MEMORANDUM

Date: November 9, 2011

To: Steve Tarlton, File

From: Edgar Ethington EJE

Subject: Cotter primary impoundment analysis

This memorandum documents the analysis of data performed to evaluate the performance of the tailings impoundments at the Cotter Corporation Uranium Mill near Cañon City, Colorado. There is no physical evidence for the presence of a significant leak in the primary or secondary impoundments. Some evidence suggests the possibility, but not the certainty, that a minor leak may exist at the primary impoundment. This follows the Hazardous Materials and Waste management Division practice of making the conservative, i.e., most cautious assumption in such cases. This situation has been and will be monitored closely. If conditions change or additional evidence is presented, I will re-evaluate this assumption. If a minor leak does exist, its impact is not detectable in an adjacent well 190 feet down gradient.

The evaluation involves three lines of physical evidence bearing on whether the primary impoundment is keeping 11e(2) byproduct material from the surrounding environment. The three lines of evidence are geochemistry, hydrology, and geophysics. The primary impoundment contains mill tailings from the uranium and vanadium production, contaminated soil, and debris. A secondary impoundment west of and adjacent to the primary impoundment holds contaminated soils excavated from the Old Ponds Area.

Using three lines of physical evidence, I find no indication of a major or significant leak from the primary impoundment. The three lines of evidence are geochemistry, hydrology, and geophysics.

Geophysics

In 2005 Cotter Corporation commissioned HydroGeophysics, Inc. to perform a high resolution electrical resistivity survey in the impoundment vicinity. The documenting report is entitled Geophysical Results for Cotter Corporation, Canon City, Colorado and is dated October 31, 2005. HydroGeophysics performed six lines of electrical surveys (pole-dipole) and three vertical sounding. The purpose of the geophysical surveys was to examine the electrical nature of soils and materials adjacent to the impoundments and determine if leakage was occurring along the northern portions of the primary and secondary impoundments. Impoundment waters are more electrically conductive than adjacent waters and detectable by this method. Figure 1 shows the location of the electrical resistivity survey lines and measure points. The surveys do not indicate the presence of measurable leakage from the impoundment based on electrical conductivity. One borehole was drilled to check an anomaly near the Donkey Room . It showed a low resistivity area at depth. This area was drilled and the material was clay rich and not a leak.

Hydrology

The second direct line of evidence is the hydrology of the surface aquifer north of the impoundments along the line of wells from 383 in the southwest to 003 in the northeast. Water elevations are measured in the wells noted in Figure 2. The orange line represents the embankment of the primary impoundment. The thin black contour lines show the slope or gradient of the ground water surface. These contour lines run almost perpendicular to the base of the impoundment embankment and in a regular interval. This means that ground water flow is parallel to the base of the impoundment. The rate at which ground water elevations is changing is fairly even indicating no significant addition of water. Water flowing out of the impoundment would change both the slope of ground water flow and the water chemistry. I do not see ground water displacement indicative of a significant release.

However, there are two areas where I see some "stretching" of the ground water slope. These are the areas around well 382 and well 379. Reasons for the "stretching" can be related to addition of water, or change of rock type or change of hydraulic conductivity. This characteristic alone is not sufficient evidence of a leak.

Geochemistry

The principal indicator of a release is a change in water chemistry. The chemicals of regulatory concern at the Cotter Mill impoundments are uranium and molybdenum. Both the primary and secondary impoundments contain these metals. So does most of the soil and ground water in the Old Ponds Area. The secondary impoundment is west of the Old Ponds Area and the water sampled by wells 383 and 384 contain uranium at approximately 1 ppb and molybdenum at 10 ppb. This is a direct measure of primary contaminants below regulatory concern

Ground water adjacent to the Primary impoundment is already contaminated with uranium and molybdenum from past activities. So, using these two metals to check for leaks in the primary impoundment is not technically defensible. Therefore, I have chosen to use magnesium as the metric, or marker, for leak evaluation. Magnesium is a major component of primary impoundment waters with concentrations averaging 60,000 ppm. Magnesium concentrations in the adjacent waters have concentrations averaging about 200 ppm, so a significant leak from the impoundment is easily detectable using this metric.

Figure 3 shows the average magnesium values for the past year from monitoring wells along the base of the primary impoundment from southwest to northeast: monitor wells 382, 360, 380, 816, 379, and 003. Well 712 samples spring waters from beneath the impoundment liner. Well 003samples are representative of average values in this drainage.

