Section II: Description of the Agricultural Water Supply and Service Area

A. Physical Characteristics

1. Size of the service area

The LHWD was formed on February 8, 1963, pursuant to Division 13 of the California Water Code, for the purpose of providing irrigation water from the State Water Project (SWP) to land within the District. The California Water Code gives the District the authority to receive grant funds and construct infrastructure projects. On September 16, 1966, the California District Securities Commission approved the District contract, dated February 4, 1966, with the Kern County Water Agency (KCWA or Agency) and the District was authorized to execute the proposed water supply contract with the Agency. The contract between the District and the Agency was executed on November 10, 1966.

Under its enabling legislation, KCWA was granted the primary power to acquire and contract water supplies, control storm water, reclaim water, reclaim land, and protect groundwater quality in Kern County. The Agency is an umbrella organization that is a State Water Contractor and obtains water from the SWP for delivery to its 13 member agencies of which LHWD is one of them. After contract execution with the Agency, the District commenced water deliveries in 1968.

District staff includes the Manager, one Operations Supervisor, six operations and maintenance personnel, and two full-time accounting/finance personnel, as well as occasional part-time help. During the off-season, the operations and maintenance personnel perform maintenance activities and some construction of new or upgraded facilities.

A five member Board of Directors, elected at large for four-year terms, governs the District. All of the Board members must be landowners in the District or be designated as a representative of a landowner. Administration of the District is the responsibility of the Manager, who reports directly to the Board. The Operations Supervisor, along with the District Manager, is in charge of operation and maintenance. The District has two offices; the administration office is located in Bakersfield and the O&M office is located at the southern end of the District in Lost Hills.

The location of the District is included as Appendix 3 and the current map of the District is included as Appendix 4. Of the 74,357 acres in the District, 70,453 acres are farmable, although not all this acreage is currently being farmed. Service Area 9 contains oil production fields and is not farmable. Service Area 8 contains lands that have been annexed into the District but are not farmed because no delivery system is available. A portion of Service Area 6 (6E) has been excluded from the District water service area. The net cropped area is currently 27,900 acres all irrigated. A breakdown of the District acreage is summarized in Table 2. The overall District history and size is summarized in Table 3.

Contract acres are those acres that have a water supply contract with the District. The remaining farmable land within a service area may be farmed, but the land does not have a water supply contract and the water user must bring water in from outside sources or transfer water from other land. The District primarily supplies agricultural water to growers within its boundaries with a small amount of industrial water delivered annually to agricultural processing facilities and oil production customers. The District supplies no municipal water. The industrial water supplied makes up about one percent of the District's normal annual water deliveries. Most of the water delivered by the District is State Water Project (SWP) water and is delivered to the District through the California Aqueduct.

Table 2. District Acreage

Service Area	Drainage Zone	Total District Acres	District Contract Acres
1		12,934.09	12,898.59
1R		3,569.41	3,565.41
	Total SA 1 Acres	16,503.50	16,464.00
2		72.85	6.85
2	1	1,004.06	991.06
2A		2,168.86	2,166.38
2A	1	3,020.71	3,020.71
	Total SA 2 Acres	6,266.48	6,185.00
3		839.94	812.94
3	1	3,630.60	3,620.11
3A	1	226.61	226.61
	Total SA 3 Acres	4,697.15	4,659.66
4		887.53	885.53
4	2	5,889.41	5,850.85
	Total SA 4 Acres	6,776.94	6,736.38
5		40.00	0.00
5	1	6,064.83	5,234.09
5A		319.79	319.79
5A	2	375.90	370.19
	Total SA 5 Acres	6,800.52	5,924.07
6		13,339.18	9,605.97
6	1	792.76	792.76
6A	1	4,689.76	2,622.67
	Total SA 5 Acres	18,821.70	13,021.40
7		3,547.96	3,294.48
7Ss		628.88	628.88
	Total SA 7 Acres	4,176.84	3,923.36
8		2,920.34	6.73
9		3,904.13	3,694.13
E6		3,202.83	0.00
E6A	1	46.19	0.00
X1		58.28	0.00
X6		181.98	0.00
	Other Acres	10,313.75	3,700.86
	Grand Totals	74,356.88	60,614.73

Table 3. Water Supplier History and Size	
Date of Formation	February 8, 1963
Source of Water	**Applicable sources**
Local Surface Water	
Local Groundwater	Limited
Wholesaler	Kern County Water Agency (KCWA)
USBR	
SWP	Via California Aqueduct
Service Area Gross Acreage	74,356.88 acres
Service Area Acreage	60,614.73 acres

Table 4. Expected Changes to Service Area		
Change to Service Area	**Estimate of Magnitude**	**Effect on the Water Supplier**
Reduced Service Area Size	0	None
Increased Service Area Size	0	None
New Governmental Entity	0	None
Other	0	None

2. Location of the service area and water management facilities

A location map of the District and its proximity to neighboring districts is included as Appendix 3. The District boundaries begin in the south at the town of Lost Hills, California and extend north and west to the Kings-Kern County line. The District lies in the northwest portion of Kern County, just west of the Kern National Wildlife Refuge. The Aqueduct and Interstate 5 bisect the District diagonally. Highway 46 is located at the south end of the District. Adjacent districts include Dudley Ridge Water District to the north, Berrenda Mesa Water District to the west, Belridge Water Storage District to the south and Semitropic Water Storage District to the east.

