MEMORANDUM

DATE: April 12, 2019
TO: Brad Stewart
Salt Lake City Department of Public Utilities
1530 South West Temple
Salt Lake City, Utah 84115

FROM: David E. Hansen, Ph.D., P.E.
Hansen, Allen & Luce, Inc. (HAL)
859 West So. Jordan Pkwy – Suite 200
South Jordan, Utah 84095

SUBJECT: 4th Avenue Well Assessment

PROJECT NO.: 083.56.100

This memorandum provides a summary overview of current conditions related to the 4th Avenue well. According the attached well log, the well is a 20" diameter well drilled in 1943 to a total depth of 464 feet. It is located within a vault on the northeast intersection of 4th Avenue and Canyon Road in Salt Lake City. The well was completed and equipped below grade and does not meet several current design and safety standards. Two major life and health safety issues include the fact that the vault has only one access point and that high voltage electrical controls are all within the vault. A change in atmosphere or a water leak coming in contact with electrical components could be life threatening. Costs are a quantifiable way of evaluating options, however there are other operational concerns and considerations that must also be taken into account during the decision-making process. Some of these other considerations have been identified as part of the discussion on the Pros and Cons of various alternatives provided later within this report.

When operating, the 4th Avenue well may supply 3-7 million gallons per day to the Salt Lake City water system, meeting the pressure and water demands of approximately 12,000 connections. It is an important and reliable water source for the City that provides culinary water to single and multi-family residential consumers as well as hundreds of commercial and industrial consumers in downtown Salt Lake City and the surrounding area.

This summary memorandum documents the basic current condition of the well as well as the results of an investigation competed to evaluate options that would remove the safety hazards and bring the well into compliance with current standards. Basic options considered well abandonment, making needed upgrades at the current location, constructing a new above ground facility with off-site chlorination, constructing a new above ground facility with on-site chlorination, and total well relocation.

INTITIAL CONDITION OF WELL

1. Date Drilling Started: June 28, 1943
2. Date Drilling Completed: July 16, 1943
3. Well Diameter: 20" Double Wall
4. Well Depth: 464'
5. Drilling Method: Cable Tool

6. Perforations (10 Holes/ft): 162' to 216'
   231' to 280'
   312' to 317'
   324' to 341'
   380' to 420'
7. Static Water Level: 142'
8. Pump Test: 8.9 cfs
9. Pump Drawdown: 12'

CURRENT WELL CONDITION

1. Pump Capacity: 5-7 mgd (3,500 – 4,700 gpm)
2. Well Casing Condition:

   To assist in determining the condition of well casing a Well Inspection Log was run by Pacific Surveys (See Attachment). The log measured temperature, caliper and Casing Inspection Thickness Measurement (CITM).

   Perforations based on depth below top of casing, which was measured to be 11' 2" below the top of concrete near the ground surface as determined by the Casing Inspection Log, are as follows. The measure down based on ground surface is approximately 10 ft. With the exception of depths below 370 feet, adding 10 feet to the Casing Inspection Log very closely matches those reported in the well drillers log. The well drillers log however shows continuous perforations from 380' to 420' whereas the Casing Inspection Log shows a break in perforations between 392' and 398'.

Perforations per CITM Survey:	Depth below Top of Casing
	152' to 206'
	221' to 280'
	303' to 308'
	314' to 331'
	370' to 392'
	398' to 412'

   When looking at the Well Inspection Log you have to remember that it is a qualitative log that represents changing conditions down the well. For example, the CITM log shows the theoretical thickness of the well to be 0.344" but the log starts out at a higher value of approximately 0.42". Discussions with the logger indicated that it was his opinion that the well casing is good in this upper zone. The logger further indicated that the decline in the thickness reading starting about 120 feet, and steepening between 144' to 155' may indicate a possible damaged area. A review of the post cleaning video of the well was reviewed carefully and no casing degradation was visually observed anywhere within the well.

   The decline in the CITM log through perforated zones starting at 150 feet is normal. Since the CTIM log is measuring the amount of material present, it responds to the holes in the perforations. Note however that with the exception of the 304' to 308' zone the well casings are fairly uniform. Also note that the log consistently rebounds to the approximate 0.43" range in blank sections.

   In summary, the well logger believes that the well casing is in good condition. This conclusion was also reached by Kyle Widdison of Widdison Turbine Service (WTS)

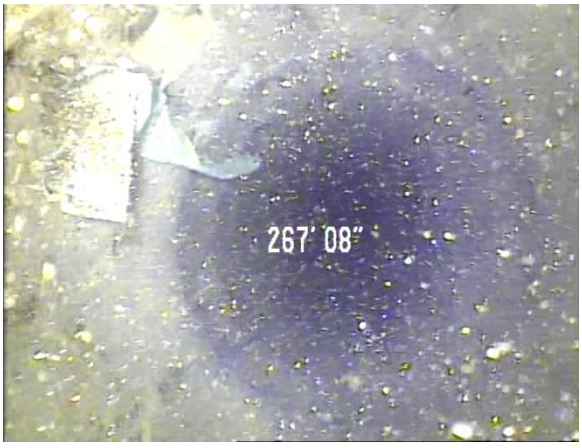
following his work on the well between February 18th and March 6th, 2019. Work performed by WTS during this time included the removal of the pump and motor, the completion of a pre-cleaning video, scrubbing and bailing the well, the completion of a post-cleaning video, and re-installation of the pump and motor.

