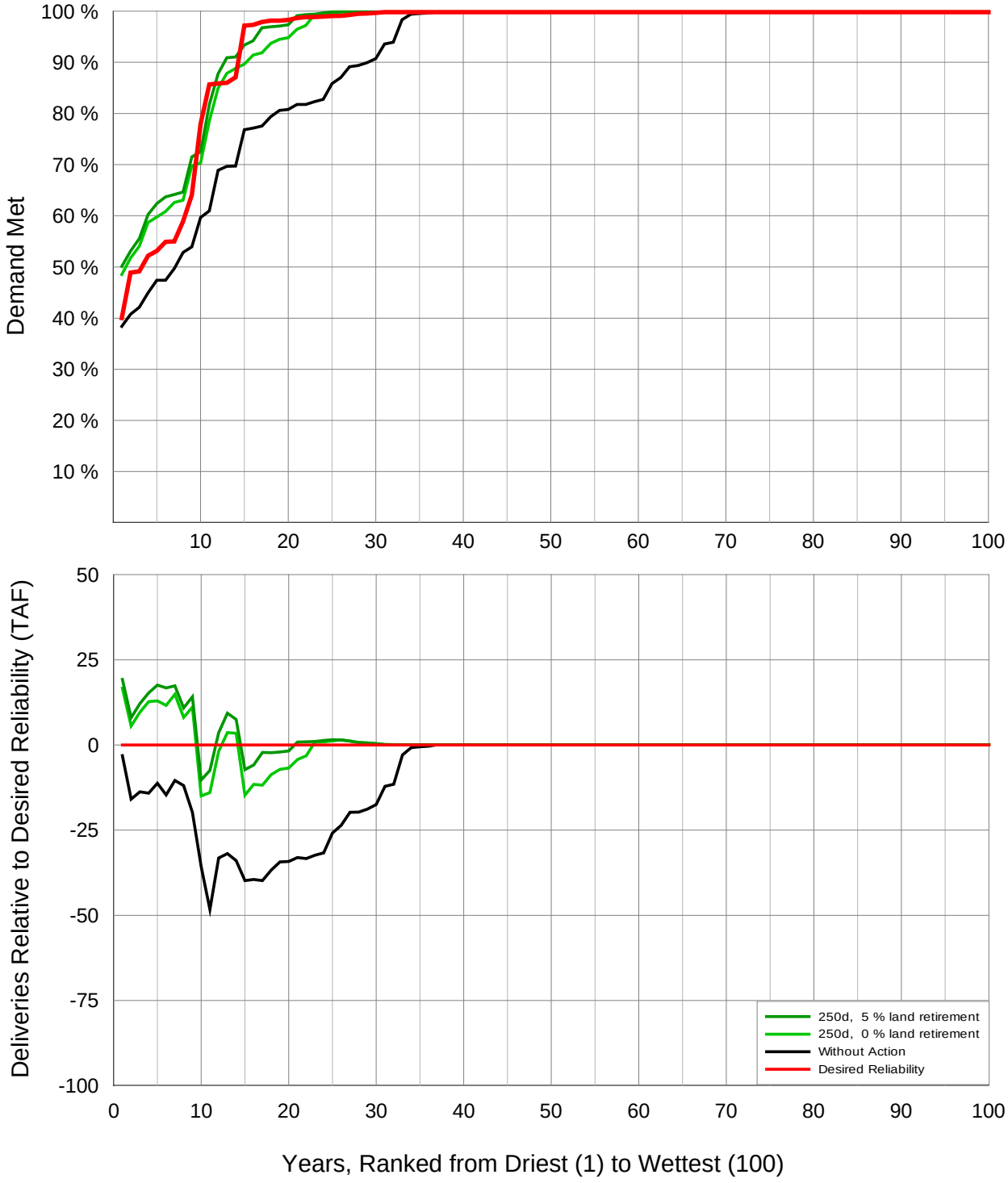
For Alternative 250.d with 5 percent permanent retirement, the long-term average delivery of Project water (95.3 percent) exceeds that of the Desired

Reliability scenario (94.6 percent) (see Table F-13). Additionally, the largest annual difference in supply relative to the Desired Reliability scenario is approximately negative-10,000 acre-feet, which meets the desired negative-10,000 acre-foot threshold (see Figure F-9).

For Alternative 250.d with 10 percent dry year fallowing, the long-term average delivery of Project water (95.5 percent) exceeds that of the Desired Reliability scenario (94.6 percent) (see Table F-14). Additionally, the largest annual difference in supply relative to the Desired Reliability scenario is approximately negative-9,000 acre-feet, which meets the desired negative-10,000 acre-foot threshold (see Figure F-10).

