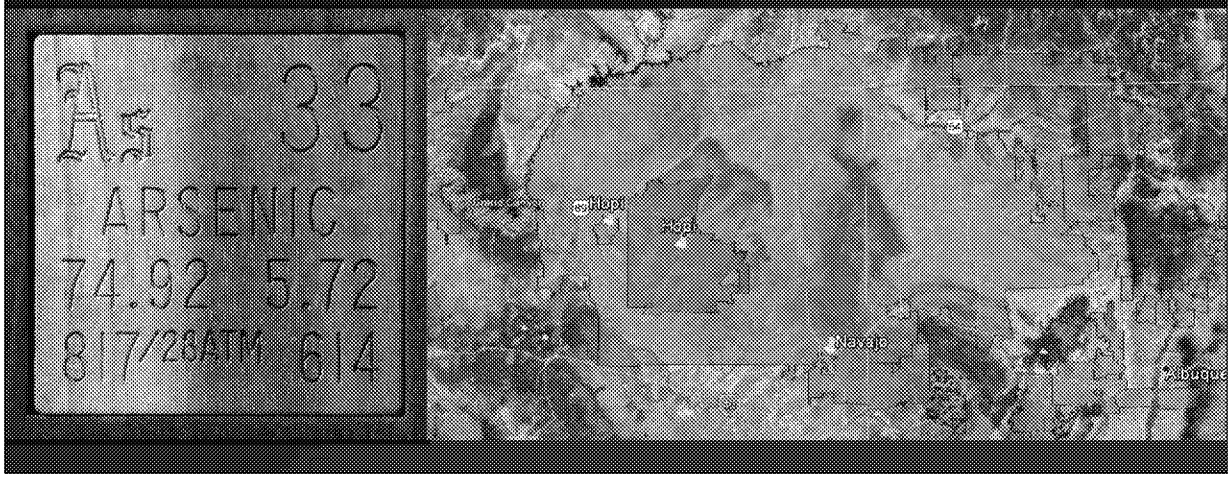
Hopi Arsenic Mitigation Project

May 5, 2017



Hopi Villages Relationship to Tribe

- Hopi Tribe consists of twelve semi-autonomous villages: Upper Moenkopi, Lower Moencopi, Hotevilla, Bacavi, Oraibi, Kykotsomovi, Shungopavi, Sipaulovi, Mishongnovi, and the First Mesa Consolidated Villages of Walpi, Sichmovi, and Hano (Tewa).
- Each Village is governed by an elected board of directors and/or a traditional leader (kikmongwi). The board or the kikmongwi appoints representation to the tribal council.
- Funding for each village is appropriated by the tribal government for village operations, including for the water systems.
- Currently the villages of Mishongnovi,* Shungopavi,* Oraibi, Hotevilla and Lower Moencopi do not have representation on the tribal council.

Hopi Public Water Systems Subject to HAMP

- **First Mesa Consolidated Villages (FMCV) or "Polacca" PWS ID# 0400106–**
  - Population Served: 3917, 496 connections;
  - Three pressure zones, 2 active wells, 3 storage tanks.
  - No certified operator
  - As levels ranges from 14-28 ppb. RAA is currently 17 ppb
- **Sipaulovi (Lower Sipaulovi/Lower Mishongnovi) PWS ID# 0400107**
  - Population Served: 523, 113 connections;
  - One pressure zones, 1 active well, 1 storage tank.
  - Operator certified at D1/T1
  - As levels ranges from 15-24 ppb. RAA is currently 17.1 ppb

Hopi Public Water Systems Subject to HAMP

- **Mishongnovi (Upper Sipaulovi/Upper Mishongnovi) PWS ID# 0400394–**
  - Population Served 450, 24 connections;
  - 1 pressure zone, 1 active well, 1 storage tank.
  - Operator certified at D1/T1
  - As levels ranges from 15-21 ppb. RAA is currently 16.7 ppb
- **Shungopavi PWS ID# 0400259**
  - Population Served 1500, 275 connections;
  - 1 pressure zone, 1 active well, 1 storage tank.
  - Operator certified at D1
  - As levels ranges from 12-17 ppb. RAA is currently 14.8 ppb

Rural Water System vs Individual Treatment

- **Rural Water System connecting four villages to arsenic compliant wells at turquoise trail (aka "HAMP")**
  - Pros – Lower overall O+M costs. Lower operator certification levels required, accommodates growth.
  - Cons – Higher Capital Cost. Necessitates coordination among autonomous villages and agreement on terms of MOA between utility and villages.
- **Individual Treatment Plants at 3-4 Villages**
  - Pros – Lower capital costs, less coordination and agreement required among villages and utility.
  - Cons – Higher O+M costs; Certified operators required; Treatment complexities; Will require upgrades to existing infrastructure. Less opportunity for growth. Higher overall cost based on 20 year operations.

