Estimated Water Demand - 1.25% Growth Rate

Customer Name	Number of Residential Service Connections	Number of "other" Service Connections	Total Number of Service Connections	2013 Reported Annual Production Volume (gallons)	2013 Reported Annual Average Production (GPM)		Year 2015 Design Demand (x1.5 and 1.0125^2)	Year 2035 Design Demand (GPM) (x2 and 1.0125^22)
Shungopavi	146	3	149	10,402,600	19.8		30.4	52
Sipaulovi/Mishongovi (lower)	100	10	110	7,142,300	13.6		20.9	35.7
Sipaulovi/Mishongovi (upper)	25	5	30	2,102,600	4		6.2	10.5
FMCV	580	40	620	49,953,900	95		146.1	249.7
Total without BIA				69,601,400	132.4		203.6	347.9
2nd. Mesa Day School	14	3	17	1,800,000	3.4		5.2	8.9
Keams Canyon	200	6	206	21,497,050	40.9		62.9	107.5
Hopi Jr./Sr. High School	48	13	61	6,501,000	12.4		19.1	32.6
Total with BIA				99,399,450	189.1		290.8	496.9

Estimated Water Demand - 2.33% Growth Rate

Customer Name	Number of Residential Service Connections	Number of "other" Service Connections	Total Number of Service Connections	2013 Reported Annual Production Volume (gallons)	2013 Reported Annual Average Production (GPM)	Year 2015 Design Demand (x1.5 and 1.0233^2)	Year 2035 Design Demand (GPM) (x2 and 1.0233^22)
Shungopavi	146	3	149	10,402,600	19.8	31.1	65.7
Sipaulovi/Mishongovi (lower)	100	10	110	7,142,300	13.6	21.4	45.1
Sipaulovi/Mishongovi (upper)	25	5	30	2,102,600	4	6.3	13.3
FMCV	580	40	620	49,953,900	95	149.2	315.4
Total without BIA				69,601,400	132.4	208	439.5
2nd. Mesa Day School	14	3	17	1,800,000	3.4	5.3	11.3
Keams Canyon	200	6	206	21,497,050	40.9	64.2	135.8
Hopi Jr./Sr. High School	48	13	61	6,501,000	12.4	19.5	41.2
Total with BIA				99,399,450	189.1	297.0	627.8

Estimated Water Demand - 1.8% Growth Rate

Customer Name	Number of Residential Service Connections	Number of "other" Service Connections	Total Number of Service Connections	2013 Reported Annual Production Volume (gallons)	2013 Reported Annual Average Production (GPM)	Year 2015 Design Demand (x1.5 and 1.018^2)	Year 2035 Design Demand (GPM) (x2 and 1.018^22)
Shungopavi	146	3	149	10,402,600	19.8	30.8	58.6
Sipaulovi/Mishongovi (lower)	100	10	110	7,142,300	13.6	21.1	40.3
Sipaulovi/Mishongovi (upper)	25	5	30	2,102,600	4	6.2	11.8
FMCV	580	40	620	49,953,900	95	147.7	281.3
Total without BIA				69,601,400	132.4	205.8	392
2nd. Mesa Day School	14	3	17	1,800,000	3.4	5.3	10.1
Keams Canyon	200	6	206	21,497,050	40.9	63.6	121.1
Hopi Jr./Sr. High School	48	13	61	6,501,000	12.4	19.3	36.7
Total with BIA				99,399,450	189.1	294.0	559.9

Estimated Well Production

Well	GPM	Pump Set Depth (ft bgs)	Pumping Water Level (ft bgs - from JSAI report)	Design Pumping Water Level (ft bgs)	Ground Elevation		Static Lift Required (ft)	Friction Losses (ft - per hydraulic model, one pump on)	Total Dynamic Head (ft)
Turquoise Trail Well #2	413	900	664	700	5890		1109	18	1127
Turquoise Trail Well #3	416	900	664	700	5895		1104	17	1121
Future Tuquoise Trail Well #4	0								
Average Capacity Based on an Alternating 12 hr Pumping Day	414.5								
Design Capacity Based on an Extended Outage of Well #2	416								

