July 17, 2012

Evaluation of Encana 12" Water Line or "CBM" – Poly Pipeline

Introduction:

The following evaluation is intended to review possible causal factors for the release of water on June 16, 2012 and suggest mitigation to prevent future failures. This pipeline was constructed in several phases to gather and transport produced water from our Coal Bed Methane project in 2004. Since this time the water line has been used to move water from our treatment facilities in the Mamm Creek field to our completion activity, and then back again to be treated at the facilities. The use of this line has become a large part of our operations to reduce truck traffic, and to streamline our operations. Upgrades to this line have increased the rate at which we can pump water, and reduce the amount of time required to complete wells.

There is still an ongoing internal review for this pipeline failure, which requires one final step in our process. We will evaluate further the casual factors mentioned in this evaluation as well as any other factors not mentioned. This will then be reported to our management team for final review. What this process will do, is build a template and record action steps that will be followed to make sure this type of event can be prevented in the future. In many cases an element of human error needs to be addressed through communication, procedures, training, and operational parameters.

Current operation of this pipeline is following the operating parameters as originally designed for this system. Testing after repairs were made and monitoring of operating pressure is within the safe operating conditions for this line.

Conclusions

There are three potential causes for this failure:

- Poor installation – Less than 100% fusion bond – Gap in the coupling installation
- Operating line at the maximum pressure (200 psi for Electro-Fusion Coupling)
- Ground disturbance from recent construction activity, combined with air pockets or settling in original trench

There is evidence for all three to have happened or a combination of any of these. After the failure it is hard to have 100% certainty that any of these was the contributing or "casual factor". However, the operating conditions for this line can be controlled, so the major contributing factor is the pressure applied to this line. The dynamic conditions of this line have changed in the last two years to improve water movement, but may have caused a section of this line to be at risk for potential failures.

The failure identified occurred in a straight line coupling in the poly pipe section of this line. This coupling also known as an "Electro-Fusion" coupling is used to bond the poly pipe to the coupling. Further investigation (WL Plastics Representative) indicates the potential that this coupling may not have been 100% bonded, due to the inspection of the cross-section of this coupling (see attached pictures).

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The most relevant and logical conclusion is the uncertainty for mechanical integrity of other “Electro-Fusion” couplings used in this line during the original installation, combined with the applied pressure reaching the maximum allowed for this type of coupling.

Recommendation:

Replacement of the “Electro-Fusion” couplings will be required for future use, which is close to the limits of the poly section of this line. Until this is completed a reduced Maximum Allowable Operating Pressure (MAOP) for this line will be used. The couplings are rated to 200 psi, and will be kept at or below 150 psi in the area with the electro-fusion couplings.

Evaluation:

A failed coupling may have several possible factors for failure. Here is a picture of the failed coupling right after we exposed this area. (figure 1)