3. Depth
    - Widdison Turbine Service (WTS) completed a pre-cleaning video on February 26, 2019.
    - Before cleaning, material was tagged in the well at a depth of 453'.
    - The well was then cleaned and bailed by WTS on February 26-27, 2019 wherein 10.5 feet of material was removed from the well. The depth after cleaning was 463.5 feet, within 1.5 feet of the reported well depth in the original well drillers log.
    - WTS completed a post-cleaning video on March 1, 2019.
    - The pump and motor were re-installed and work completed on March 6, 2019.

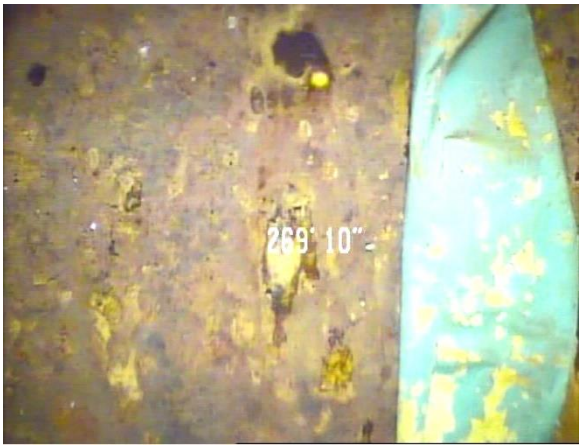
4. Other maintenance needs:

    WTS did experience one problem while completing their work. While removing the well they found that the pump and motor got stuck between about 268 to 270 feet. Unable to pull it further WTS brought in a heavier crane which also failed to be able to pull the pump and motor. WTS then rented a larger crane and was finally able to pull the equipment from the hole. Upon retrieval they found that one of the well intake screens had stuck to the side of the casing and was missing from the pump intake.

    While re-installing the pump and motor WTS again found that the pump and motor again hung up at the 268 to 270-foot range, however they were able to get the motor past this point and reset the pump to its proper position. A review of the pre-cleaning video shows some debris caught on the side of the well casing while the camera was at 267' 08".



The log also shows a blue material stuck to the casing in the side video shot at 269' 10".



Because of irregularities seen in the vertical video in this section there is the possibility of casing damage, although the CITM log shows little variation in this zone. If the casing is damaged in this zone the installation of a liner will help resolve and eliminate any casing anomaly.

Upon completion of their work WTS set the top of pump at 270 feet and the bottom of the motor at 286 feet.

Based on the work completed by WTS it appears that the well is and will continue to be operational and a viable and important water source for the city. In its present condition it is believed that the well could potentially continue to perform for another 20-30 years, and perhaps even longer.

WELL OPTIONS

Option 0: Continue to use well As-Is – Do Nothing

This option has no additional cost. The well will continue to function for a time but it will continue to degrade, have ongoing health and safety concerns, and although it is grandfathered in, will be non-compliant with current regulations. It must be remembered however that continued use of the well will need upgrades. The following list provides a few health and safety issues with the existing vault that can be life threatening.

- The well is located approximately 10 feet below the ground surface in a vault.
- The vault is a confined space with only one ladder exit. It would be difficult to remove someone from the space should they have an injury or medical problem.
- Excess moisture within the vault will promote bacterial growth and deplete the oxygen supply. Unless monitored and detected before entry, a depleted oxygen source will render a worker unconscious within seconds.
- The electronic controls are out of date and don't meet current clearance standards that could prevent a life-threatening electrical discharge.
- A sudden large water leak could injure a worker rendering him/her either partially or fully unconscious.
- A water discharge has nowhere to go and will fill the vault space. Any water coming in contact with electrical equipment, whether as a spray or a flooded space, would be life threatening.
- Although grandfathered, the well as it exists today does not meet Utah Division of Drinking Water standards.

Option 1: Leave Well in-Place – Add New Well Liner

Before serious consideration should be given to upgrade the well in-place, the question must be asked, what is its expected remaining life? A typical well life span is between 50 and 100 years for steel casing and the well is now 76 years old. The well inspection log however shows that the well casing appears to be in good condition with little deterioration. It is therefore believed that the well could easily have 20 to 30 years or more of additional life in its current condition. It is believed that the life of the well could be extended to between 75 and 100 years if the existing 20" well casing was shredded followed by the installation of a new 18" blank and screened well liner within the well to stabilize the aquifer formation as the steel casing deteriorates over time. Costs estimated cost to accomplish this is estimated to be $152,000.

Option 2a: Leave Well In-Place – Build Wellhouse

The safety/design issues with the current installation can be easily rectified by modifying the well and constructing a wellhouse. Modifications would include adding casing to the well so it is raised above the ground level and constructing a new wellhouse that incorporates current standards.