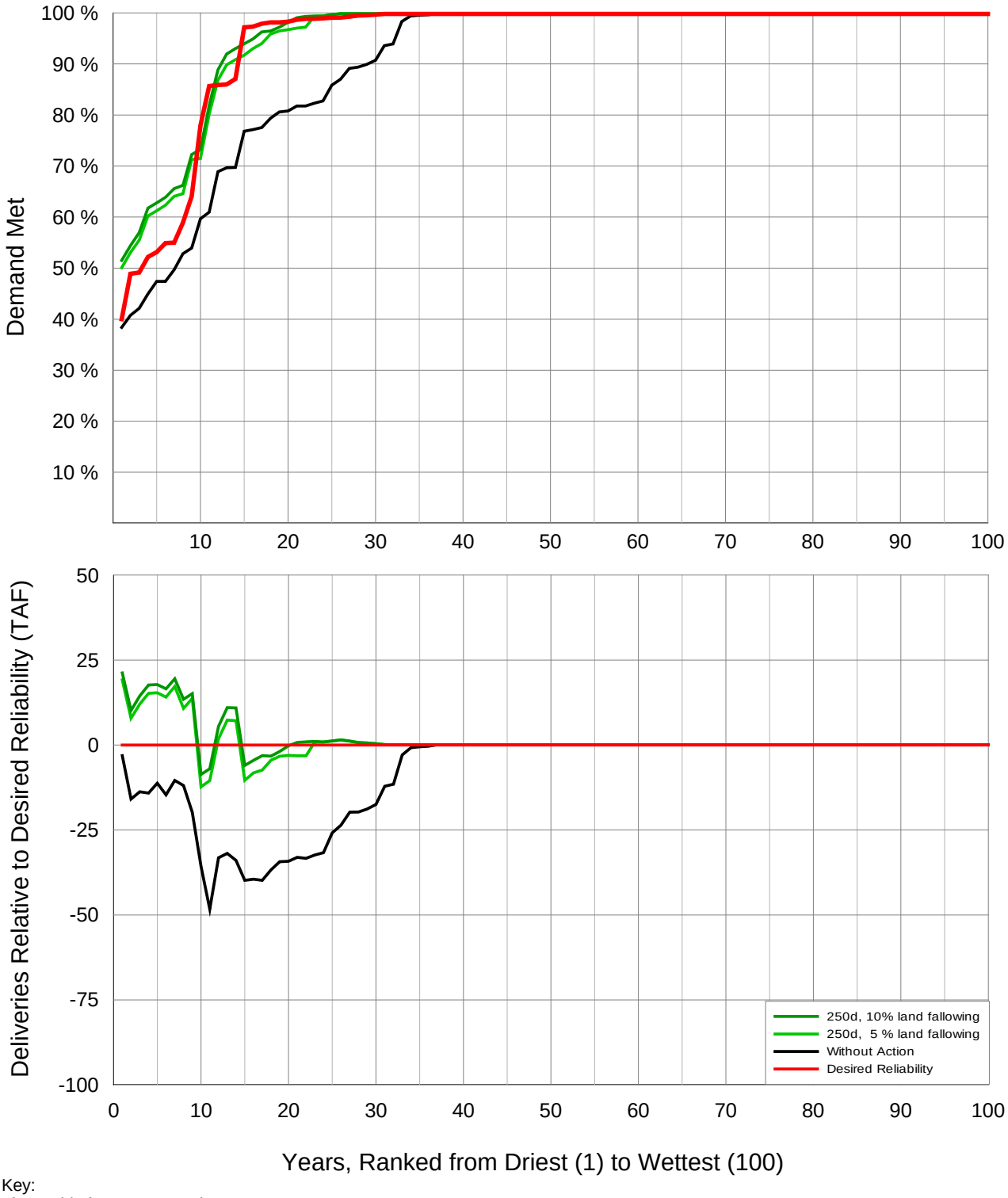
For Alternative 250.d, the Study selected the dry-year fallowing measure as the most appropriate option for demand reduction in this alternative. While the fallowing option is more expensive than the retirement, its selection was made with regard to completeness and acceptability considerations identified by Project water rights holders. This selection was made during the screening and selection of Study alternatives, as described in Chapter 4.

The data summarized in Table F-14 were used to assess economic and financial conditions of the Project (Chapter 5 and Appendix G) and environmental conditions within the study area (Chapter 5) under Alternative 250.d.