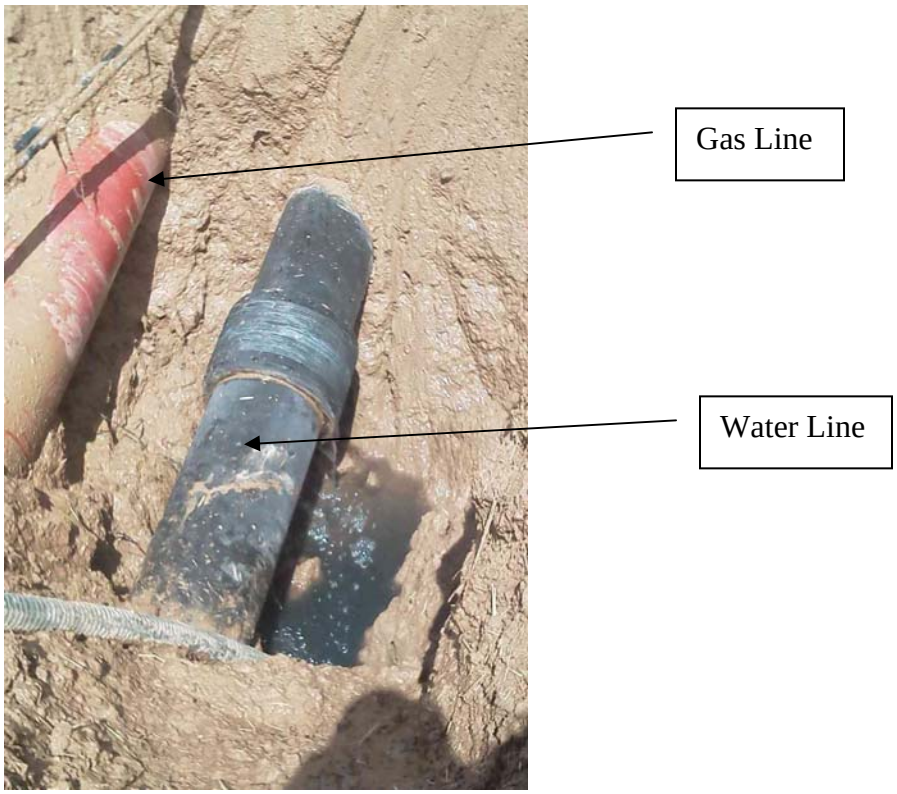

Fig 1

There is a gas gathering line and fiber-optic lines run in very close proximity to the water line. The evidence to evaluate proper backfill and soil conditions was lost in the result of the leak and the process of “pot hole” or “hydro-vac”. This could be important if the coupling was put into a stress condition due to lack of support around this area.

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Here is the coupling cut in half or the Cross-Section of “Electro-Fusion” Coupling to expose the inside. (figure 2 – 3)

Fig 2 1” Gap on bottom

Fig 3 1/8” Gap on Top

This evidence indicates improper installation of this coupling. A normal or proper connection should look like this. (figure 4)

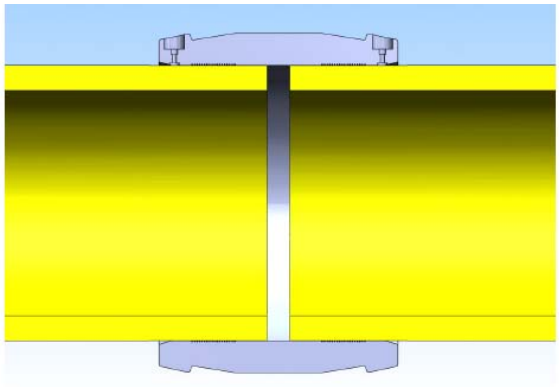

Fig 4

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Good Fusion with even alignment (90 deg)

A connection that is misaligned will look like this (figure 5)

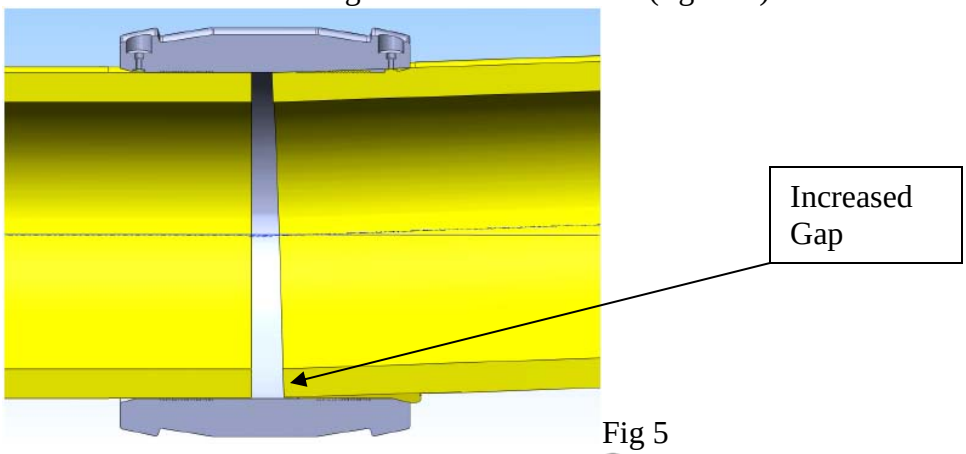

Fig 5

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Notice the larger gap on bottom

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Other indications of this coupling failure was the lack of 100% bonding found in the coupling. (figure 6, 7)