Technical complexities with Treatment

Water Quality Issues

- pH (ranges from 9.4 to 9.9)
- Alkalinity (Buffering Capacity)
- Scaling
- Arsenic Speciation, As III vs. As V (First Mesa Water)
- Competing Ions (Vanadium interference in Second Mesa Water)

Most arsenic treatment systems operate with optimal pH between 6 and 8.5
Ion Exchange, Adsoption, RO, Coagulation Filtration
Alkalinity ranges from 264-330 mg/L which is very high. Significant acid addition is required. In Keams Canyon, they use CO2 gas.
Once pH is reduced it increases corosivity and it should be readjusted upward post treatment to avoid scaling on the pipes. Both arsenic and lead deposits could form on the interior of the pipes. In Keams Canyon, they exceeded the action level in 2015 for lead. Hopi High School too in 2011
Arsenic removal technologies require arsenic to be in the pentavalent form (charged ion). First Mesa arsenic is 80% trivalent. So will require a strong oxidizer such as potassium permanganate or chlorine to oxidize.
High levels of Vanadium in Second Mesa will preferentially compete for removal over As5. At second mesa day school they first have to harden the water. They also have additional bag filters. They've had lots of problems

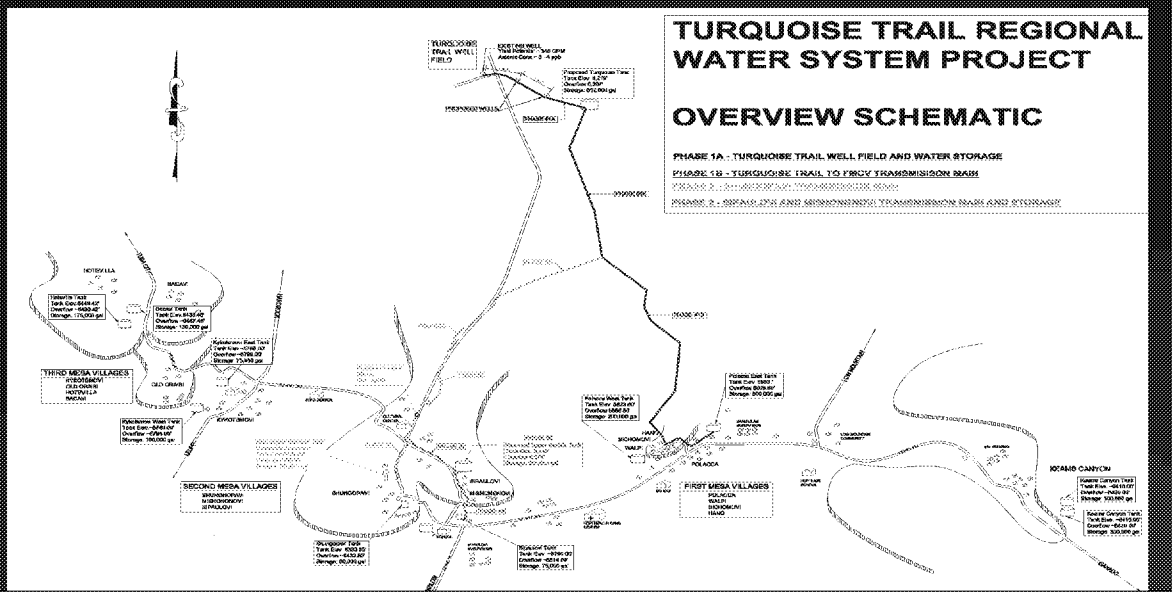
Hopi Area Public Water Systems with As Treatment