It has been suggested by some local residents that the chlorine facility be moved to another location. To move the chlorine facility off-site a full-size transmission line would need to be extended to the off-site facility where the chlorine would be injected, then tied back into the distribution system. This increases capital cost for the pipeline and secondary facility as well as operation and maintenance on two separate facilities. It is clear based on the Pro's and Con's listed later in this report that such a move is not optimal. In addition, the footprint reduction which could be achieved by implementing an off-site chlorination facility would reduce the overall footprint by approximately 300 square feet (15'x20'). The estimated cost for this option is $2,688,000.

Option 2b: Leave Well In-Place – Build Wellhouse and Add New Well Liner

This option is identical to Option 2a, but includes the installation of a new 18" screened liner inside the existing 20" casing. Before the installation of a new liner the existing casing would be shredded thus enhancing flow through the existing casing. The reduction is casing size from 20" to 18" will not affect the flow capacity of the well. With the addition of a wellhouse, the pump and motor system can also be converted from the existing submersible pump and motor to a line shaft pump and motor where the pump is down the well but the motor is above ground within the pumphouse. Line shaft systems are easier to maintain and typically have longer life expectancies than submersible motors. This option should effectively increase the well life another 75 to 100 years. The estimated cost for this option is $2,826,000. Options 2c-1 and 2c-2 shown below all assume chlorination will be part of the wellhouse design. Adding chlorine at the source will help ensure the distribution and water delivery system meets drinking water standards. Chlorination can be eliminated from the design, however doing so may induce public health risks.

Option 2c-1: Leave Well In-Place – Build Wellhouse, Add New Well Liner, use Off-Site Chlorination in Old City Hall Building

This option is identical to Option 2b but it moves the chlorine facility to the Old City Hall Building north of the well. The estimated cost for this option is $3,272,000.

Option 2c-2: Leave Well In-Place – Build Wellhouse, Add New Well Liner, use Off-Site Chlorination in a New Building

This option is identical to Option 2b but it moves the chlorine facility to a new building at a location yet to be determined. The estimated cost for this option is $3,632,000.

Option 3a: Abandon the Existing Well and Move to an Alternate Location within 300' of the Existing Well

It has been suggested by some that the well be abandoned and moved. If issues with the water right are to be avoided the well cannot be moved for than 150', or perhaps 300' if a variance is granted by the State. If it moves more than that the City would be required to file a formal Water Right Change Application with its associated process. A review of properties within these distances show no vacant lots upon which the well could be relocated. To move the well within these distances two or more homes would have to be demolished to provide enough room for equipment to drill the well.

Moving the well this short distance would likely be hydrologically successful, however, it gains little since two potentially historic homes would be lost at significant capital cost. The facilities would still be in the neighborhood with likely similar or increased protests. The estimated cost for this option is $5,463,000.

Option 3b: Abandon the Existing Well and Move to an Alternate Location > 300' of the Existing Well

Moving the well to distances greater than 300' from its existing location would require the submittal and approval of a water right change application. The well could not be re-drilled at another location until an approval of the change is received from the state and the timing to go through the process. If a water right hearing is required this process typically takes 12 to 18 months, and the submittal of a water right change application does not guarantee approval. Some of the major issues and risks in moving the well out of the neighborhood are outlined in the Pro's and Con's section below. The estimated cost for this option would be in excess of the $5,463,000 cost for Option 3a since it is highly likely that a longer connecting pipeline would be needed to get water to the zone currently supplied by the 4th Avenue Well.

Option 4: Alternative to Bury the Flow Meter for Options 2a, 2b, 2c-1 and 2c-2

This alternative removes the flow meter from inside the wellhouses identified in Options 2a, 2b, 2c-1 and 2c-2 and places the meter in a buried vault outside the wellhouse. Although this may reduce the footprint of the building slightly it will not reduce the total footprint of the building and buried vault. In addition, burying the meter does not eliminate a confined space to house and maintain the flow meter, does not eliminate the need for above grade electrical components (thus minimizing the potential reduction in building size by burying the meter), and may impact to existing tree roots. Since the electrical panels cannot be stacked, the above grade building would have to be wider than that shown in preliminary design. A wider structure is not feasible due to other local utilities.

COST SUMMARY OF ALTERNATIVES

A more detailed summary of preliminary costs are provided in the attached cost spreadsheet.

Option	Description	Estimated Cost	% of Option 2a
0	Do Nothing	$0.00	n/a
1	Leave Well In-Place – Add New Well Liner	$151,800	n/a
2a	Leave Well In-Place – Build Wellhouse	$2,688,000	100
2b	Leave Well In-Place – Build Wellhouse and Add New Liner	$2,826,000	105
2c-1	Leave Well In-Place – Build Wellhouse, Add New Liner and Off-Site Chlorinate in Old City Hall Building	$3,272,000	122
2c-2	Leave Well In-Place – Build Wellhouse, Add New Liner and Off-Site Chlorinate in New Building	$3,632,000	135
3a	Abandon the Existing Well and Move to an Alternate Location within 300' of the Existing Well	$5,463,000	203
3b	Abandon the Existing Well and Move to an Alternate Location > 300' of the Existing Well	>$5,463,000	>203
4	Alternative to Bury the Flow Meter for Options 2a, 2b, 2c-1 and 2c-2	$20,000	Additive Cost

PROS AND CONS EVALUATION

A general list of major Pro's and Con's to each of the above identified options is provided below, costs are not listed with the pros and cons; rather the costs are listed above. In the Pro's column, dark green is used to identify issues of major importance to the decision-making process. In the Con's column red represents issues that are considered to be of major importance to decision making while yellow represents issues that are less critical.