Close up of bonding area – failure occurred in this section

Fig 6

Cross-section of bonding

Fig 7

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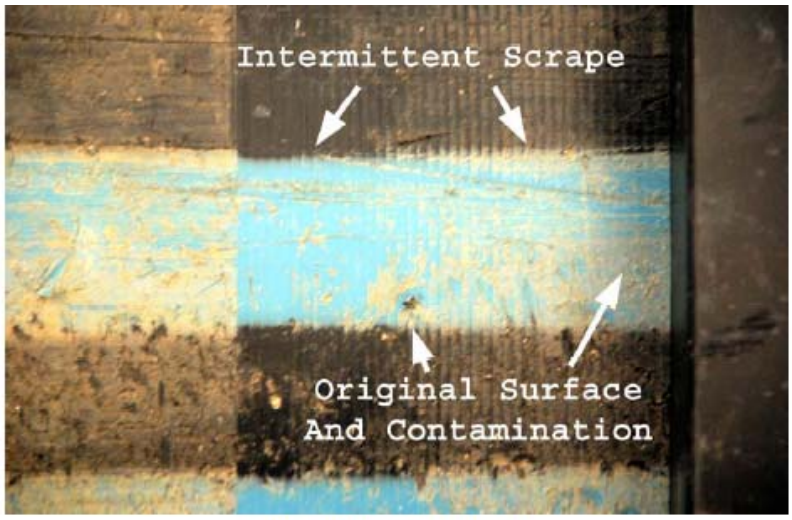
Here is an example of poor bonding from the Plastics Institute. This is very similar to what is seen in the coupling that failed.



Poor Scrape Unacceptable

Possible Causes: Incorrect Scraper, Poorly Maintained Scraper. Inadequate Number of Passed With Scraper, and Ineffective evaluation of Scraping

Fig 8

Here is an email from WL Plastics, a manufacturer of Poly Pipe, also confirming the findings in this coupling.

From: Phil Lopez [mailto:plopez@wlplastics.com]
Sent: Wednesday, July 11, 2012 8:30 PM
To: Raymond, Dale R.
Subject: RE: 12'' CBM Poly Failure

Dale,

Per our earlier conversation regarding the Electro Fusion coupler failures. After looking at these pictures all indication are directed at improper installation of these fittings. It appears that the pipe O.D. was not properly prepared and shows signs of contamination this contamination was also evident in the coupler.
It appears that the coupling was not put on the end of the pipe square this would account for the deviation in the center of the fitting. In other words the pipe was put in on one end at an angle which is improper. The pipe should have been marked to prevent this from Happening. Dale Electro Fuse couplers are rated for 200 PSI especially 6-8 years ago. To sum it up the failure was most likely caused from improper installation.

Regards
Phil Lopez
WL Plastics

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Map of the pipeline – Area with "Electro-Fusion" Couplings

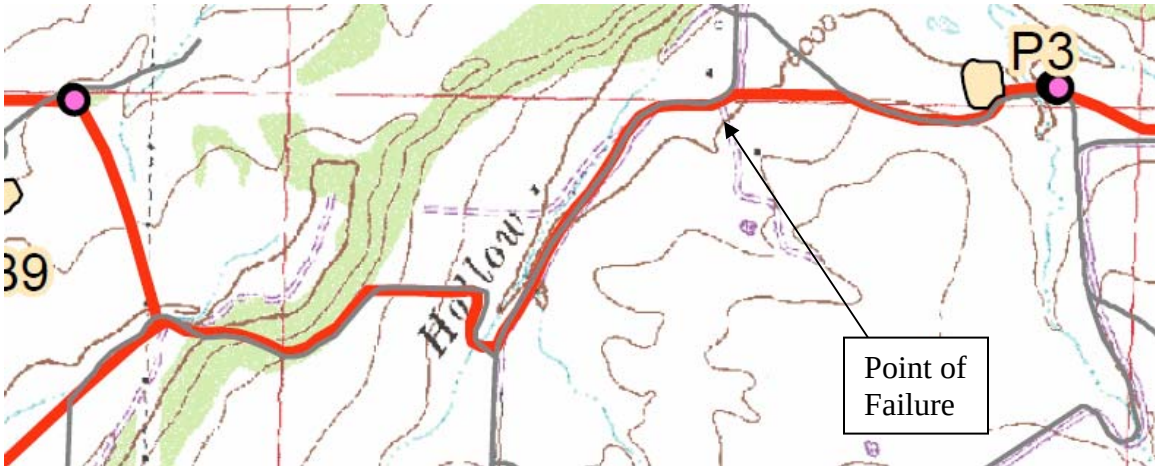

Fig 9

From "pink dot to pink dot" Is the – 12" Poly pipeline
Recommend that this section is replaced with steel or
Upgrade the couplings