The District delivers SWP water through four turnout locations within Reach 9 and four turnout locations within Reach 10A of the Aqueduct. The District currently owns and operates over 23 miles of concrete and geo-membrane lined canals, 42 miles of pipeline and 27 miles of unlined canals. The District has installed interceptor drains adjacent to a significant portion of the unlined canals, and has taken a majority of the unlined canals out of service. The District has four regulating and spill reservoirs as a part of the distribution system. There are currently 159 active metered turnouts within the District. The District distribution system is shown on Appendix 4. An inventory of the District distribution system facilities currently in use is shown in Table 5 and Table 6.

Table 5. Water Distribution System Inventory

Supply Canals and Laterals

Description	Construction	Length (miles)	Note		Description	Construction	Length (miles)	Note
Main Canal 1	Concrete lined	6.0			Lateral 4-1	Pipe	3.2	
Main Canal 1	Pipe	1.2			Lateral 4-2	Pipe	2.9	
Lateral 1-1	Pipe	1.4			Lateral 4-3	Pipe	2.5	
Lateral 1-2	Pipe	2.3			Lateral 5-1	Pipe	2.6	
Lateral 1-3	Pipe	3.1			Lateral 5-2	Pipe	1.8	
Lateral 1-4	Pipe	3.1			Connector 5 to 6-1	Pipe	1.9	
Lateral 1-5	Pipe	1.6			Lateral 5-3	Pipe	1.4	
Lateral 1-5	Concrete lined	1.5			Lateral 5-4	Pipe	1.4	
Lateral 1-6	Pipe	2.6			Canal 6N	Earthen Canal	4.0	ab
Lateral 1-7	Pipe	1.0			Canal 6E (por)	Earthen Canal	3.3	ab
Canal 2S	Concrete lined	1.3			Canal 6E (por)	Earthen Canal	5.0	ab
2-3 Intertie	Earthen Canal	1.2	a		Canal 6E	Earthen Canal	0.5	ab
Canal 3N	Concrete lined	0.5			Lateral 6-1	Earthen Canal	0.7	b
Canal 3S	Concrete lined	0.8			Lateral 6-5E	Earthen Canal	3.0	ab
Canal 4N	EPDM Lined	0.7			Lateral 6-6	Earthen Canal	1.5	ab
Canal 4S	EPDM Lined	2.2			Lateral 6-7	Earthen Canal	1.5	ab
Canal 5N	Pipe	0.2			Canal 7N (por)	EPDM Lined	1.0	
Canal 5N	Concrete lined	1.1			Canal 7N (por)	HDPE Lined	2.5	
Canal 5S	Pipe	1.2			Canal 7N (por)	Earthen Canal	0.7	a
Canal 5S	Concrete lined	0.5			Canal 7S	Earthen Canal	1.8	a
Lateral 2-1	Concrete lined	2.0			Canal 7S	HDPE Lined	1.3	
Lateral 2-1	Earthen Canal	2.0	a		District Totals	Lined Canals	22.7	
Lateral 2-2	Concrete lined	1.3				Unlined Canals	27.4	
Lateral 2-2	Earthen Canal	2.2	a		**Notes**	Pipeline	41.9	
Lateral 3-1	Pipe	3.4			(a)	Not in Use	26.7	
Lateral 3-2	Pipe	3.1			(b)	Interceptor Lines	19.5	

Supply Points - California Aqueduct Turnouts

Description	Pump or Gravity	Capacity (cfs)	Meter Type	Aqueduct Milepost
Turnout 1	Pump	225	Venturi	189.69
Turnout 2	Gravity	115	Venturi	191.18
Turnout 3	Gravity	60	Venturi	194.22
Turnout 4	Gravity	100	Venturi	196.75
Turnout 5	Both	400	Parshall Flume	202.05
Turnout 6	Pump	0.5	Not in Use	204.69
Turnout 7A	Pump	75	Parshall Flume	201.24
Turnout 7B	Pump	1.8	Magnetic	201.24
Turnout 8	Pump	0.3	Propeller	205.26

Miscellaneous Distribution System Components

		Pump Stations				Radio
Service Area	Water Meters	Name	Number of Pumps	HP	Reservoirs	Telemetry Units
1	68	P.S. 1	7	4800	11 & 12	8
1R	13	P.S. 2	5	950	13	2
2	15	---	---	---	21	1
3	11	---	---	---	---	1
4	21	---	---	---	---	2
5	10	P.S. 5	3	250	---	3
6	5	---	---	---	---	2
7	16	P.S. 7	3	150	---	2

Reservoir 11 Bentonite lined
Reservoir 12 HDPE lined

Table 6. Water Conveyance and Delivery System	
System Used	**Number of Miles**
Unlined Canal	27.4 (not currently in use)
Lined Canal	22.7
Pipelines	41.9
Drains	

The District's distribution system can be classified as a fixed duration-restricted arranged system with deliveries arranged in advance and a normal duration in 24-hour time intervals.

Much of the District's delivery system is automated. Lift pump operation and canal and reservoir water levels can be monitored and controlled remotely through the District's Supervisory Control and Data Acquisition (SCADA) system. Check structures, water levels, and flow rates can be adjusted from nearly anyplace there is an internet connection. This aids in operation of the system and virtually eliminates operational spills.

The District does not own or operate any surface water drainage facilities (on-farm tailwater return systems are owned and operated by the landowners). The District also does not own any on-farm subsurface drainage systems. The District does own a subsurface drain water evaporation pond system, which was acquired from the landowners who built the system. This system includes the evaporation ponds and associated land, and the discharge sumps, pumps and piping (see Section IV.A.4 for a detailed discussion of the subsurface drain water evaporation pond system).