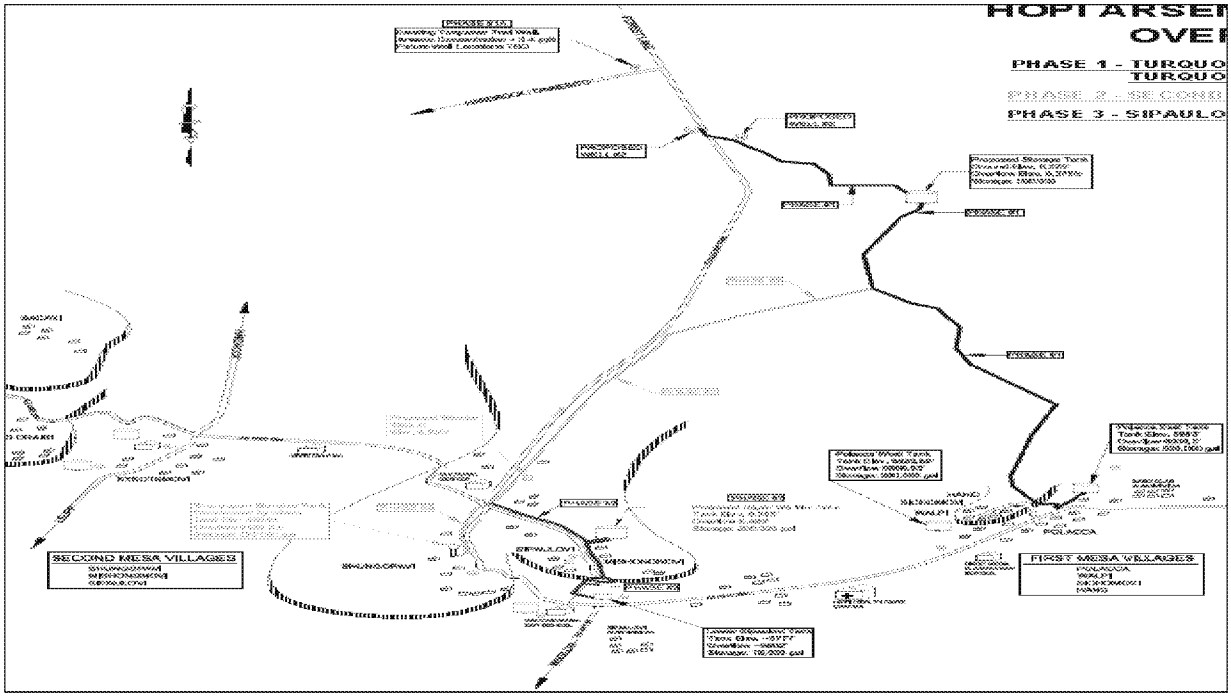
- **BIA Keams Canyon PWS ID# 0400054–**
  - Population Served 861, 169 connections; 1 pressure zone, 2 active wells, 2 storage tanks.
  - Two operators certified at D2/T1 and contract support
  - In 2012 installed Adedge adsorptive media with pre-treatment pH adjustment
  - Raw Water As levels range from 35-45 ppb. Have been meeting As MCL since installation but treatment plant is not optimized.
  - They have had lead hits in their distribution because they don't do a post treatment pH adjustment
- **Hopi High School PWS ID# 0400395**
  - Population Served 1150, 55 connections;
  - 1 pressure zone, 1 active well, 1 storage tank. Operator certified at T1.
  - Reverse Osmosis Treatment with pH adjustment and micro filtration installed in 1998. Inconsistent results with long periods of non-compliance. From late 2015-April 2017 the plant was not achieving arsenic removal.