Map of entire pipeline

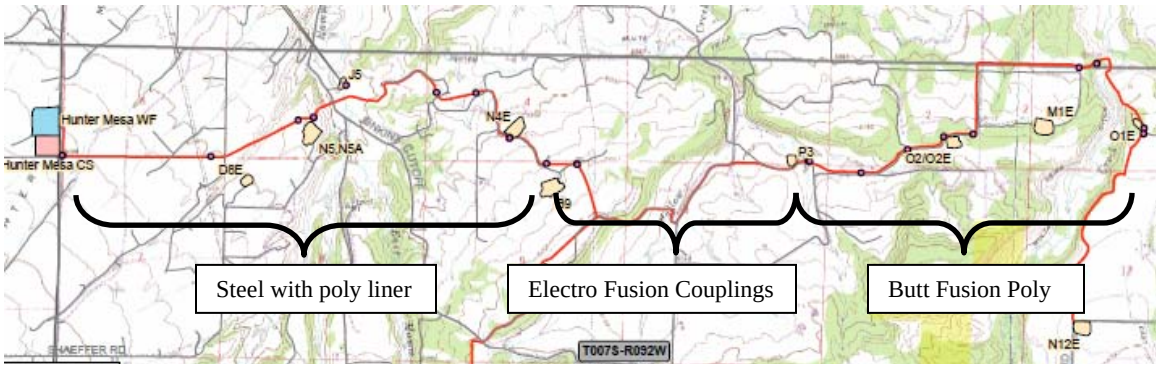

Fig 10

In the map of the entire water pipeline (figure 10), there is three different types of construction and pipe. The weakest section is in the middle or the Electro Fusion Couplings. The material used and confirmed in the removal of the failed coupling is stamped with a 200 psi rating. The rating of the 12" SDR 7 poly pipe used is a calculated number, but for this installation the design was for 250 psi. The area shown in figure 10 that says "Butt Fusion" is an expression for poly pipe that fused together end to end. This type of connection has the same properties of the pipe so the maximum internal pressure is the same of 250 psi. this would yield a higher rating than the area that has the electro-fusion couplings.

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Operating Pressures:

Chart of pressure at the “P3” point (see figure 9)