Growers within LHWD have utilized all three of the major irrigation system types: furrow, sprinkler and micro irrigation. Furrow irrigation cannot be used in all parts of the District because of the topography. Historically, furrow irrigation made up the majority of the irrigation systems and the remainder of the systems were sprinkler systems. As drip irrigation technology became available, drip irrigation systems were installed on some of the permanent crop acreage. In the 1980's, many of the permanent crops were converted from furrow or sprinkler systems to micro irrigation systems, either drip or fan-jet irrigation. All of the recent permanent crop plantings have been installed with micro irrigation systems. Currently, pressurized micro irrigation systems (drip and fan-jet systems) account for 100% of the irrigated permanent crop acreage. The permanent crop acreage irrigated with micro irrigation has increased from 8,643 acres (21%) in 1990 to 27,900 acres (100%) in 2015.

For more than 20 years the District has supported and utilized the mobile lab program to measure single event irrigation system distribution uniformities for District Water Users.

Each year the mobile lab evaluates several irrigation systems and provides a report to Water Users identifying their distribution uniformity along with recommendations for improvement if needed. The average distribution uniformity from the 2006 - 2012 evaluations ranged between 91% and 97%. This compares to the average distribution uniformity of 82% in 2000 and 75% in 1990. The improved results are directly related to Water User investments in irrigation system improvements and continual management of those systems.

In addition, District Water Users continually monitor soil moisture profiles and utilize CIMIS data to assist in irrigation scheduling. Water Users base irrigation decisions on sophisticated soil moisture reports that evaluate current soil moisture at 1 foot intervals and project crop use based on local CIMIS information.

Table 7. Water Supplier Reservoirs

Number	4
Total Capacity	95 AF

Table 8. Tailwater/Spill Recovery System

System	Yes/No
District Operated Spill Recovery	Yes
Grower Operated Tailwater Recovery	Yes

3. Terrain and soils

The United States Department of Agriculture, Natural Resource Conservation Service (NRCS) (formerly the Soil Conservation Service), issued a soil survey of the northwestern portion of Kern County in the fall of 1988. This detailed soil survey included the Lost Hills Water District area. A general soils map of the District taken from the NRCS soil survey is included as Appendix 5. There are numerous soil types within the District with the predominant soil types being the Twisselman and Nahrub clay units, the Panoche and Yribarren clay loam units, the Milham and Twisselman sandy loam units and Kimberlina fine sandy loam. The majority of these soils were formed in alluvium derived predominantly from granitic and/or sedimentary rock. Table 10 gives the general characteristics of the major soil types within the District and accompanies Appendix 5.

The ground surface within the District slopes generally to the east and northeast and ranges in elevation from about 550 feet in the southwestern portion to 215 feet in the northeast corner of the District. The Aqueduct is approximately at elevation 310 feet and Interstate 5 (I-5) varies from approximately 225 to 240 feet in elevation. Steep slopes are encountered until just east of the Aqueduct and then the slopes start tapering off until east of I-5 where the ground surface is nearly flat.

The Kern River Channel is the only major stream in the District and this channel generally only carries sporadic flood flows. During major storms, minor streams in the hills to the west may produce runoff that will occasionally enter the District.

Land use within the LHWD consists primarily of agricultural lands. Approximately 31,915 acres are in agricultural production with the most common crops being pistachios, pomegranates, and almonds. Other crops include grapes, figs, and other row crops. Some livestock grazing also occurs on previously farmed land (fallow). Table 9 below shows the water year land use in the District. As a result of SWP supply limitations, landowners are not able to irrigate the remaining contract acres in the District.

Table 9. 1990-2015 Water Year Land Use

Lost Hills Water District (LHWD)							
Planted Crops	**Year**						
	1990	**2000**	**2009**	**2012**	**2013**	**2014**	**2015**
Cotton	16,569	21,460	0	0	75	0	0
Other Row Crops	9,907	12,580	640	75	0	75	0
Row Crop Total	**26,476**	**34,040**	**640**	**75**	**75**	**75**	**0**
	64.3%	**63.1%**	**2.0%**	**0.2%**	**0.2%**	**0.2%**	
Almonds	2,579	1,800	7,175	7,335	7,095	7,095	7,095
Figs	510	520	520	520	520	520	520
Grapes	2,510	2,560	720	640	560	560	560
Olives	1,619	0	0	0	0	0	0
Pistachios	7,385	12,645	13,685	13,685	13,765	13,765	13,765
Pomegranates	79	2,375	8,760	9,660	9,700	8,420	5,960
Permanent Crop Total	**14,682**	**19,900**	**30,860**	**31,840**	**31,640**	**30,360**	**27,900**
	35.7%	36.9%	98.0%	99.8%	99.8%	99.8%	100.0%