<u>I do not see evidence of a significant leak from either impoundment based on geochemistry.</u>

The magnesium concentration is well 379 is twice the average. This data coupled with the hydrology information <u>may</u> indicate a minor leak. There are other explanations equally plausible. However, it is the practice of the HMWMD to make the conservative assumption.

Figure 1

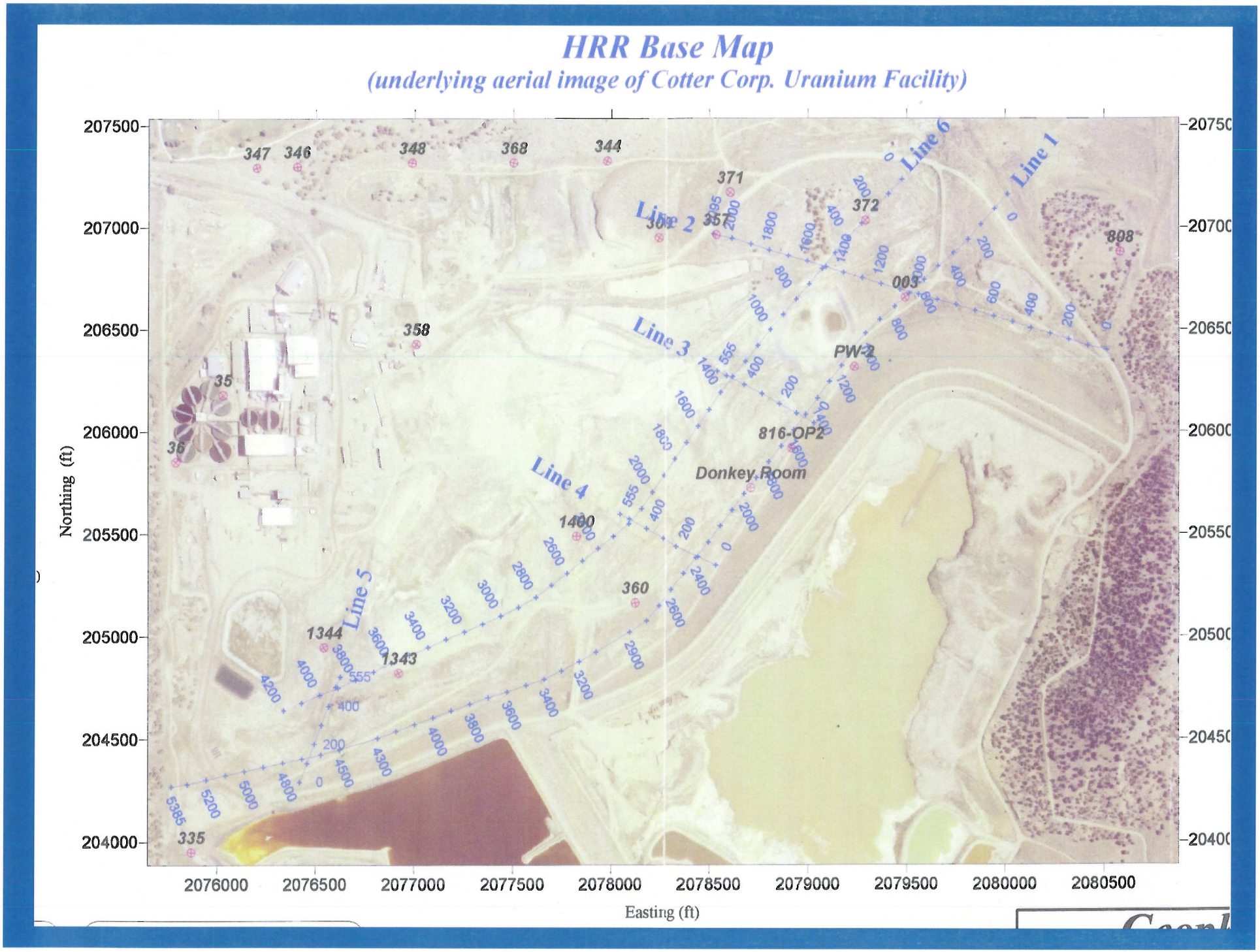

HRR Base Map
(underlying aerial image of Cotter Corp. Uranium Facility)
Line 1
Line 2
Line 3
Line 4
Line 5
Line 6
347
346
348
368
344
371
372
357
302
808
003
358
PW-2
35
36
816-OP2
Donkey Room
1400
360
1344
1343
335
Northing (ft)
Easting (ft)
207500
207000
206500
206000
205500
205000
204500
204000
2076000
2076500
2077000
2077500
2078000
2078500
2079000
2079500
2080000
2080500