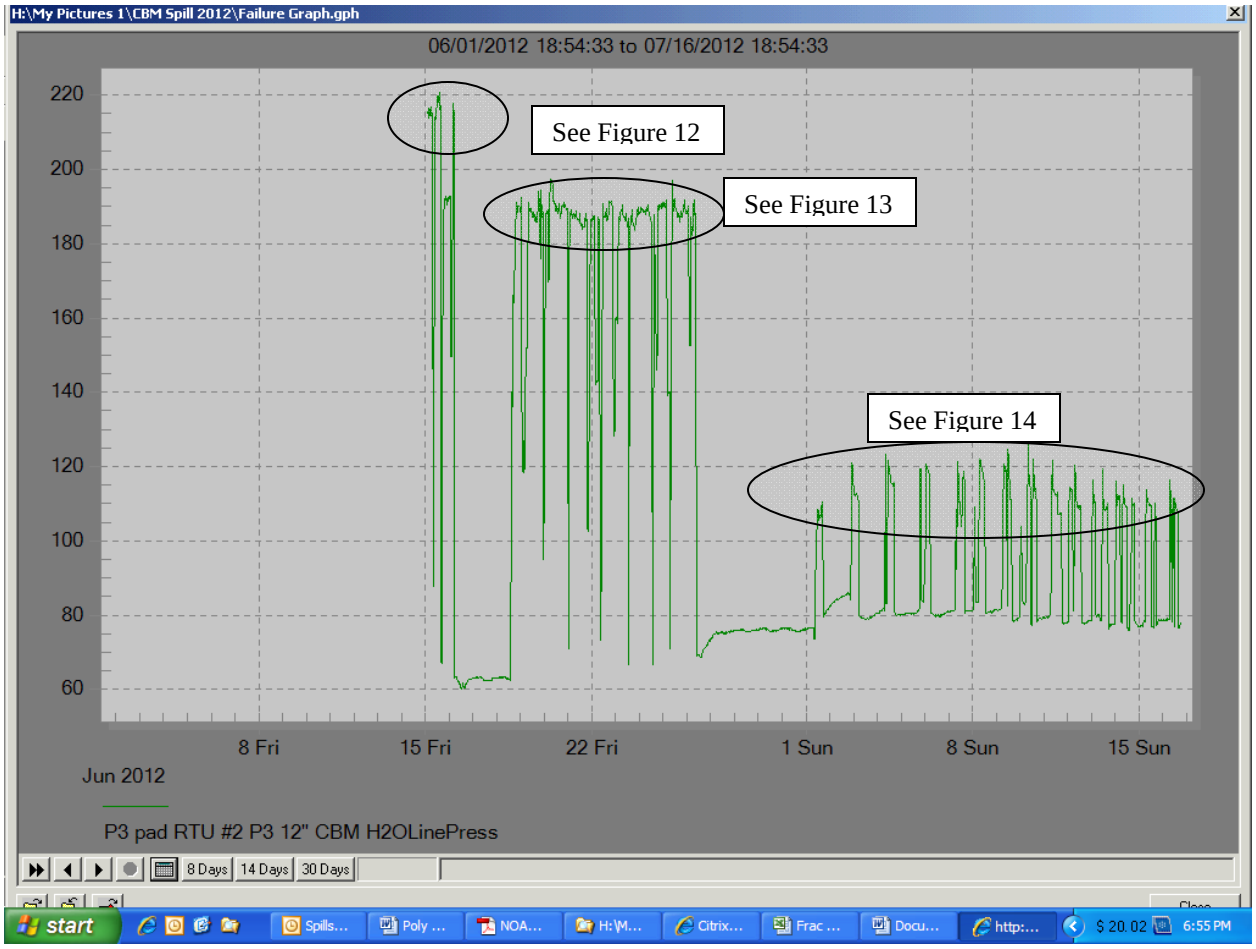

Fig 11

This chart shows the various operating conditions (pressure) at the closest point to the failure in the line. Next figures will look at the various operations in greater detail.

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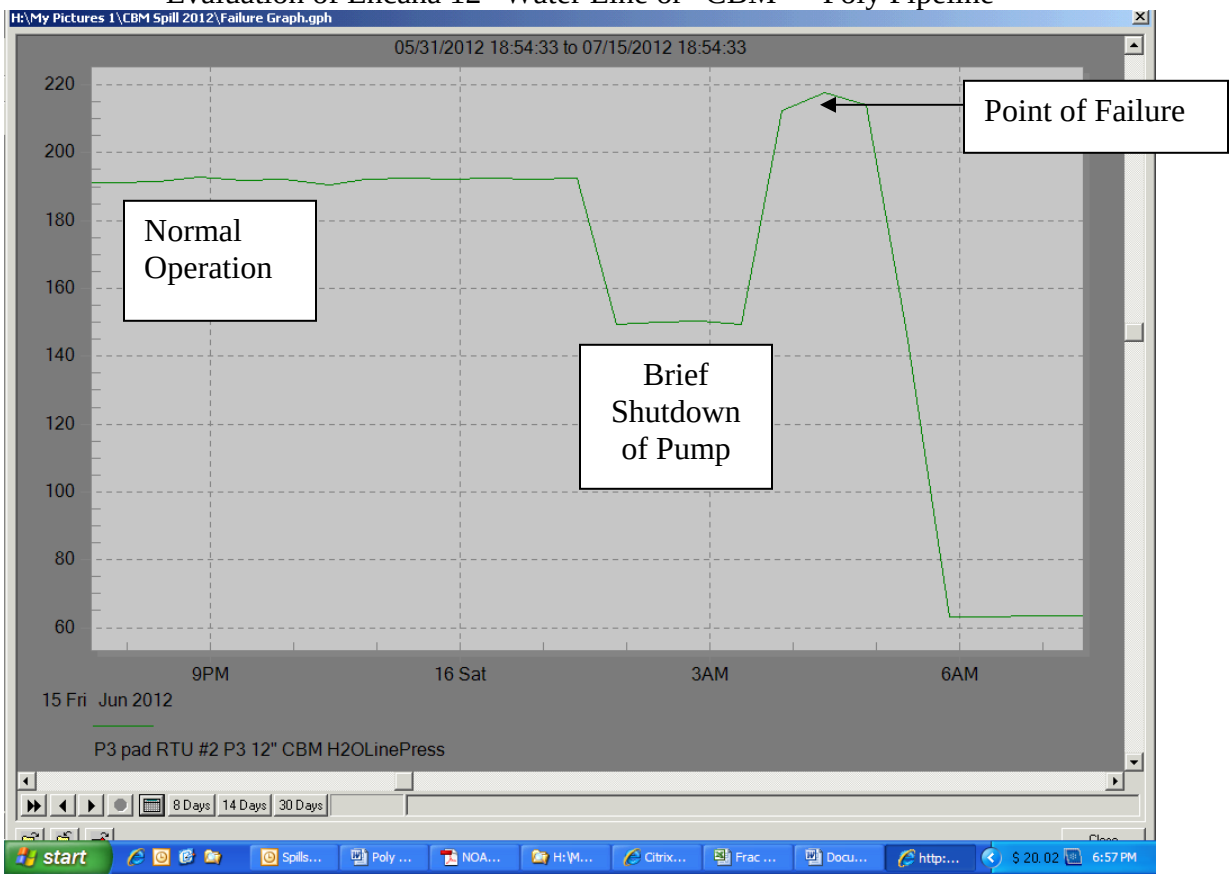