Table 10. Landscape Characteristics

Topography Characteristic			% of the District				Effect on Water Operations and Drainage
Rolling Land			(20% of Irrigated land)				Land is adaptable to sprinkler and micro irrigation systems. There are no effects on water operations and drainage because of the existence of pressurized irrigation systems
Flat Land			(80% of irrigated land)				Land is adaptable to flood and other types of irrigation systems
Soil Unit	**Soil Name / Characteristic / Classification**	**Description**	**Percent of District**	**Depth (in)**	**Clay (%)**	**Permeability (in/hr)**	**Effect on Water Operations and Drainage**
115	Bitterwater sandy loam, 9 to 15 percent slopes	Deep, well drained soil is on foothills. Formed in residuum derived dominantly from sandstone.	0.00	0-23	5-10	1.98 - 5.95	No irrigation operations impact
				23-60	5-10	1.98 - 5.95	
				60-70	---	1.98 - 5.95	
124	Buttonwillow clay, partially drained	Deep, somewhat poorly drained soil is in basins. Formed in alluvium derived dominantly from granitic rock. Slope is 0-2 percent.	0.29	0-28	40-55	0.06 - 0.2	No irrigation operations impact
				28-55	8-15	1.98 - 5.95	
				55-64	35-50	0.06 - 0.2	
125	Cajon loamy sand, 0 to 2 percent slopes	Deep, somewhat excessively drained soil is on alluvial fans. Formed in alluvium derived dominantly from granitic rock.	0.05	0-9	5-18	5.95 - 19.98	No irrigation operations impact
				9-44	0-5	5.95 - 19.98	
				44-60	5-10	5.95 - 19.98	
129	Carollo-Twisselman saline alkali association, 2 to 15 percent slopes	Carollo (60% of area), clay loam, saline-alkali. Moderately deep and well drained soil is on hill tops. Formed in residuum derived dominantly from shale.	0.01	0-2	27-32	0 - 0.06	No irrigation operations impact
				2-15	40-60	0 - 0.06	
				15-30	30-40	0 - 0.06	
		Twisselman (40% of area), clay, saline-alkali. Deep and well drained soil is on side slopes and drainageways. Formed in alluvium derived dominantely from sedimentary rock.		0-9	40-60	0 - 0.06	
				9-60	35-60	0 - 0.06	
				30-60	---	0 - 0.2	
144	Delgado sandy loam, 5 to 30 percent slopes	Shallow , somewhat excessively drained soil is on hills. Formed in residuum derived dominantly from sedimentary rock.	0.06	0-2	8-20	1.98 - 5.95	No irrigation operations impact
				2-10	8-20	1.98 - 5.95	
				10-14	---	0.2 - 1.98	
150ki	Panoche loam, 0 to 2 percent slopes	Component is on alluvial fans. Parent material consists of alluvium derived from sedimentary rock. Natural drainage class is well drained.	0.16	0-7	18-27	0.57 - 1.98	No irrigation operations impact
				7-60	18-35	0.57 - 1.98	
156	Garces silt loam	Deep, well drained, saline-alkali soil is on basin rims. Formed in alluvium derived dominantly from granitic rock.	1.19	0-2	10-18	0.2 - 0.57	No irrigation operations impact
				2-9	27-35	0 - 0.06	
				9-23	20-35	0 - 0.06	
				23-37	20-27	0	
				37-60	10-27	0.2 - 0.57	
157	Garces silt loam, moderately wet	Deep, well drained, saline-alkali soil is on basin rims. Formed in alluvium derived dominantly from granitic rock.	0.40	0-2	10-18	0.2 - 0.57	No irrigation operations impact
				2-9	27-35	0 - 0.06	
				9-23	20-35	0 - 0.06	
				23-37	20-27	0	
				37-60	10-27	0.2 - 0.57	
164	Houser fine sandy loam, partially drained	Deep, somewhat poorly drained, saline-alkali soil is on basin rims. Formed in alluvium derived dominantly from granitic rock. Slope is 0-1 percent.	1.77	0-4	5-20	1.98 - 5.95	No irrigation operations impact
				4-60	40-60	0 - 0.06	
165ki	Twisselman silty clay. Slopes are 0 to 1 percent	Component is on alluvial fans. Parent material consists of alluvium derived from sedimentary rock. Natural drainage class is well drained.	0.27	0-9	40-60	0.06 - 0.2	No irrigation operations impact
				9-60	35-60	0.06 - 0.2	
166ki	Twisselman silty clay, saline-alkali	Component is on alluvial fans. Parent material consists of alluvium derived from sedimentary rock. Natural drainage class is well drained.	0.80	0-9	40-60	0.06 - 0.2	No irrigation operations impact
				9-60	35-60	0.06 - 0.2	
174	Kimberlina fine sandy loam, 0 to 2 percent slopes	Deep, well-drained soil on alluvial fans & plains. Formed in alluvium derived dominantly from granitic & sedimentary rock.	7.44	0-9	6-18	1.98 - 5.95	No irrigation operations impact
				9-45	10-18	1.98 - 5.95	
				45-71	10-25	0.57 - 1.98	
175	Kimberlina sandy loam, 2 to 5 percent slopes	Deep, well-drained soil on alluvial fans & plains. Formed in alluvium derived dominantly from granitic & sedimentary rock.	1.46	0-9	6-18	1.98 - 5.95	No irrigation operations impact
				9-45	10-18	1.98 - 5.95	
				45-71	10-25	0.57 - 1.98	
176	Kimberlina sandy loam, 5 to 9 percent slopes	Deep, well-drained soil on alluvial fans & plains. Formed in alluvium derived dominantly from granitic & sedimentary rock.	0.12	0-9	6-18	1.98 - 5.95	No irrigation operations impact
				9-45	10-18	1.98 - 5.95	
				45-71	10-25	0.57 - 1.98	
183	Lethent silt loam	Deep, moderately well drained, saline-alkali soil on basin rims. Formed in alluvium derived dominantly from granitic & sedimentary rock.	0.07	0-3	20-27	0.2 - 0.57	No irrigation operations impact
				3-53	35-55	0 - 0.06	
				53-60	10-30	0.06 - 0.2	
189	Lokern clay, saline-alkali, partially drained	Deep, somewhat poorly drained soil is on basins. Formed in alluvium derived from mixed rock sources, mainly granitic rock. Slope is 0-2 percent.	0.16	0-7	40-55	0.06 - 0.2	No irrigation operations impact
				7-21	40-60	0.06 - 0.2	
				21-48	40-60	0.57 - 1.98	
				48-66	10-26	0.57 - 1.98	