Key:
cfs = cubic feet per second

Figure F-9. Relative Performance of Alternative 250.d with Permanent Land Retirement on Annual Newlands Project Deliveries



Key:
cfs = cubic feet per second

Figure F-10. Relative Performance of Alternative 250.d with Dry-Year Land Fallowing on Annual Newlands Project Deliveries

Table F-13. Performance Summary of Alternative 250.d, 5% Permanent Agricultural Land Retirement

	Alternative 250.d, 5% Permanent Agricultural Land Retirement	Without-Action Alternative	Desired Reliability Scenario
Average Demand Met[1] (%)	95.3%	90.5%	94.6%
Number of Years where >95% of Demand is Met	84 years	68 years	86 years
Number of Years where <50% of Demand Met	0 years	7 years	3 years
Percent of Demand Met in Driest Year (%)	50.1%	38.4%	40.0%
Average Annual Deliveries to Ag/Irrigation (TAF)	101.1	111.2	NA[4]
Average Annual Deliveries to M&I (TAF)	13.4	13.2	NA[4]
City of Fernley Demand Met[2] (%)	57%	99%	121%
Average Annual Deliveries to Lahontan Valley Wetlands (TAF)	67.1	63.6	NA[4]
Deliveries to Stillwater NWR (TAF)	*58.9*	*55.8*	*NA[4]*
Deliveries to other LV Wetlands (TAF)	*8.2*	*7.8*	*NA[4]*
Average Annual Hydropower Generation (MWh)	20,135	18,467	NA[4]
Avg. Annual Spill from Lahontan Dam (TAF)	13.2	11.0	12.5
Annual Flow to Pyramid Lake[3] (TAF)	504	516	460

Notes:

[1] The 100 year average of Project deliveries, as a percent of total demand met.

[2] Where average Truckee Division demand met was 94.5%. Refer to Appendix B4 for methods.

[3] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

[4] Study alternatives and the Desired Reliability scenario differ substantially in the distribution of water rights among user groups, which prevents appropriate comparison of average annual deliveries to specific water user groups.

Key:
Ag = agriculture
LV = Lahontan Valley
M&I = municipal and industrial
MWh = megawatt-hours
NA = Not Applicable
NWR = national wildlife refuge
TAF = thousand acre-feet

Table F-14. Performance Summary of Alternative 250.d, 10% Dry-Year Land Fallowing

	Alternative 250.d, 10% Dry-year Land Fallowing	Without-Action Alternative	Desired Reliability Scenario
Average Demand Met[1] (%)	95.5%	90.5%	94.6%
Number of Years where >95% of Demand is Met	84 years	68 years	86 years
Number of Years where <50% of Demand Met	0 years	7 years	3 years
Percent of Demand Met in Driest Year (%)	51.1%	38.4%	40.0%
Average Annual Deliveries to Ag/Irrigation (TAF)	115.4	111.2	NA[4]
Average Annual Deliveries to M&I (TAF)	13.3	13.2	NA[4]
City of Fernley Demand Met[2] (%)	56%	99%	121%
Average Annual Deliveries to Lahontan Valley Wetlands (TAF)	67.2	63.6	NA[4]
Deliveries to Stillwater NWR (TAF)	*59.0*	*55.8*	*NA[4]*
Deliveries to other LV Wetlands (TAF)	*8.2*	*7.8*	*NA[4]*
Average Annual Hydropower Generation (MWh)	20,219	18,467	NA[4]
Avg. Annual Spill from Lahontan Dam (TAF)	12.7	11.0	12.5
Annual Flow to Pyramid Lake[3] (TAF)	501	516	460

Notes:

[1] The 100 year average of Project deliveries, as a percent of total demand met.

[2] Where average Truckee Division demand met was 94.5%. Refer to Appendix B4 for methods.

[3] Because the Desired Reliability scenario is based upon current demands, which are smaller than the future demands used for Study alternatives, the flow to Pyramid Lake will automatically be somewhat higher for the alternatives than for the Desired Reliability scenario.

[4] Study alternatives and the Desired Reliability scenario differ substantially in the distribution of water rights among user groups, which prevents appropriate comparison of average annual deliveries to specific water user groups.

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Ag = agriculture
LV = Lahontan Valley
M&I = municipal and industrial
MWh = megawatt-hours
NA = Not Applicable
NWR = national wildlife refuge
TAF = thousand acre-feet

Appendix F
Performance of Selected Alternatives on Newlands Project Water Supply Reliability

Attachment: Data Table

Newlands Project Planning Study
Special Report

Prepared by

Bureau of Reclamation
Mid-Pacific Region
Lahontan Basin Area Office

U.S. Department of the Interior
Bureau of Reclamation

April 2013

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Attachment: Data Table

The table in this attachment summarizes water supply over the 100-year period of screening analysis, and includes results from the same period for Without-Action Alternative, Study alternatives, and the Desired Reliability scenario.