Fig 12

Fig 13

Resume operations after repairs – Finish Frac Operations on F12E

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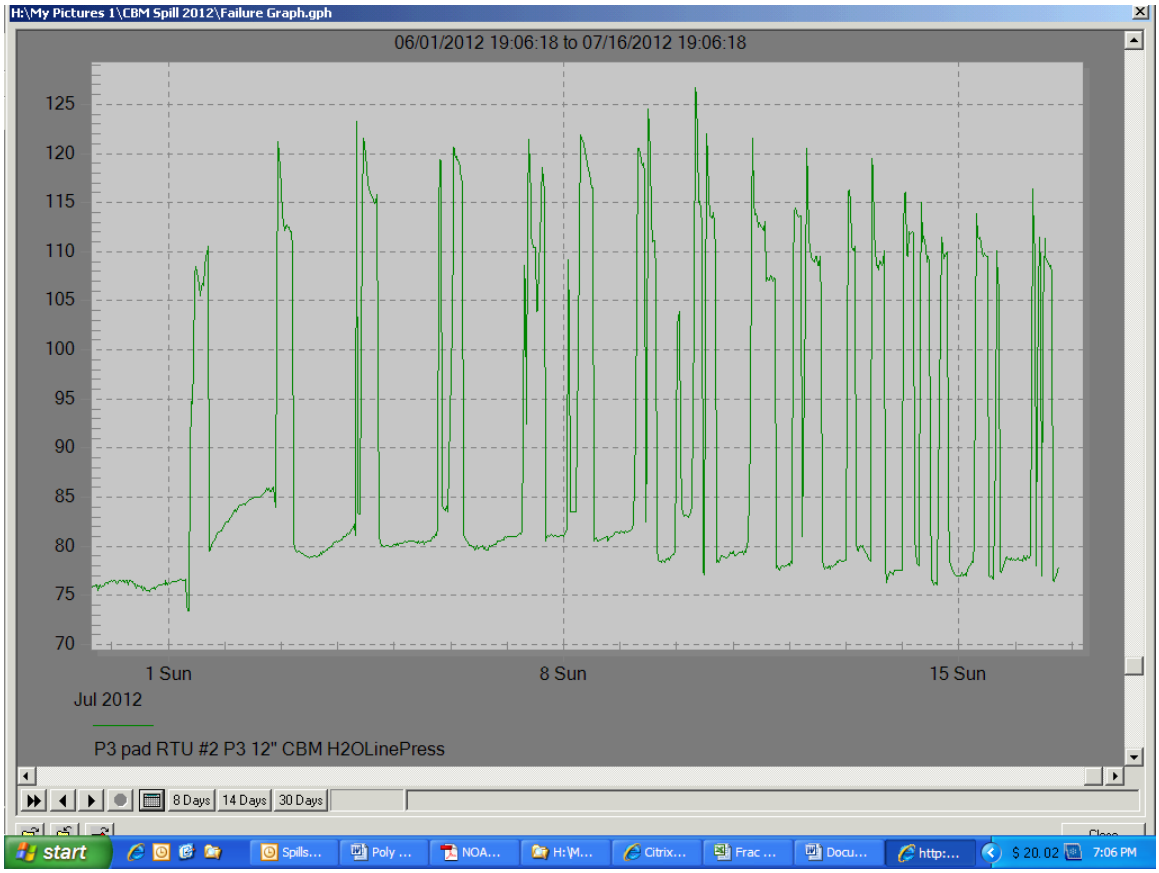

Fig 14

Chart of pressure to pump water back to Hunter Mesa