196	Milham sandy loam, 0 to 2 percent slopes	Deep, well-drained soil on alluvial fans, plains, & low terraces. Formed in alluvium derived dominantly from granitic & sedimentary rock.	7.95	0-10	5-20	1.98 - 5.95	No irrigation operations impact
				10-49	20-35	0.2 - 0.57	
				49-60	5-25	0.57 - 1.98	
197	Miham sandy loam, 2 to 5 percent slopes	Deep, well drained soil on alluvial fans, plains, & low terraces. Formed in alluvium derived dominantly from granitic & sedimentary rock.	0.01	0-10	5-20	1.98 - 5.95	No irrigation operations impact
				10-49	20-35	0.2 - 0.57	
				49-60	5-25	0.57 - 1.98	
207	Nahrub clay, drained	Deep, somewhat poorly drained soil; is in basins. Derived dominately from granitic and sedimentary rock.	3.54	0-18	40-50	0 - 0.06	No irrigation operations impact
				18-52	35-50	0 - 0.06	
				52-61	15-30	0.57 - 1.98	
208	Nahrub clay, partially drained	Deep, somewhat poorly drained soil; is in basins. Derived dominately from granitic and sedimentary rock.	9.90	0-18	40-50	0 - 0.06	No irrigation operations impact
				18-52	35-50	0 - 0.06	
				52-61	15-30	0.57 - 1.98	
209	Nahrub, drained-Lethent complex	Located in basins. 75% Nahrub clay & 25% Lethent silt loam; intermingled	1.42	0-18	40-50	0 - 0.06	No irrigation operations impact
				18-52	35-50	0 - 0.06	
				52-61	15-30	0.57 - 1.98	
210	Nahrub, partially drained-Lethent complex	Located in basins. 75% Nahrub clay & 25% Lethent silt loam; intermingled	3.21	0-18	40-50	0 - 0.06	No irrigation operations impact
				18-52	35-50	0 - 0.06	
				52-61	15-30	0.57 - 1.98	
211	Panoche clay loam, 0 to 2 percent slopes	Deep, well-drained soil on alluvial fans & plains. Formed in alluvium derived dominately from granitic or sedimentary rock.	13.64	0-16	27-35	0.57 - 1.98	No irrigation operations impact
				16-60	18-35	0.57 - 1.98	
212	Panoche clay loam, 2 to 5 percent slopes	Deep, well-drained soil on alluvial fans & plains. Formed in alluvium derived dominately from granitic or sedimentary rock.	4.51	0-16	27-35	0.57 - 1.98	No irrigation operations impact
				16-60	18-35	0.57 - 1.98	
213	Panoche clay loam, 5 to 9 percent slopes	Deep, well-drained soil on alluvial fans & plains. Formed in alluvium derived dominately from granitic or sedimentary rock.	0.10	0-16	27-35	0.57 - 1.98	No irrigation operations impact
				16-60	18-35	0.57 - 1.98	
214	Panoche clay loam, saline-alkali, 0 to 2 percent slopes	Deep, well drained soil on alluvial fans & plains. Formed in alluvium derived dominately from granitic or sedimentary rock.	0.19	0-16	27-35	0.57 - 1.98	No irrigation operations impact
				16-60	18-35	0.57 - 1.98	
215	Panoche clay loam, saline-alkali, moderately wet, 0 to 2 percent slopes	Deep, well drained soil on alluvial fans & plains. Formed in alluvium derived dominately from granitic or sedimentary rock.	0.77	0-16	27-35	0.57 - 1.98	No irrigation operations impact
				16-60	18-35	0.57 - 1.98	
233	Twisselman sandy loam, saline-alkali, 0 to 2 percent slopes	Deep, well-drained soil on alluvial fans & basin rims. Formed in alluvium derived dominately from sedimentary rock. Drainage has been altered due to extensive irrigation.	5.14	0-8	5-20	1.98 - 5.95	No irrigation operations impact
				8-60	35-60	0 - 0.06	
234	Twisselman sandy loam, saline-alkali, moderately wet, 0 to 2 percent slopes	Deep, well-drained soil on alluvial fans & basin rims. Formed in alluvium derived dominately from sedimentary rock. Drainage has been altered due to extensive irrigation.	3.42	0-8	5-20	1.98 - 5.95	No irrigation operations impact
				8-60	35-60	0 - 0.06	
235	Twisselman clay, 0 to 2 percent slopes	Deep, well-drained soil on alluvial fans. Formed in alluvium derived dom-inantly from sedimentary rock.	12.88	0-14	40-60	0.06 - 0.2	No irrigation operations impact
				14-60	35-60	0.06 - 0.2	
236	Twisselman clay, 2 to 5 percent slopes	Deep, well-drained soil on alluvial fans. Formed in alluvium derived dom-inantly from sedimentary rock.	1.06	0-14	40-60	0.06 - 0.2	No irrigation operations impact
				14-60	35-60	0.06 - 0.2	
237	Twisselman clay, saline-alkali, 0 to 2 percent slopes	Deep, well-drained soil on basin rims. Formed in alluvium derived dom-inantly from sedimentary rock. Drainage has been altered due to extensive irrigation.	1.88	0-9	40-60	0 - 0.06	No irrigation operations impact
				9-60	35-60	0 - 0.06	
238	Twisselman clay, saline-alkali, moderately wet, 0 to 2 percent slopes	Deep, well-drained soil on basin rims. Formed in alluvium derived dom-inantly from sedimentary rock. Drainage has been altered due to extensive irrigation.	9.65	0-14	40-60	0 - 0.06	No irrigation operations impact
				14-60	35-60	0 - 0.06	
239	Typic Gypsiorthids-Kimberlina association, 0 to 5 percent slopes	Deep and well drained. Formed in alluvium derived dominantly from sedimentary rock.	2.94	0-9	6-18	1.98 - 5.95	No irrigation operations impact
				9-45	10-18	1.98 - 5.95	
				45-71	10-25	0.57 - 1.98	
251	Yribarren loam, 0 to 2 percent slopes	Deep, well drained soil on alluvial fans & plains. Formed in alluvium derived dominantly by sedimentary rock.	0.65	0-7	20-27	0.57 - 1.98	No irrigation operations impact
				7-19	35-55	0 - 0.06	
				19-22	15-35	0 - 0.06	
				22-60	15-30	0.2 - 0.57	
253	Yribarren clay loam, 2 to 5 percent slopes	Deep, well-drained soil on alluvial fans & plains. Formed in alluvium derived dominantly by sedimentary rock.	2.90	0-7	20-27	0.57 - 1.98	No irrigation operations impact
				7-19	35-55	0 - 0.06	
				19-22	15-35	0 - 0.06	
				22-60	15-30	0.2 - 0.57	