Option	SCENARIO	PRO	CON
0	**Continue to Use Well As-Is Do Nothing**	The well is a vital, viable and important water source for the city	There are many health and safety issues with the current facility
		The well is in the ideal location to provide 5-7 mgd at the right pressure and flow to meet local peaking demands	The vault is a confined space and does not allow easy escape if an injury were to occur
		The existing well provides vital drinking water and fire protection	Workers could be injured or killed if a leak occurred while in the vault
		The 75-year-old well casing is in overall good condition and will likely function well for several years to come. The time is unknown but it could be 20-30 years or more	Rocky Mtn Power no longer services the 2300V transformer. If it goes down, the well will go down
			The well does not meet DDW requirements to be 18" above ground
			Not chlorinating the well could increase public health risk
			A leak would flood and destroy the equipment in the vault
			The electrical equipment does not meet current safety standards
			The well is difficult to maintain by SLCDPU personnel
			Service vehicles interrupt traffic while working on the well
1	**Leave Well As-Is Add New Well Liner** (Similar to Option 0 with the added Pro's and Con's)	The well is a vital, viable and important water source for the city	There are many health and safety issues with the current facility
		The well is in the ideal location to provide 5-7 mgd at the right pressure and flow to meet local peaking demands	The vault is a confined space and does not allow easy escape if an injury were to occur
		The existing well provides vital drinking water and fire protection	Workers could be injured or killed if a leak occurred while in the vault
		The installation of a New Well Liner would likely increase the life of the well to between 75 and 100 Years	Rocky Mtn Power no longer services the 2300V transformer. If it goes down, the well will go down
		The addition of a liner will not decrease the overall production of the well	The well does not meet DDW requirements to be 18" above ground
			Not chlorinating the well could increase public health risk
			A leak would flood and destroy the equipment in the vault
			The electrical equipment does not meet current safety standards
			The well is difficult to maintain by SLCDPU personnel
			Service vehicles interrupt traffic while working on the well
			Adds $150,000 to the cost of the well

Option	SCENARIO	PRO	CON
2a	**Leave Well In-Place Build Wellhouse**	The well is in the ideal location to provide 5-7 mgd at the right pressure and flow to meet local peaking demands	Would add a building on the site that is now a walking park
		The existing well provides vital drinking water and fire protection	3 existing trees would be removed but the area would be re-landscaped
		The well is in place and will can continue to be a viable and important water source	The existing well is now 75 years old and either now or in the future will have to be re-lined
		The well can be extended upward and eliminate the hazards of a below grade well and meet DDW Standards	
		An above ground facility can be designed to eliminate all current safety and health concerns	
		Adding chlorine to the distribution system helps keep water pure and is a Public Health benefit to the end user	
		Preliminary engineering design has been done with engineering costs expended	
		There is adequate space on-site to construct the wellhouse and chlorination facilities	
2b	**Leave Well In-Place Build Wellhouse Add New Well Liner** (Similar to Option 2a)	The well is in the ideal location to provide 5-7 mgd at the right pressure and flow to meet local peaking demands	Would add a building on the site that is now a walking park
		The existing well provides vital drinking water and fire protection	3 existing trees would be removed but the area would be re-landscaped
		The well is in place and can continue to be a viable and important water source	A screen sleeve will reduce the diameter of the well from 20" to 18"
		The well can be extended upward and eliminate the hazards of a below grade well and meet DDW Standards	The addition of the liner Increases costs
		An above ground facility can be designed to eliminate all current safety and health concerns	
		Added chlorine is a Public Health benefit	
		A screen sleeve can be added to protect the integrity of the well should the original casing fail	
		The addition of a liner will not affect the overall production capacity of the well	
		A new liner will extend the life of the well 75-100 years	
		Preliminary engineering design has been done with engineering costs expended	
		There is adequate space on-site to construct the wellhouse and chemical treatment facilities	