Hopi Area Public Water Systems with As Treatment

- **Second Mesa Day School PWS ID# 0400057**
  - Population Served 376, 15 connections;
  - 1 pressure zone, 1 active well, 1 storage tank. No Certified Operator
  - In 2007, installed Isolux adsorptive media treatment with pre and post chlorination, pH adjustment, bag filtration, CaCl for hardness
  - Plant has experienced issues with vanadium interference and inconsistent As removal. Has been out of compliance since summer 2016.
- **Hopi Cultural Center PWS ID# 0400260**
  - Population Served 325, 2 connections;
  - Currently subject to EPA Administrative Order for As compliance
  - Installed Isolux adsorptive media treatment February 2016 but not yet operational

Overview Schematic of Regional Water System




HOPI ARSE
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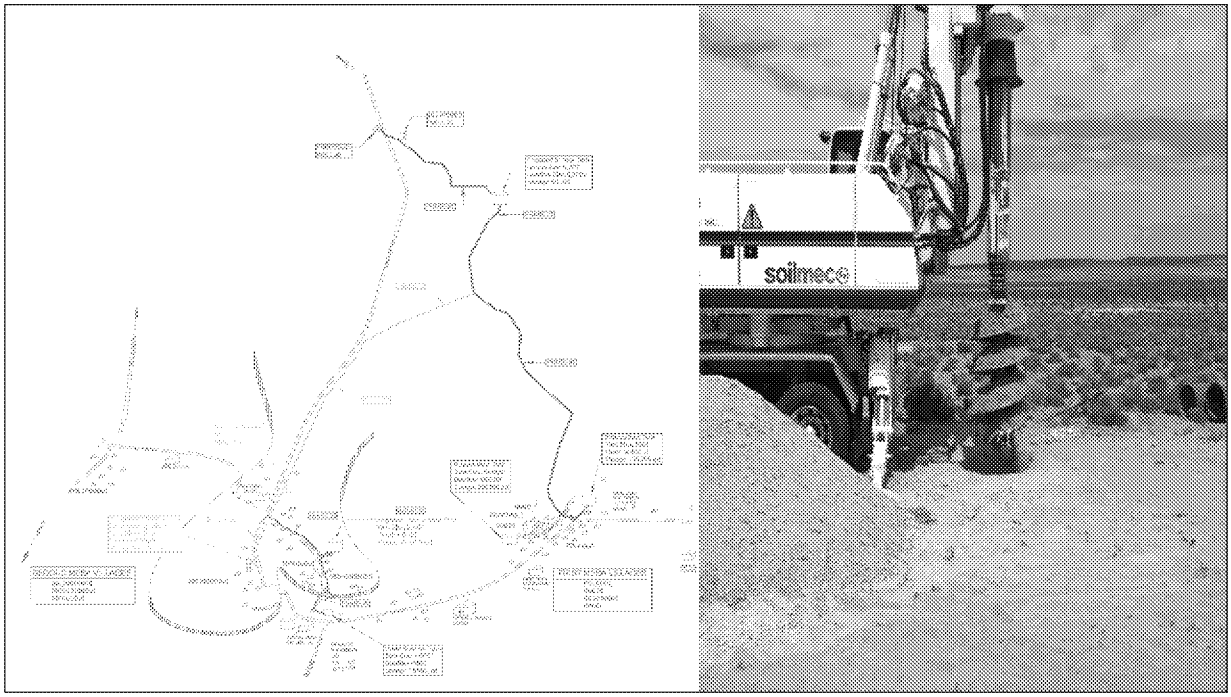
PHASE 1 - TURQUO
TURQUO
PHASE 3 - SIPAULO
SECOND MESA VILLAGES
FIRST MESA VILLAGES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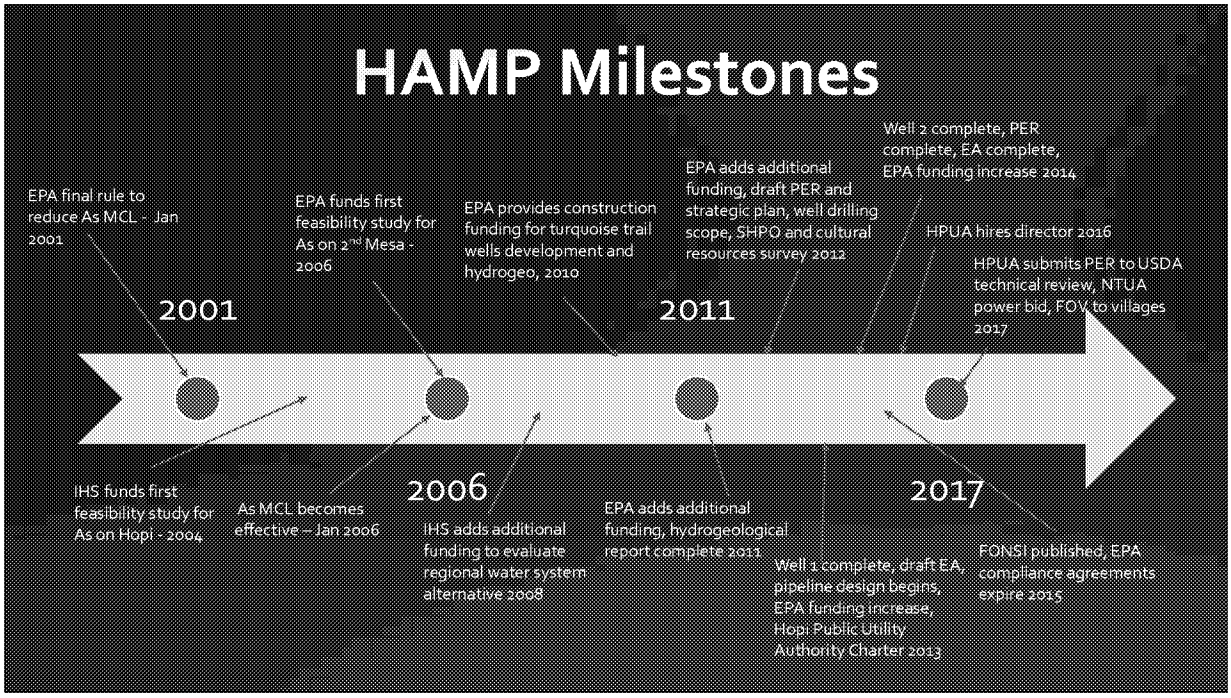