4. Climate

The climate of the District is typical of the southern San Joaquin Valley with temperatures in the summer often exceeding one hundred degrees Fahrenheit and low temperatures in the winter occasionally falling below freezing. Summers are generally hot and dry and winters are semi-arid with fog being a common occurrence during the winter. The rain season typically occurs from November to April, and ranges from 2.9 to 9.3 inches per year, with an average of 5.1 inches per year, where about nine-tenths of the rainfall occurs from November through April. The rainfall is sufficient for grazing purposes, but not sufficient for intensive agricultural purposes. Historical average climatology is presented in Table 11 and Table 12.

The growing season runs from May through October, although various crops are grown year-round. Reference evapotranspiration ranges from 52.4 to 62.8 inches per year with an average of 58.3 inches per year. The length of the growing season (frost-free period) is about nine months, or around 250 days per year that are available for growing most agricultural crops. The crops must be sustained by irrigation during the hot, dry summers.

Table 11. Summary Climate Characteristics (CIMIS Station #146 - Belridge, 1998-2012)

Climate Characteristic	Value
Average Annual Evapotranspiration (inches)	58.3
Average Annual Precipitation (inches)	5.1
Annual Minimum Precipitation (inches)* (2007)	2.9
Annual Maximum Precipitation (inches)* (2010)	9.3
Average Annual Minimum Temperature (^{o}F)	49.3
Average Annual Maximum Temperature (^{o}F)	76.7
Average Minimum Temperature (^{o}F) (January)	36.9
Average Maximum Temperature (^{o}F) (July)	96.5
Average Minimum Temperature Range (^{o}F) (November-April)	36-46
Average Maximum Temperature Range (^{o}F) (May-October)	78-96

Note:
* Annual minimum and maximum precipitation correspond to the total minimum and maximum value recorded in the corresponding years.

Table 12. Detailed Climate Characteristics (CIMIS Station #146 - Belridge, 1998-2012)

Month/Time	Average Precipitation, Inches	Average Reference Evapotranspiration (ET_o), Inches	Average Minimum Temperature, °F	Average Maximum Temperature, °F
January	1.04	1.41	36.9	56.7
February	1.01	2.24	40.2	62.8
March	0.64	4.12	43.3	68.7
April	0.75	5.44	46.3	73.4
May	0.18	7.61	52.8	83.4
June	0.02	8.28	59.0	90.3
July	0.00	8.45	63.8	96.5
August	0.00	7.65	62.3	95.4
September	0.01	5.85	58.9	90.8
October	0.19	3.76	50.2	78.7
November	0.39	2.00	41.7	65.7
December	0.86	1.41	36.2	58.1
Wet Season* (Nov-Apr)	0.41	16.62	40.7	64.2
Dry Season* (May-Oct)	4.69	41.61	57.8	89.2
Extreme Conditions (if applicable) [e.g., 100-year event]	NA	NA	NA	NA
Other	NA	NA	NA	NA

Notes:
Wet season is defined for November through April. Dry season is defined for May through October.
NA = Not applicable

B. Operational characteristics

1. Operating rules and regulations

The District Board of Directors has adopted policies for allocation and delivery of water for agricultural use to lands within the District. A copy of the Water Supply Contract, the Water Supply Contract Standard Provisions, and the Rules and Regulations for Distribution and Use of Water is included in Appendix 7, Appendix 8, and Appendix 9. These policies specify how water is allocated to lands eligible to receive water. The District allows its landowners to buy and sell water among themselves. Landowners that lease their land can assign their water allocation to their lessee, who becomes the water user within the District.

LHWD is a member of the KCWA, a State Water Contractor, and as such the District can only be as flexible with deliveries as the State Department of Water Resources (DWR) allows. Generally, the DWR requires 24-hour advance notice for start up, shut off and flowrate changes at each District turnout. These changes generally occur at 6:00 a.m. and 6:00 p.m. on a daily basis as needed. In an emergency, changes can be made with DWR with little or no warning. In recent years, DWR has been flexible in generally allowing changes with less warning and has allowed limited changes during the day; this aids in District operation and helps growers to irrigate more efficiently.