#	SCENARIO	PRO	CON
2c-1 & 2c-2	**Leave Well In-Place Build Wellhouse Move Chemical Feed Off-Site** (Similar to Option 2a)	Added chlorine is a Public Health benefit	Would add a building on the site that is now a walking park
		The well is in the ideal location to provide 5-7 mgd at the right pressure and flow to meet local peaking demands	Requires the purchase of new land
		The existing well provides vital drinking water and fire protection	Requires the construction of a separate building
		Reduces building footprint by approximately 300 ft^2 (15' x 20')	New transmission pipelines will be required
		The well is in place and can continue to be a viable and important water source	3 existing trees would be removed but the area would be re-landscaped
		The well can be extended upward and eliminate the hazards of a below grade well and meet DDW Standards	The existing well is now 75 years old and either now or in the future will have to be re-lined
		An above ground facility can be designed to eliminate all current safety and health concerns	There is an increased potential for a loss in communication between facilities which could result in health & safety concerns
		Added chlorine is a Public Health benefit	With two facilities, energy consumption will increase
		Preliminary engineering design has been done with engineering costs expended	Maintenance costs will increase with two facilities
		There is adequate space on-site to construct the wellhouse	Additional permits and engineering will be required
3a	**Relocate the Well within 300' of Existing Well**	All facilities would be designed and built to meet health and safety codes	There is no guarantee that the well would produce as much as the current location
		A new well would provide a new life for the well over its present condition, perhaps extending its life to 75-100 years	Would requires the acquisition of residential properties, involving the purchase of multiple existing homes to acquire enough space to drill the well
		Added chlorine is a Public Health benefit	Requires additional engineering
			Would involve new pipelines and traffic disruptions
			Requires additional permits
			Abandonment of the existing well

Option	SCENARIO	PRO	CON
3b	**Relocate the Well at a Remote Location**	The well would be eliminated from the current Neighborhood	There is no guarantee that the well would produce as much as the current location
		All facilities would be designed and built to meet health and safety codes	Will be possible similar local resistance at the new location
		Added chlorine is a Public Health benefit	An up-canyon location will likely receive similar resistance
		A new well would provide a new life for the well over its present condition, perhaps extending its life to 75-100 years	A down-canyon location will interfere with other existing water right holders and likely receive significant opposition
			A well outside the canyon drainage, or on an adjacent hillside will not likely be able to provide the volume of local water needed
			May require the acquisition of property, most likely involving the purchase of multiple existing homes to acquire enough space to drill the well
			Requires an approved water right change application that could take 18 months
			May not be able to acquire an adequate source at a new location
			A new well location may not be proximate to the water demand area
			Requires additional engineering
			Would involve new pipelines and traffic disruptions
			New pipeline would have to connect with existing pressure zone
			Sewer upgrades may be needed to meet DDW requirements
			Requires additional permits
			Abandonment of the existing well
4	**Bury the Flow Meter in Options 2a, 2b, 2c-1 and 2c-2**	Makes slight reduction in the footprint of the building but electrical panels are still required within the building	Potentially would require the removal of additional trees
			The meter vault area could not be re-landscaped
			Vault would be considered a confined work space
			There is a risk of electrocution if lighting or other electrical equipment is needed and there is a leak within the vault while maintenance is performed
			It is an increased inconvenience for operators to monitor and maintain a meter within a vault outside the wellhouse
			Requires access to two separate spaces
			Maintenance more difficult during inclement weather

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Report No. 3197
Filed Nov. 30, 1943
Rec. By Mail
Ret'd.

Report of Well and Tunnel Driller

STATE OF UTAH

(Separate report shall be filed for each well or tunnel)

GENERAL INFORMATION:

Report of well or tunnel driller is hereby made and filed with the State Engineer, in compliance with Utah Code Annotated, 1943. (This report shall be filed with the State Engineer within 30 days after the completion or abandonment of well or tunnel. Failure to file such report constitutes a misdemeanor.)

1. Name and address of ~~person, company or~~ corporation ~~boring or~~ drilling well ~~or tunnel~~ (Strike words not needed)
   Roscoe Moss Company, 4360 Worth Street, Los Angeles, California
2. Name and address of owner of well ~~or tunnel~~ (Strike words not needed) City of Salt Lake
3. Source of supply is in Salt Lake County; .... (Leave blank) drainage area; .... (Leave blank) artesian basin
4. The number of approved application to appropriate water is A-11816 & 15398
5. Location of well ~~or mouth of tunnel~~ is situated at a point near 4th Ave. & Canyon Road in Salt Lake City --- N. 1655 ft. & E. 1510 ft. from SW. Cor. Sec.31,T1N,R1E,SLM.
   (Describe by rectangular co-ordinates or by one course and distance with reference to U. S. Government Survey Corner — Copy description from well owner's approved application)
6. Date on which work on well ~~or tunnel~~ (Strike words not needed) was begun June 28, 1943
7. Date on which work on well ~~or tunnel~~ (Strike words not needed) was completed ~~or abandoned~~ July 16, 1943
8. Maximum quantity of water measured as ~~flowing~~, pumped ~~or~~ (Strike words not needed) .... on completion of well ~~or tunnel~~ in sec. ft. 8.9; or in gals. per minute .... Date ....

DETAIL OF COLLECTING WORKS:

9. **WELL:** It is a drilled, ~~dug, flowing or~~ pump well. (Strike words not needed) Temperature of water .... °F.
   (a) Total depth of well is 464 ft. below ground surface.
   (b) If flowing well, give water pressure (hydrostatic head) above ground surface .... ft.
   (c) If pump well, give depth from ground surface to water surface before pumping 142'; during pumping 154'
   (d) Size and kind of casing 20" #8 ga. Double Well Casing (If only partially cased, give details)
   (e) Depth to water bearing stratum As per attached log (If more than one stratum, give depth to each)
   (f) If casing is perforated, give depth from ground surface to perforations As per attached log
   (g) Log of well As per attached log
   (h) Well was equipped with cap, valve, or .... (Strike words not needed) to control flow.