Well Pump Selection	Pump Make	Pump Model	Rated Motor Horsepower	Expected Actual Horsepower	Flow (GPM)		Head (FT)	Outlet Diameter (in)	Motor Diameter (in)	Efficiency	Phase/Volts/Hz	Starting Amps	Maximum Load Amps
Well #2 Submersible Well Pump	Grundfos	475S-1000-10	100	94.5	413		712	6	8	78%	3/460/60	1211	142
Well #2 Submersible Booster Pump	Grundfos	475S-600-6	60	55.5	413		415	6	8	78%	3/460/60	658	86
Well #3 Submersible Well Pump	Grundfos	475S-1000-10	100	94.5	416		708	6	8	78%	3/460/60	1211	142
Well #3 Submersible Booster Pump	Grundfos	475S-600-6	60	55.5	416		413	6	8	78%	3/460/60	658	86

Hydraulic Analysis

Approximate Elevations	feet	static pressure (psi)	static pressure (ft)
Radio Tower WST Base Elevation	6275	8.3	19.2
Radio Tower WST Overflow Elevation	6299	0.0	0.0
Turquoise Trail 2 Well Head Elev	5890	175.0	404.2
Turquoise Trail 3 Well Head Elev	5895	172.8	399.2
Tawa'ovi Approximate High Elev	5955	146.8	339.2
Tawa'ovi Approximate Low Elev	5885	177.1	409.2
Booster Station Base Elev - Inlet	6275	8.3	19.2
Hopi Cultural Center	6315	73.5	169.9
Shungopavi Elevated Tank Ground	6352	57.5	132.9
Shungopavi Elevated Tank Base Elev	6464.5	8.8	20.4
Shungopavi Elevated Tank Overflow	6490	0.0	0.0
North Shungopavi	6330	67.1	154.9
South Shungopavi	6370	49.7	114.9
Shungopavi High Point	6385	43.2	99.9
Sipaulovi Proposed Upper Tank Base	6348	11.1	25.6
Sipaulovi Proposed Upper Tank Over	6380	0.0	0.0
Sipaulovi Hydropneumatic System	6305	29.7	68.6
Upper Sipaulovi	6320	23.2	53.6
Sipaulovi Existing Well - Upper Village	6185	81.6	188.6
Upper Mishongnovi	6285	38.4	88.6
Proposed Toreva PRV inlet	6050	140.1	323.6
Proposed Toreva PRV outlet	6050	45.0	104.0
Toreva	5900	109.9	254.0
Proposed Lower Sipaulovi PRV inlet	5850	131.6	304.0
Proposed Lower Sipaulovi PRV outlet	5850	40.0	92.4
Lower Sipaulovi WST Base Elevation	5780	70.3	162.4
Lower Sipaulovi WST Overflow Elev	5804		
2nd Mesa Day School WST Base Elev	5700	104.9	242.4
Alternate WST Base Elevation	6225	30.0	69.2
Original Elevated WST Base Elevation	6290	1.8	4.2
East Polacca WST Base Elev - Inlet	5984.5	134.1	309.7
East Polacca WST Overflow Elev	6006.8	0.0	0.0
West Polacca WST Base Elev	5823.5	11.4	26.4
West Polacca WST Overflow Elev	5856.5	0.0	0.0
Keams Canyon WTP Elev	5813	218.7	505.2
Pressure Class Threshold	5757.8	232.2	536.4
Phase 1a Low Point Elevation	5740	239.9	554.2
Phase 1a High Point Elevation	6145	64.9	149.2
Keams Canyon WST base elevation	6410	-50.3	-116.3
Keams Canyon WST overflow elevation	6430	-59.0	-136.4
Keams Canyon - Base of Highest Home	6240	23.6	54.4
Hopi High School Elevated Tank Ground	5930	158.3	365.8
Hopi High School Elevated Tank Base Elev		2736.6	6321.6
Hopi High School Elevated Tank Overflow		2736.6	6321.6
FMCV Well #8	5730	117.9	272.3