Irrigation deliveries within the District can be classified as a fixed duration-restricted arranged schedule (Table 13). Most of the constraints placed on the District by DWR are passed on to the water user. There are no restrictions on how often a grower can request water, but the quantity of water taken during a season is restricted to the grower's water allocation (Table 14). The only restriction on maximum flowrate is the limitation of the delivery structures (Table 14). Water orders must be placed with the District office 24 hours in advance of the desired irrigation start time (Table 15). Generally irrigation flowrate changes, including start up and shut off, are accomplished at approximately 6:00 a.m. and 6:00 p.m. to correspond to the turnout changes. The District does have some capacity to allow growers to adjust their flowrate or shut off at odd times occasionally, and makes provisions to reduce flows during the 12:00 p.m. to 6:00 p.m. peak energy usage period, but there is not sufficient storage capacity in the District distribution system to allow unlimited rate changes.

Table 13. Supplier Delivery System

Type	Check if Used	Percent of System Supplied
On Demand		
Modified Demand		
Rotation		
Other (fixed duration-restricted arranged schedule)	x	100

Table 14. Water Allocation Policy

	(Check if applicable)			Allocation	
Basis of Water Allocation	**Flow**	**Volume**	**Seasonal Allocations**	**Normal Year**	**Percent of Water Deliveries (%)**
Area within the service area					
Amount of land owned					
Riparian rights					
Other (Water supply contract amount*)		x		2012	65% SWP Table A

Note:
*Some turnouts can be prorated on some days based upon delivery capacity of facilities serving them. Available delivery capacities of distribution facilities are shared in proportion to water supply contract amounts held by turnout operators.

Table 15. Actual Lead Times

Operations	Hours/Days
Water orders	24 hours
Water shut-off/changes	6 a.m. and/or 6 p.m.

2. Water delivery measurements or calculations

All of the field turnouts within the District are equipped with flowmeters that indicate the instantaneous flowrate and accumulate the quantity delivered in acre-feet. The meters are read on a daily basis on the turnouts that are operating and all meters are read once a month (Table 16). The District staff is capable of repairing these meters when required.

The DWR maintains measuring devices that measure the amount of water delivered through each of the District's turnouts from the Aqueduct. Measurements are taken continuously by the State (Table 16). At the end of each month, the District totalizes the field turnout deliveries served from each Aqueduct turnout and correlates this with the water orders and the Aqueduct turnout deliveries measured by DWR.

A majority of the pressurized irrigation systems that serve the permanent crops are equipped with in-field meters that are maintained by the farming operation. These meters are used for on-farm water management.

The District maintains software that allows the District to track daily water deliveries for each turnout being used and maintains records of daily water orders for each turnout. The software also summarizes a grower's water use to date and remaining allocation. The District maintains records on the drainage activities on a monthly basis.

DWR maintains records of daily diversions to the District and records of all diversions, water quality, and storage operations related to the SWP. Operational reports are distributed weekly and monthly to the District and published annually in DWR Bulletin 132.

Table 16. Water Delivery Measurements

Measurement Device	Frequency of Calibration (Months)	Frequency of Maintenance (Months)	Estimated Level of Accuracy (%)
Orifices (meter gates)			
Propeller Meters	As needed	As needed	<4%
Weirs			
Flumes			
Venturi Meters (i.e, DWR)	As needed	As needed	<2%
Pump, Run Time			
Pump, KWH			
Other (e.g., some land owner operators)	As needed	As needed	<4%

3. Water rate schedules and billing

The KCWA has a contractual obligation with DWR for SWP water. The District in turn has a contractual agreement with KCWA to pay its proportionate share of capital and operations costs for SWP water.

The District has nine service areas that have different charges associated with them. The District collects its annual water charges through the implementation of the landowner water supply contracts. The water charges are computed by summing five different types of charges that can vary with each service area, all of which are collected on a per acre-foot basis:

The Agency Charge is collected to pay the District's annual obligation of KCWA costs associated with water from the SWP. This cost is the same for all service areas.

The District Capital Charge is collected to satisfy payments of principal and interest, which is due that year on account of then outstanding bonds or repayment contracts, or both, of the District along with any required bond reserve fund. This cost varies from one service area to another.

The Delivery Charge is collected to pay for District costs incurred during the year for operations, maintenance, replacements and energy in delivering water to each service area. This cost does vary in each service area.

The Administrative Charge is collected to meet the costs of the District not included in the Agency Charge, District Capital Charge, Delivery Charge and the ID#9 Charge, and generally includes salaries and other administrative costs as well as potential development and maintenance of reasonable reserves. This charge is the same for all service areas.

The ID#9 Charge is collected to meet the annual fixed costs for the care, operation, management and improvement of the drainage facilities within ID#9, including the payment of salaries and other expenses and for drainage debt repayment obligations. There are two zones of benefit in ID#9 that correspond to whether the lands are tile drained or not; the tile drained lands pay a higher ID#9 charge than the untitled lands.

A summary of the water delivery charges for contract water for year 2015 is presented in Table 17. The total contract costs/acre-foot totals are based on a full water allocation but are helpful to show trends in the water costs. The actual water cost each year can be significantly higher if the water supply was significantly reduced as a result of shortages.

The District also imposes a Drainage Charge that is levied on a per acre-foot basis for drainwater discharged to the evaporation ponds. The Drainage Charge is only paid by those landowners with on-farm drainage systems that discharge to the evaporation pond system.