(Over)

ROSCOE MOSS COMPANY
4360 Worth Street
Los Angeles, Cal.

A-11816

RENTAL TOOLS

WELL CONTRACTORS

Log of Well No. 2 At Canyon Rd. and 4th Avenue, Drilled for Salt Lake City, Utah
Of Salt Lake City, Utah
Exact Location.....4th Avenue and Canyon Rd. Salt Lake City, Utah
Started Work.....June 28, 1943
Completed Work.....July 16, 1943
Total depth.....464 ft. Size of shoe.....20 x 14 x 1¼"
464 ft. of 20 inch 8 gauge casing used and left in Well

Type of Perforator used.....Mills

Perforated...420 ft. to....	408 ft.	10	Holes per	12	inches		
408 " "	380 "	10	"	"	"	"	
341 " "	324 "	10	"	"	"	"	
317 " "	312 "	10	"	"	"	"	
280 " "	231 "	10	"	"	"	"	
216 " "	162 "	10	"	"	"	"	

Diameter of Perforations.....⅛ inches
Length of Perforations.....5 inches
Depth at which water was first found.....160 ft.
Standing level before perforating.....142 ft.
Standing level after perforating.....142 ft.
Note below your observation of any change in water level while drilling...
None.

Formation: Mention size of water gravel-

0 ft.	to	26 ft.	Sand and gravel
26 "	"	34 "	Clay, sand and gravel
34 "	"	40 "	Clay
40 "	"	140 "	Tight sand and gravel
140 "	"	170 "	Coarse sand and gravel
170 "	"	176 "	Cemented sand and gravel
176 "	"	216 "	Coarse sand, gravel up to 6"
216 "	"	231 "	Clay sand and gravel
231 "	"	289 "	Sand, gravel some boulders 12"
289 "	"	296 "	Clay and sand, gravel
296 "	"	310 "	Clay
310 "	"	318 "	Sand, gravel 2"
318 "	"	324 "	Clay and gravel
324 "	"	341 "	Sand, and gravel to 6"
341 "	"	350 "	Clay, sand and gravel
350 "	"	380 "	Clay
380 "	"	400 "	Coarse gravel, little sand 6"
400 "	"	408 "	Clay, sand and gravel
408 "	"	420 "	Sand and gravel to 2"
420 "	"	464 "	Clay and sand and gravel
464 "	"		Conglomerate same as the mountains

Is well straight, top to bottom?....First 300' practically straight, below 300' slightly off.

Will there be any detrimental effect on pump?....None

Date of report.....July 21, 1943

Type and Rig No. used.....No. 34

B. Hatherley, Driller

CASING INSPECITON

PACIFIC SURVEYS

Job No.	25077
Company	HANSEN, ALLEN & LUCE, INC.
Well	4TH AVENUE WELL
Field	SALT LAKE CITY
County	SALT LAKE
State	UT

Location: NORTHEAST CORNER OF 4TH AVE & CANYON RD.
GPS: 40.7740 -111.8860

Other Services: NONE

Sec. | Twp. | Rge.

Permanent Datum	T.O.C.	Elevation
Log Measured From	T.O.C.	above perm. datum
Drilling Measured From	N/A	

Elevation: K.B. / D.F. / G.L.

Date	02-26-2019
Run Number	ONE
Depth Driller	464'
Depth Logger	444'
Bottom Logged Interval	444'
Top Log Interval	5'
Static Water Level	128'
Depth Of Pump Bowls	270'
Density / Viscosity	N/A
Max. Recorded Temp.	56.6F
Pump Rate (GPM)	N/A
Time Well Ready	1000
Time Logger on Bottom	1100
Equipment Number	PS-8
Location	SAC
Recorded By	SCHUMACHER
Witnessed By	D. HANSEN

Borehole Record			Tubing Record			
Run Number	Bit	From	To	Size	Weight	From	To

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String				
Prot. String				
Production String	20" ID	0.344" WALL	0'	464'
Liner				