Static pressures estimated at tank levels of 80% full
For PRVs: Pressure max upstream = 3(pressure downstream)+23psi*
DR 18 PVC C900 Pipe will be used for static pressures under 235 psi
DR 14 PVC C900 Pipe will be used for static pressures over 235 psi

Cost of Generator Power	Diesel Fuel Consumption (gal/hr)	Run Time (hrs/day)	Cost of Diesel ($/gal)	Daily Fuel Consumption (gal/day)	Fuel Delivery Surcharge ($/gal)	Daily Fuel Cost	Monthly Fuel Cost	Annual Fuel Cost	Annual O&M or Rental Cost	Total Annual Cost
Well 2 (375KW generator)	18	12	5.25	216	1.50	$1,458	$44,348	$532,170	$100,000	$632,170
Well 3 (375KW generator)	18	12	5.25	216	1.50	$1,458	$44,348	$532,170	$100,000	$632,170
2nd Mesa Booster (40KW generator)	3	12	5.25	36	1.50	$243	$7,391	$88,695	$20,000	$108,695
Total	39			468		$3,159	$96,086	$1,153,035	$220,000	$1,373,035

Booster Pump Sizing	Base Elev	Shungopavi WST Overflow	Maximum Static Lift Required (ft)	Minimum Required Flow Rate (gpm)	Flow (gpm)		Head (ft)	Horsepower	Phase
2nd Mesa Booster	6275	6490	215	120.8					
Grundfos CR20-4					102		223.5	10	1
Grundfos CR32-3					132		229.7	15	3
Grundfos CR45-2					121		227.3	15	3
Grundfos CR64-2					207		250.7	25	3

Proposed Water Storage Tanks	Number of Tanks	Capacity (gals)	Capacity (ft^3)	Height	Diameter		Total Storage
Phase 1B WSTs - Radio Tower Tanks	1	260,717	34853	24	43		260,717
Phase 3 WST - Upper Sipaulovi Tank	1	110,547	14778	24	28		110,547
Total Proposed Storage	2						371,264

Existing Water Storage Tanks	Existing Capacity (gals)	Existing Capacity (ft^3)	Height	Diameter	Current (2013) Days of Water Storage
East Polacca Tank	500,000	66,840			5.2
West Polacca Tank	200,000	26,736			
Upper First Mesa Tank	8,000	1,069			
Shungopavi Tank	250,000	33,420			8.8
Lower Sipaulovi Tank	75,000	10,026			3.8
Upper Sipaulovi/Mishongnovi Tank	16,000	2,139			2.8
Totals	1,049,000	140,231			4.8 (ave)

Village Water Storage Analysis	Existing Capacity (gals)	Existing Capacity (ft^3)	Height	Diameter	Current (2013) Days of Water Storage		Additional Storage Proposed by HAMP	Estimated 2015 Days of Water Storage	Estimated 2035 Days of Storage	Required 2035 Design Storage per Navajo Area Guidelines (Based on a Pro-Rata Share of HAMP Storage and Well 3 Yield)	Total Storage (Existing and Proposed)
FMCV											
East Polacca Tank	500,000	66,840			5.2			4.2	2.2	690,276	895,115
West Polacca Tank	200,000	26,736									
Upper First Mesa Tank	8,000	1,069									
Pro-Rata Share of Radio Tower Tanks							187,113				
Shungopavi											
Shungopavi Tank	250,000	33,420			8.8			6.5	3.4	144,282	289,019
Pro-Rata Share of Radio Tower Tanks							39,019				
Lower Sipaulovi/ Mishongnovi											
Lower Sipaulovi Tank	75,000	10,026			3.8			6.2	3.2	98,891	187,172
Pro-Rata Share of Radio Tower Tanks							26,730				
Pro-Rata Share of Upper Sipaulovi Tank							85,441				
Upper Sipaulovi/ Mishongnovi											
Upper Sipaulovi/Mishongnovi Tank	16,000	2,139			2.8			5.5	2.9	28,956	48,960
Pro-Rata Share of Radio Tower Tanks							7,854				
Pro-Rata Share of Upper Sipaulovi Tank							25,106				
Totals	1,049,000	140,231			4.8 (ave)		371,264	6.4 (ave)	3.4 (ave)		