PH 06-D33 – In 2006 EPA funded an IHS project for $205k to research arsenic mitigation strategies and published a feasibility study for the Sipaulovi/Mishongovi water systems that recommended consolidation of the two systems and installation of a single treatment system. The construction portion was never funded. The project also provided funding for the inspection services during the construction of the two turquoise trail wells and the Environmental Assessment for the HAMP preliminary engineering report (PER) alternatives.

PH 10-E37 – In 2010 EPA provided $1.85 million toward the construction of two turquoise trail wells, a hydrogeologic study by Kennedy Jenks prior to the well drilling which recommended their location and well completion profiles and an asset management and O+M plan for the proposed Hopi Public Utility Authority.

IHS contributed $950k of their funds toward the Turquoise Trail Well construction, EA, Inspections, Hydrogeological study and well drilling inspection.

PH 11-E55 – In 2011, EPA provided $1.1 million towards Phase 1 construction of the HAMP to first mesa, the development of the environmental assessment (EA), aerial mapping, and a geotechnical investigation for a new water storage tank. Thus far, the EA and preliminary engineering report (PER) have been completed. $625k remains.

PH 12- E73 – In 2012 and 2013 we provided an additional $1.234 million toward phase 1 construction and other planning activities. The full balance (minus PTS) is remaining.

PH 14-U62 – In 2014, $985,000 was provided to begin construction in Upper Sipaulovi/Upper Mishongovi including a new water storage tank.

PH 15-U67 - $700,000 funded in 2015 to construct a new water storage tank and provide a direct fill line between the east and west sides of the water system.

Shungopavi – Tank and water line to cultural center. Direct grant to Tribe.

Summary of HAMP Related Projects

Funding Agency	IHS Project #	Scope and/or Outcomes	Total	Available Funds	IA expiration
EPA	PH 15-U67	New tank at Polacca and fill line from East to West	$700,000	$700,000**	12/31/2018*
EPA	PH 14-U62	Upper Sipaulovi/Mishongnovi Tank and transmission main	$985,000	$817,400	12/31/2018*
EPA	PH 12-E73	Phase 1 transmission main	$1,233,458	$1,061,600	7/31/2017
EPA	PH 11-E55	PER, EA, strategic plan, Bio Survey	$1,100,000	$621,000	7/31/2017
EPA	PH 10 E-37	Turquoise Trail Wells, EA, strategic plan, hydrogeological study	$1,857,400	$0	7/31/2017
IHS	PH 08- T38	Environmental Assessment (EA)	$150,000	$0	N/A
EPA	PH 06-D33	Bio Survey, Second Mesa feasibility study, well drilling	$205,000	$0	Closed
IHS	PH 04-S63	EA, strategic plan	$800,000	$0	N/A
Totals			**$7,030,858**	**$2,500,000*** **	