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Table: Annual Deliveries to Carson Division in TAF

	ALTERNATIVES														
Year	Without Action	600	350.a	350.b	350.d	250.a, 25% fallowing	250.a, 20% fallowing	250.a, 15% retirement	250.a, 10% retirement	250.a, 5% retirement	250.b	250.d, 10 % fallowing	250.d, 5 % fallowing	250.d, 5 % retirement	250.d, 0 % retirement
1901	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1902	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1903	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1904	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1905	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1906	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1907	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1908	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1909	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1910	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1911	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1912	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1913	164	189	189	189	189	187	187	173	179	184	189	189	189	184	189
1914	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1915	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1916	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1917	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1918	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1919	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1920	154	189	189	189	189	181	181	173	179	181	189	189	189	184	189
1921	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1922	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1923	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1924	155	189	186	189	189	163	168	173	179	176	189	184	184	184	184
1925	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1926	129	189	180	189	189	156	157	164	161	160	188	168	168	172	169
1927	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1928	170	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1929	113	171	158	188	168	131	132	143	140	138	165	146	147	150	148
1930	144	189	176	189	184	156	157	158	159	160	180	166	167	167	168
1931	86	117	106	126	110	98	98	99	99	99	113	103	103	103	104
1932	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1933	146	184	175	189	183	158	160	168	168	167	189	171	172	175	174
1934	90	128	120	143	125	106	107	108	108	108	125	112	112	112	113
1935	170	189	189	189	189	185	185	173	179	184	189	189	189	184	189
1936	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1937	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1938	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1939	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1940	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1941	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1942	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1943	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1944	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1945	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1946	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1947	156	189	189	189	189	183	183	173	179	184	189	189	189	184	189
1948	149	189	189	189	189	163	165	171	169	167	189	175	176	179	177
1949	151	189	189	189	189	163	168	170	170	171	189	178	178	179	179
1950	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1951	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1952	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1953	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1954	177	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1955	130	189	176	189	187	151	152	160	157	156	186	164	165	167	166
1956	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1957	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1958	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1959	145	189	180	189	189	163	163	173	170	166	189	172	173	178	173
1960	97	175	142	177	151	120	120	121	121	122	147	129	130	130	130
1961	88	134	126	141	132	106	106	107	107	107	122	113	114	114	114
1962	177	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1963	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1964	152	189	189	189	189	163	168	173	174	174	189	182	182	182	182
1965	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1966	168	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1967	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1968	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1969	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1970	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1971	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1972	186	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1973	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1974	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1975	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1976	130	179	164	189	173	146	147	155	153	151	189	158	159	161	160
1977	72	116	110	134	116	92	92	93	93	93	106	98	98	98	98
1978	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1979	188	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1980	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1981	162	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1982	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1983	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1984	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1985	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1986	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1987	171	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1988	80	132	127	152	136	101	101	114	111	107	132	113	114	118	114
1989	154	189	183	189	189	163	168	169	170	170	189	177	178	178	179
1990	93	140	123	148	131	113	111	112	112	112	129	118	119	119	119
1991	102	127	120	135	126	111	112	113	113	114	128	118	118	119	119
1992	78	100	97	111	102	89	89	90	90	89	103	93	93	93	93
1993	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1994	115	138	137	158	142	121	123	131	131	130	151	131	133	136	135
1995	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1996	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1997	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1998	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
1999	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
2000	189	189	189	189	189	189	189	173	179	184	189	189	189	184	189
Average	**171**	**183**	**181**	**184**	**182**	**177**	**177**	**166**	**170**	**174**	**182**	**179**	**179**	**176**	**179**
Maximum	**189**	**189**	**189**	**189**	**189**	**189**	**189**	**173**	**179**	**184**	**189**	**189**	**189**	**184**	**189**
Minimum	**72**	**100**	**97**	**111**	**102**	**89**	**89**	**90**	**90**	**89**	**103**	**93**	**93**	**93**	**93**