Storage Required per Navajo Area Guidelines: 2.5 days less the production from the lower yielding well over 18 hrs

Existing Water Sources	Average Yield	As Conc. (mg/L)	Depth (ft bgs)	Motor Size (hp)	Smallest Casing Diameter (in)
FMCV Well #5	100	0.018	910	40	8
FMCV Well #6	-	0.012	915	40	8
FMCV Well #8	110	0.020	1,120	40	6
Shungopavi Well	65	0.016	1,530	35	6
New Shungopavi Well	-	0.030			
Upper Sipaulovi/Mishongnovi Well	9	0.018	1,442	5	7
Lower Sipaulovi/Mishongnovi Well	90	0.018	983	20	6
Total	374				

Regional Water Storage Analysis	Gallons
Storage Required to Top Off All Existing Tanks (assuming each is 50% empty)	524,500
Storage Required to Replace Well 2 Production for 2.5 Days	1,486,800
Storage Requred per Navajo Area Guidelines (2.5 Days less Well 3 Production for 18 hrs)	961,920
Total Proposed Storage Provided by the HAMP	371,264
Total Existing Water Storage	1,049,000
Total Storage after Completion of the HAMP	1,420,264

Population and Housing Estimates	First Mesa		Second Mesa		Shungopavi			Keams Canyon		Average
Occupied Housing Units - 2010 US Census	458	3.82%	247	2.71%	204		2.65%	104	4.04%	3.31%
Occupied Housing Units - 2000 US Census	301		189		157			70		
Population - 2010 Census	1555	3.30%	962	1.68%	831		2.78%	304	1.58%	2.33%
Population - 2000 Census	1124		814		632			260		
Average Increase from 2000 to 2010		3.56%		2.20%			2.71%		2.81%	2.82%

*Future Population = Current Population * (1+%Growth Rate)^(# of years)*

ADES Population Projection

Year	First Mesa		Second Mesa		Shungopavi			All Hopi Lands	
2010	1555	0.58%	962	0.59%	831		0.56%	6040	0.54%
2013	1582		979		845			6138	
2015	1617	1.10%	1001	1.12%	864		1.12%	6261	1.00%
2035	1961	0.97%	1213	0.97%	1048		0.97%	7455	0.88%
25 Year Average		**0.93%**		**0.93%**			**0.93%**		**0.85%**

*Future Population = Current Population * (1+%Growth Rate)^(# of years)*

Population Growth Rate Estimates - Summary

Entity	2000 - 2010 Average Growth Rate	Estimated Range of Possible Growth Rates through 2035	Suggested Population Growth Rate through 2035
US Census - Population	2.33%		
US Census - Occupied Housing	3.31%		
ADES		0.85 - 0.93%	0.93%
TetraTech (2006 report)			2.0%
HDR (2003 report)		1.3 - 2.75%	2.5%
Draft PER			2.0%
USDA (draft PER comments)		1.0 - 1.25%	
This Report:		**1.25 - 2.33%**	**1.8%**

Design Demand vs. Estimated Growth Rate

Estimated Growth Rate	Year 2035 Design Demand (GPM) without the BIA	Year 2035 Design Demand (GPM) with the BIA
1.25%	347.9	496.9
1.80%	392	559.9
2.33%	439.5	627.8