*Can be extended to 2021/2022 ***Does not included U67
** only a portion of cost offsets HAMP

PH04-S63 – Originally funded to investigate new well locations in first mesa. Ultimately funding was shifted to HAMP activities in 2008 to fund EA and strategic plan
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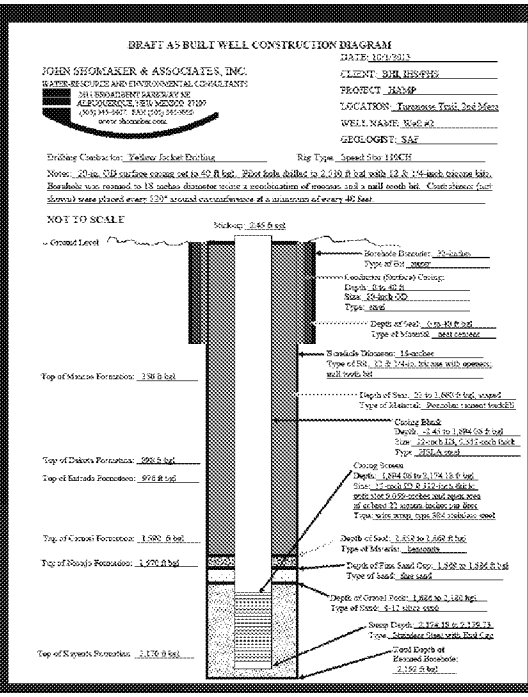
Shungopavi Grant– Tank and water line to cultural center. Direct grant to Tribe. $308,111
Shungopavi funding to IHS - $200k for water line E89

Work Completed to Date

- Hydrogeologic study published by Kennedy Jenks;
- Drilling and development of the two Turquoise Trail Wells;
- Well drilling inspection services and publishing of a final well report;
- Hopi Public Water System Strategic Plan creation;
- Life Cycle Cost Analysis and Comparison of Alternatives published;
- Archeological and biological resource surveys of the project area;
- Development of an Environmental Assessment;
- Project management, conceptual project design, and engineering consultation by the IHS;
- Development and publishing of Preliminary Engineering Report (PER) in 2014.
- Finding of No Significant Impact published 2015

HAMP Remaining Scope and Cost

Funding Summary	Amount	Description
Total HAMP Capital Cost	$16,914,000	Estimated cost of the HAMP scope in 2014
Maximum Possible USDA Grant	$12,685,500	75% of the total capital cost is eligible per USDA to be funded with federal grant monies
Minimum Tribal Contribution Required	$ 4,228,500	25% of the total capital cost is required from the recipient (Tribe) and may be a combination of loan and/or up-front cash, per USDA
Current Available Federal Grant Funds	$ 2,500,000	Available USEPA grant funding already appropriated to the Tribe for construction of the HAMP
Expected USDA Grant to the HAMP	$10,185,500	Maximum possible USDA grant amount less the already appropriated EPA grant monies
Expected Hopi Tribal Council Grant	$ 2,179,000	Tribal resolution pending
Expected other Hopi Tribal Cash Contribution	$ 71,000	Source to be determined
Expected USDA Loan Amount	$ 1,978,500	Minimum tribal contribution required less the expected Hopi Tribal Council grant and Hopi cash contributions



Turquoise Trail Well Completion Profile

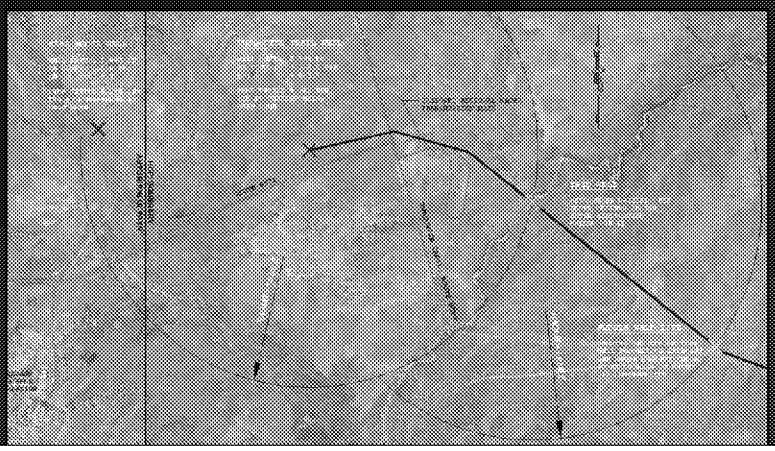
New HPUA Director questioned the turquoise trail well construction. He raised the concern that the Dakota "D" aquifer would bleed into the Navajo "N" aquifer over longer pumping periods.