<<< Fold Here >>>

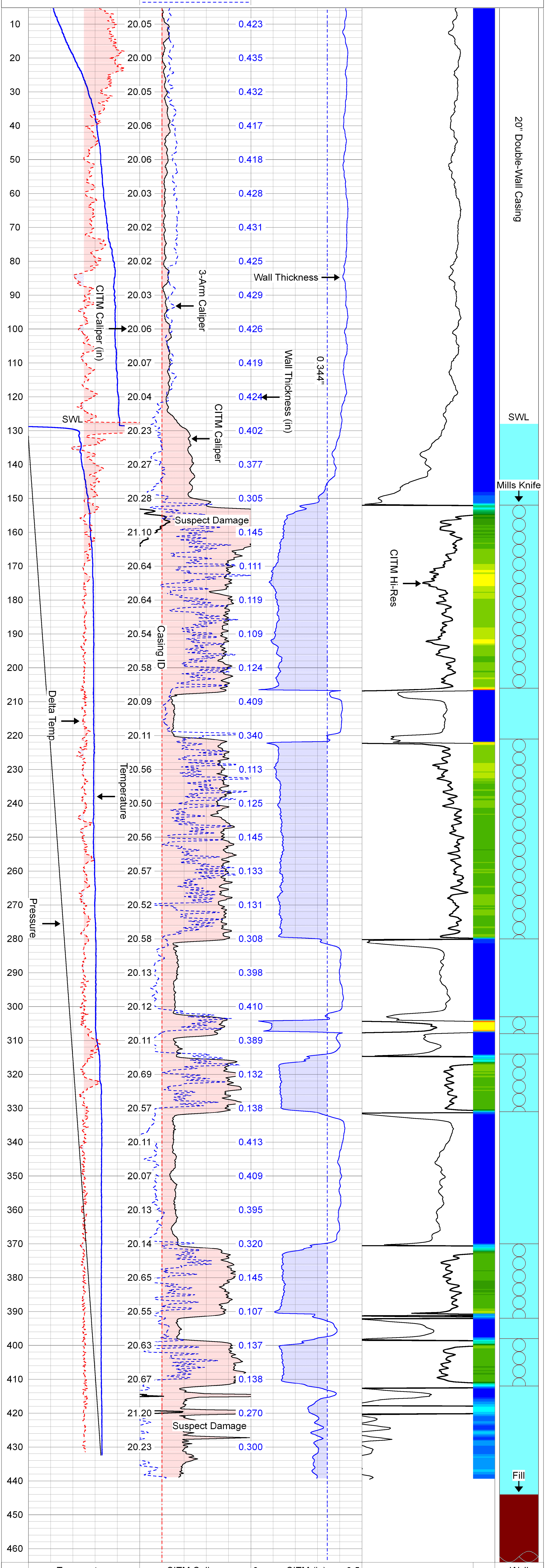
Comments

REPORTED 20" 8 GA. DOUBLE-WALL CASING.

MILLS KNIFE PERFORATIONS (1/8" X 5", 10 PERFS PER FOOT) REPORTED.
PERFORATIONS OBSERVED FROM:
152 FT - 206 FT
221 FT - 280 FT
303 FT - 308 FT
314 FT - 331 FT
370 FT - 392 FT
398 FT - 412 FT

Database File	25077.db
Dataset Pathname	citm_F
Presentation Format	citm_final
Dataset Creation	Tue Feb 26 13:32:32 2019
Charted by	Depth in Feet scaled 1:240

Temperature: 54 (degF) 58
Delta Temp: -0.1 (DegF/ft) 0.1
Pressure (psi): 0 – 200
CITM Caliper: 19.8 (in) 20.8
CITM Caliper: 20.8 (in) 22.8
Casing ID (in): 19.8 – 20.8
CITM Caliper (in)
3-Arm Caliper: 19.8 (in) 20.8
CITM (in): 0 – 0.5
CITM back-up (in): 0.5 – 1
Wall (in)
CITM Hi-Res (back-up): 200 (cps) 1500
Hi-Res (cps): 1400 – 2700
Well Diagram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0.131
0.308
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0.410
0.389
0.132
0.138
0.413
0.409
0.395
0.320
0.145
0.107
0.137
0.138
0.270
0.300
SWL
CITM Caliper (in)
3-Arm Caliper
CITM Caliper
Wall Thickness
Wall Thickness (in)
0.344"
Suspect Damage
CITM Hi-Res
Casing ID
Delta Temp
Temperature
Pressure
20" Double-Wall Casing
SWL
Mills Knife
Fill

Temperature: 54 (degF) 58
Delta Temp: -0.1 (DegF/ft) 0.1
Pressure (psi): 0 – 200
CITM Caliper: 19.8 (in) 20.8
CITM Caliper: 20.8 (in) 22.8
Casing ID (in): 19.8 – 20.8
CITM Caliper (in)
3-Arm Caliper: 19.8 (in) 20.8
CITM (in): 0 – 0.5
CITM back-up (in): 0.5 – 1
Wall (in)
CITM Hi-Res (back-up): 200 (cps) 1500
Hi-Res (cps): 1400 – 2700
Well Diagram