Table: Annual Deliveries to Truckee Division in TAF

	ALTERNATIVES														
Year	Without Action	600	350.a	350.b	350.d	250.a, 25% fallowing	250.a, 20% fallowing	250.a, 15% retirement	250.a, 10% retirement	250.a, 5% retirement	250.b	250.d, 10 % fallowing	250.d, 5 % fallowing	250.d, 5 % retirement	250.d, 0 % retirement
1901	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1902	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1903	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1904	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1905	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1906	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1907	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1908	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1909	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1910	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1911	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1912	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1913	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1914	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1915	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1916	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1917	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1918	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1919	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1920	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1921	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1922	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1923	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1924	6	6	6	6	6	5	5	5	6	6	189	6	6	6	6
1925	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1926	6	6	6	6	6	5	5	5	6	6	188	6	6	6	6
1927	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1928	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1929	6	6	6	6	6	4	5	5	5	5	165	5	5	5	6
1930	6	6	6	6	6	5	5	5	5	6	180	5	6	6	6
1931	2	2	2	2	2	2	2	2	2	2	113	2	2	2	2
1932	6	6	6	6	6	6	6	5	5	6	189	6	6	6	6
1933	4	4	4	4	4	3	4	4	4	4	189	4	4	4	4
1934	2	2	2	2	2	2	2	2	2	2	125	2	2	2	2
1935	5	5	5	5	5	5	5	4	5	5	189	5	5	5	5
1936	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1937	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1938	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1939	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1940	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1941	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1942	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1943	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1944	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1945	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1946	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1947	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1948	6	6	6	6	6	5	5	5	6	6	189	6	6	6	6
1949	6	6	6	6	6	5	5	5	6	6	189	6	6	6	6
1950	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1951	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1952	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1953	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1954	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1955	6	6	6	6	6	5	5	5	6	6	186	6	6	6	6
1956	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1957	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1958	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1959	6	6	6	6	6	5	5	5	6	6	189	6	6	6	6
1960	6	6	6	6	6	5	5	5	6	6	147	6	6	6	6
1961	5	5	5	5	5	4	4	4	4	5	122	4	5	5	5
1962	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1963	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1964	6	6	6	6	6	5	5	5	6	6	189	6	6	6	6
1965	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1966	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1967	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1968	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1969	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1970	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1971	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1972	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1973	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1974	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1975	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1976	6	6	6	6	6	5	5	5	6	6	189	6	6	6	6
1977	3	3	3	3	3	2	2	2	2	3	106	2	3	3	3
1978	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1979	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1980	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1981	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1982	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1983	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1984	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1985	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1986	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1987	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1988	3	3	3	3	3	2	2	2	2	3	132	2	3	3	3
1989	6	6	6	6	6	5	5	5	6	6	189	6	6	6	6
1990	4	4	4	4	4	3	3	4	4	4	129	4	4	4	4
1991	3	3	3	3	3	3	3	3	3	3	128	3	3	3	3
1992	2	2	2	2	2	1	2	2	2	2	103	2	2	2	2
1993	5	5	5	5	5	5	5	5	5	5	189	5	5	5	5
1994	2	2	2	2	2	2	2	2	2	2	151	2	2	2	2
1995	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1996	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1997	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1998	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
1999	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
2000	6	6	6	6	6	6	6	5	6	6	189	6	6	6	6
Average	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**5**	**5**	**6**	**182**	**6**	**6**	**6**	**6**
Maximum	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**5**	**6**	**6**	**189**	**6**	**6**	**6**	**6**
Minimum	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**103**	**2**	**2**	**2**	**2**

Table: Annual Deliveries to Newlands Project in TAF

	ALTERNATIVES														
Year	Without Action	600	350.a	350.b	350.d	250.a, 25% fallowing	250.a, 20% fallowing	250.a, 15% retirement	250.a, 10% retirement	250.a, 5% retirement	250.b	250.d, 10 % fallowing	250.d, 5 % fallowing	250.d, 5 % retirement	250.d, 0 % retirement
1901	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1902	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1903	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1904	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1905	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1906	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1907	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1908	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1909	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1910	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1911	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1912	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1913	170	195	195	195	195	194	194	179	184	190	378	195	195	190	195
1914	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1915	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1916	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1917	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1918	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1919	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1920	160	195	195	195	195	187	187	179	184	187	378	195	195	190	195
1921	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1922	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
1923	195	195	195	195	195	195	195	179	184	190	378	195	195	190	195
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Average	**177**	**189**	**187**	**190**	**188**	**182**	**183**	**171**	**175**	**179**	**365**	**185**	**185**	**181**	**185**
Maximum	**195**	**195**	**195**	**195**	**195**	**195**	**195**	**179**	**184**	**190**	**378**	**195**	**195**	**190**	**195**
Minimum	**75**	**101**	**99**	**113**	**103**	**90**	**91**	**91**	**91**	**91**	**205**	**95**	**95**	**95**	**95**