He would like to do additional hydrogeological studies to ensure the viability of the wells to produce arsenic compliant water in the longer term.

IHS may support retaining the hydrogeo consultants that performed well construction inspection to evaluate the theory though they generally believe they have enough assurance from their initial report to support the long term viability of the wells.

NTUA wells in proximity to Turquoise Trail

- The Hard Rock Community operates two wells within ~ two miles of the Turquoise Trail Wells. They are drilled to similar depths, similar screened intervals and have very similar water quality as the Turquoise Trail wells. They also have similar pumping capacity. They have been in operation since 1985.
- Most recent arsenic results for both wells: August 2016 <0.003 ppm (non-detect). Last arsenic detection 2ppb in 1996.



Rated for 245 gpm, though actual pumping ~85 gpm

Next Steps for HAMP

- HPUA is awaiting technical comments from USDA-RD on their engineering review of the HAMP PER (2014). Meeting proposed for late May 2017 between USDA, HPUA, IHS.
- In order to apply for RD funding, the Hopi Tribe would need to come into compliance with the single audit act or the Hopi Public Utility Authority would need to establish its financial viability by merging with Hopi Telecommunications. A tribal charter to merge the utilities is currently under review by the Tribal Council.
- HPUA needs to ratify agreements with the four villages where they agree to purchase HAMP water from HPUA as the wholesaler.
- Hopi Tribe plans to secure Tribal funding for the NTUA power connection to Turquoise Trail wells.

Expiring DWTSA Funds

- EPA's Interagency Agreements with the Indian Health Service have a time limit of 7 years for completion. They are very difficult to extend.
- The agreement that encompasses projects PH 12-E73, PH 11-E55, PH 10 E-37 will expire on July 31, 2017. There is approximately $1.6 million remaining in unspent funds.
- The original scope of work is not likely to be completed until full funding for the HAMP is secured so we believe it's best to close the agreement and request the funds be returned to EPA.
- Region 9 receives ~ $6.6 million/year for DWTSA projects. We have told HPUA that we will be able to re-obligate any returned funds under a new scope of work that is agreed to by EPA and IHS and/or the Tribe can apply for new funding in FY18.
- There are still funds remaining in PH14-U62 that can be used for any planning activities in the interim.

Interim Compliance Options

- Individual Treatment Plants at the Villages would likely derail the HAMP due to large capital and O+M costs that would have a smaller rate payer base.
- Water Hauling from existing turquoise trail wells would likely be prohibitively expensive in terms of fuel costs and O+M.
- POU devices would be very difficult to regulate and significantly increase O+M and monitoring costs in the interim.
- Latest proposal is the installation of individual water filling stations in each village. The filling stations would utilize individual RO treatment units and be connected to the existing village systems. Potential challenges include the installation costs, and vandalism.

Life Cycle Present Net Worth Cost Analysis Summary – 20 year

	HAMP with Electric Grid Power	Arsenic Treatment
Capital Costs	$16,914,000	$13,155,000
Annual O&M Costs	$430,000	$765,000
O&M Present Value	$7,032,000	$12,502,000
Renewal and Replacement Costs	$1,097,000	$2,425,000
Total Present Value Cost	$25,043,000	$28,076,000
Remaining Useful Life	$7,232,000	$3,520,000
Net Present Value	**$17,811,000**	**$24,556,000**

HAMP Projected Village Utility Rates

Village	Current monthly utility cost per residential connection	Estimated monthly utility cost per residential connection once HAMP is complete	Cost Increase
FMCV	$15	$67.05	347%
Shungopavi	$20	$66	230%
Sipaulovi/Mishongnovi	$27.49	$71.25	268%