4th Avenue Preliminary Well Cost Estimates

	Qty	Length	Unit $	Cost	Comment
Option 1 - Leave Well In-Place - Add New Well Liner					
Install new 18" Well Liner	1	460	$ 300	$ 138,000.00	Preliminary Estimate from Contractor
10% Contingency			$ 13,800	$ 13,800.00	
			Subtotal:	$ 151,800.00	
Option 2a - Leave Well In-Place - Build Wellhouse					
Wellhouse	1	1	$ 2,000,000	$ 2,000,000.00	Existing Engineer's Estimate
Engineering Design and SDC	1	1	$ 240,000	$ 240,000.00	Preliminary Design Completed. Assume 12% of Wellhouse cost
20% Contingency			$ 448,000	$ 448,000.00	
			Subtotal:	$ 2,688,000.00	
Option 2b - Leave Well In-Place - Build Wellhouse and Add New Well Liner					
Wellhouse	1	1	$ 2,000,000	$ 2,000,000.00	Existing Engineer's Estimate
Engineering Design and SDC	1	1	$ 240,000	$ 240,000.00	Preliminary Design Completed. Assume 12% of Wellhouse cost
Add new 18" Well Liner	1	460	$ 300	$ 138,000.00	WTS estimates $250-$300/ft to install
20% Contingency			$ 448,060	$ 448,060.00	
			Subtotal:	$ 2,826,060.00	
			Cost Increase:	105%	
Option 2c-1 - Leave Well In-Place - Build Wellhouse, add New Well Liner, use Off-Site Chlorination in Old City Hall Bldg					
Add new 18" Well Liner	1	460	$ 300	$ 138,000.00	Preliminary Estimate from Contractor
Wellhouse	1	1	$ 2,000,000	$ 2,000,000.00	Existing Engineer's Estimate
Engineering Design and SDC	1	1	$ 16,560	$ 16,560.00	Preliminary Design Completed. Assume 12% of Wellhouse cost
Interior Piping/Electrical/Tanks/Mechanical	1	1	$ 400,000	$ 400,000.00	Based on Similar Bid Items for West Jordan City
Connection Piping Between Buildings	1	500	$ 350	$ 175,000.00	
20% Contingency			$ 542,600	$ 542,600.00	
			Subtotal:	$ 3,272,160.00	
			Cost Increase:	122%	
Option 2c-2 - Leave Well In-Place - Build Wellhouse, add New Well Liner, use Off-Site Chlorination in a New Building					
Add new 18" Well Liner	1	460	$ 300	$ 138,000.00	Preliminary Estimate from Contractor
Wellhouse	1	1	$ 1,900,000	$ 1,900,000.00	Existing Engineer's Estimate - 5% to eliminate chemical portion
Engineering Design and SDC	1	1	$ 16,560	$ 16,560.00	Preliminary Design Completed. Assume 12% of Wellhouse cost
New Building	1	1	$ 800,000	$ 800,000.00	Based on Similar Bid for West Jordan City
Chemical Feeds - Supply, Chlorine, Flouride	1	500	$ 350	$ 175,000.00	Assumes full flow pipe & the well is within 500' of the existing well
20% Contingency			$ 602,600	$ 602,600.00	
			Subtotal:	$ 3,632,160.00	
			Cost Increase:	135%	
Option 3 - Abandon the Existing Well and Move to an Alternate Location					
Studies, Site Acquisition, Site Preparation					
Site Investigation / Negotiations	1	1	$ 30,000	$ 30,000.00	Areal search. Does not include a Well Siting Study based on hydrogeology
Public Involvement	1	1	$ 100,000	$ 100,000.00	Public will be heavily involved regardless of where the well is located
Property Purchase	1	1	$ 1,000,000	$ 1,000,000.00	Assume the cost of 2 homes/lots in vicinity
Effort to Complete Sale	1	1	$ 10,000	$ 10,000.00	
Home Demolition, Disposal & Site Prep	1	1	$ 80,000	$ 80,000.00	
Water Right					
Prepare WaterRight Change Application	1	1	$ 2,500	$ 2,500.00	
Water Right Hearing	1	1	$ 15,000	$ 15,000.00	
Water Right Permit	1	1	$ 600	$ 600.00	Could take 12-18 months
Well					
Well Bid Package	1	1	$ 15,000	$ 15,000.00	
Well Construction	20	500	$ 70	$ 700,000.00	$70/dia in/ft depth
Well SDC	1	1	$ 35,000	$ 35,000.00	
Wellhouse					
Engineering Design - 7% of Construction	1	1	$ 165,200	$ 165,200.00	Includes wellhouse, sewer & Interconnecting Pipelines
Engineering SDC - 7% of Construction	1	1	$ 165,200	$ 165,200.00	Includes wellhouse, sewer & Interconnecting Pipelines
Permits	1	1	$ 10,000	$ 10,000.00	
Wellhouse w/Chlorination	1	1	$ 2,000,000	$ 2,000,000.00	Existing Engineer's Estimate
Upgrade Proximte Sewer Lines per DDW	1	250	$ 600	$ 150,000.00	Sewer upgrades required in 100' well protection zone
Interconnecting Pipeline	1	600	$ 350	$ 210,000.00	Assuming a 24" pipe with the well is in Park @ State Street & N Temple
Abandon Existing Well					
Abandon Well	464	1	$ 60	$ 27,840.00	Grout
Electrical	1	1	$ 5,000	$ 5,000.00	
Cap Piping	1	1	$ 2,500	$ 2,500.00	
Remove Vault	1	1	$ 5,000	$ 5,000.00	
Landscaping	1	1	$ 5,000	$ 5,000.00	
20% Contingency			$ 729,416	$ 729,416.00	
			Subtotal:	$ 5,463,256.00	
			Cost Increase:	203%	

HANSEN ALLEN & LUCE INC ENGINEERS

Filename: H:\Projects\083 - SLCDPU\56.100 - 2018 Well Assessment\ENG\4th Ave Well\Memo\[4th Ave Well Cost Estimates.xlsx]Sheet1