In synthesis, the District bills Water Users based on Contract amounts (volume) using uniform rates (Table 18 and Table 19). Bills are sent to the users on a semiannual basis (i.e., 50% by Dec 15 prior year and June 15).

Table 17. Water Charges for Year 2015

Summary of District Charges ($/AF)

	SERVICE AREAS								
Charge	SA 1	SA 1R	SA 2	SA 2A	SA 3	SA 3A	SA 4	SA 5	SA 5A
Agency Charge	102.76	102.76	102.76	102.76	102.76	102.76	102.76	102.76	102.76
District Capital Charge	0.00	0.00	0.00	7.55	0.00	7.55	0.00	0.00	0.00
Delivery Charge	34.96	66.12	6.06	6.06	4.45	4.45	4.36	11.05	11.05
Administrative Charge	5.21	5.21	5.21	5.21	5.21	5.21	5.21	5.21	5.21
ID#9 Charge	0.00	0.00	1.05	1.05	1.05	1.05	2.58	1.05	2.58
Total	142.93	174.10	115.08	122.63	113.48	121.03	114.93	120.07	121.61

	SERVICE AREAS							
Charge	SA 6	SA 6A	SA 7 No	SA 7Nn	SA 7 So	SA 7 Ss	SA 8	SA 9
Agency Charge	102.76	102.76	102.76	102.76	102.76	102.76	102.76	102.76
District Capital Charge	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Delivery Charge	1.86	1.86	22.65	45.40	22.65	25.09	1.72	22.65
Administrative Charge	5.21	5.21	5.21	5.21	5.21	5.21	5.21	5.21
ID#9 Charge	0.00	1.05	0.00	0.00	0.00	0.00	0.00	0.00
Total	109.83	110.88	130.63	153.38	130.63	133.07	109.70	130.63

Table 18. Water Rate Basis

Water Charge Basis	Check if Used	Percent of Water Deliveries (%)	Description
Volume of Water Delivered	x	100	Charges are per acre foot
Rate and Duration of Water Delivered			
Acre			
Crop			
Land Assessment			
Other			

Table 19. Rate Structure

Type of Billing	Check if Used	Description
Declining		
Uniform	x	Per acre foot
Increasing Block Rate		
Other		

Table 20. Frequency of Billing

Frequency	Check if Used
Weekly	
Biweekly	
Monthly	
Bimonthly	
Semiannually (50% by prior December 15 and 50% by June 15)	x
Annually	

4. Drought Management Plan and Water Shortage Allocation Policy

As described in Section IV the District relies on water transfers, supplemental water purchases, and groundwater banking programs as its primary mechanism for enduring periods of drought. Unlike farmers in other areas who can fallow lands during periods of drought, farmers in the District have permanent plantings (trees and vines) that require a minimum water supply to keep alive. In water short years these farmers use deficit irrigation (the application of water below full crop-water requirements) to reduce irrigation water use. This can result in reduced crop yields and, if taken to the extreme, no crop yield and long-term damage.

Determining Drought Severity

The District's primary water source is imported surface water supplies from the SWP. In the fall of each year, DWR operations staff review current Project storage and projected deliveries through the end of the year, and develop allocation projections for the following year based on a range of forecasted hydrology. DWR declares the initial allocation forecast for the following year at the end of November; this allocation is adjusted up or down as hydrology dictates.

District management maintains a close relationship with Kern County Water Agency and DWR operations staff and uses these allocation projections to determine water supply availability and level of drought severity. These projections are conveyed to District landowners for use in planning their farming operations and projecting supplemental water needs.

Water Shortage Allocation

The District's water allocation policy is described under Article IV Allocation of Water Item 4.02 of the District's Rules and Regulations for Distribution and Use of Water (Appendix 9). When there is shortage of water, water is allocated pro rata among water users (or buyers) on the basis of each user's annual entitlement.

Alternative Water Supplies

As discussed in Section IV, the District relies on banking, transfers, and exchanges to supplement its annual water supply. At all but the higher SWP water allocations, the District is proactive in seeking and securing supplemental water supplies. Since 2009, the District has collaborated in securing additional water with four other agricultural water districts that also rely heavily on the SWP for their water supplies. The other districts are Belridge Water Storage District, Berrenda Mesa Water District, Dudley Ridge Water District, and Wheeler Ridge–Maricopa Water Storage District. Due to their common location on the Westside of the southern San Joaquin Valley, the five districts are informally referred to at the Westside Districts or Westside 5.

Coordination and Collaboration

In addition to the Westside 5, the District coordinates with neighboring local districts where there are common landholders to utilize limited supplies in the most beneficial manner.

Revenues and Expenditures

The majority of the District's expenses are DWR charges that are due regardless of the amount of water delivered. As the SWP allocation gets reduced, the actual cost of the water to the water users increases proportionately. For example, the District is expected to spend $12.8 million for its 2015 SWP water supply. At 100% allocation, this would equate to approximately $110/AF, but at the 2015 allocation of 20%, the unit charge rises to over $552/AF.

In addition, at lower SWP allocations, the market for supplemental water becomes more active, which results in higher unit costs to the water users.

Table 21. Decreased Water Supplies Allocations

Allocation Method	Check if used
By crop	
First come first served	
Area in district	
Other (% of contract x Available Supplies)	x
No specific policy	

Table 22. Enforcement Methods of Allocation Policies

Enforcement Method	Check if used
Fines	
Water Shut-off	
Other (pro rata on the basis of each user's annual entitlement)	x
No specific policy	