	Alignment A	Alignment B	Alignment C
static head available	149.2		
Headloss 12"	105.58 @ 690		
Headloss 8"	108.87 @ 330		
Headloss 6"	107.86 @ 170		
Flow - 12"	690 w/a FCV		
Flow - 8"	330 w/a FCV		
Flow - 6"	170 w/a FCV		

Estimated Water Demand - 1.8% Growth Rate

System Name	Number of Residential Service Connections	Number of "other" Service Connections	Total Number of Service Connections	2013 Reported Annual Production Volume (gallons)	2013 Reported Annual Average Production (GPM)	Year 2015 Design Demand (x1.5 and 1.018^2)	Year 2035 Design Demand (GPM) (x2 and 1.018^22)
Shungopavi	146	3	149	10,402,600	19.8	30.8	58.6
Sipaulovi/Mishongovi (lower)	100	10	110	7,142,300	13.6	21.1	40.3
Sipaulovi/Mishongovi (upper)	25	5	30	2,102,600	4	6.2	11.8
FMCV	580	40	620	49,953,900	95	147.7	281.3
Total without BIA				69,601,400	132.4	205.8	392
2nd. Mesa Day School	14	3	17	1,800,000	3.4	5.3	10.1
Keams Canyon	200	6	206	21,497,050	40.9	63.6	121.1
Hopi Jr./Sr. High School	48	13	61	6,501,000	12.4	19.3	36.7
Total with BIA				99,399,450	189.1	294.0	559.9

Existing Water Storage Tanks	Existing Capacity (gals)	Existing Capacity (ft^3)	Height	Diameter	Overflow Elevation	Current (2013) Days of Water Storage	Year 2035 Days of Water Storage (Existing)	Storage Required to Meet Navajo Area Guidelines (gals)	Additional Storage Required (gals)	Proposed Storage (gals)
East Polacca Tank	500,000	66,840	60	24	6006.8	5.2	1.7	904,680	196,680	200,000
West Polacca Tank	200,000	26,736	33	40	5856.5					
Upper First Mesa Tank	8,000	1,069			6228 (est.)					
Shungopavi Tank	250,000	33,420			6490	8.8	3.0	140,760	-	
Lower Sipaulovi Tank	75,000	10,026	26	24	5804	3.8	1.3	91,080	16,080	100,000
Upper Sipaulovi/Mishongnovi Tank	16,000	2,139	12	26	6380	2.8	0.9	84,960	68,960	
Totals	1,049,000	140,231				4.8 (ave)				

Existing Water Sources	Average Yield (gpm)	Representative Arsenic Conc. (mg/L)	Total Depth (ft bgs)	Pump Set Depth (ft bgs)	Drop Pipe Nominal Diameter (in)	Static Water Level (ft bgs)	Motor Size (hp)	Smallest Casing Diameter (in)	Approximate Ground Elevation	Year Constructed	Current Age
FMCV Well #5	100	0.018	915			182	40	8	5,633	1986	28
FMCV Well #6	100	0.012	915			158	40	8	5,633	1986	28
FMCV Well #8	110	0.020	1,100	822	4	365	40	6	5,730	1988	26
Shungopavi Well	65	0.016	1,530	1,113	2	990	35	6	6,352	1969	45
New Shungopavi Well	-	0.030	1,620	-	-		-	6-5/8	6,370	2008	6
Upper Sipaulovi/Mishongnovi Well	9	0.018	1,442			779	5	7	6,190	1979	35
Lower Sipaulovi/Mishongnovi Well	90	0.018	983	651	3	430	20	6	5,790	1978	36
Total	474										

Additional Water Sources Required	Expected Yield
Future FMCV Well	255
Future Lower Sipaulovi Well	50
New Shungopavi Well	55

Water Treatment Facilities	Elevation	Minimum Capacity (GPM)
FMCV	5,730	465
Sipaulovi/Mishongnovi	5,790	140
Shungopavi	6,352	120