Figure 2

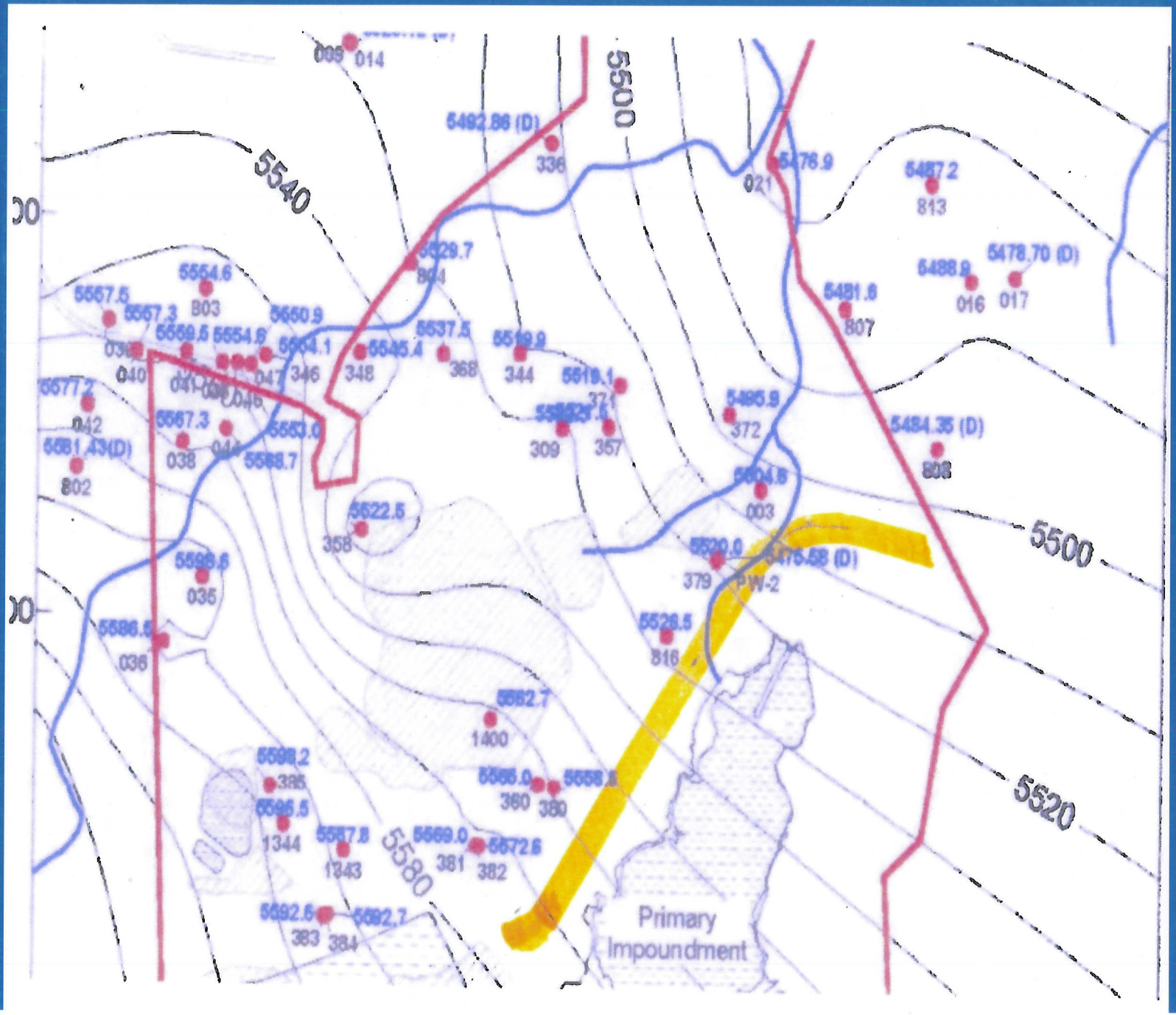
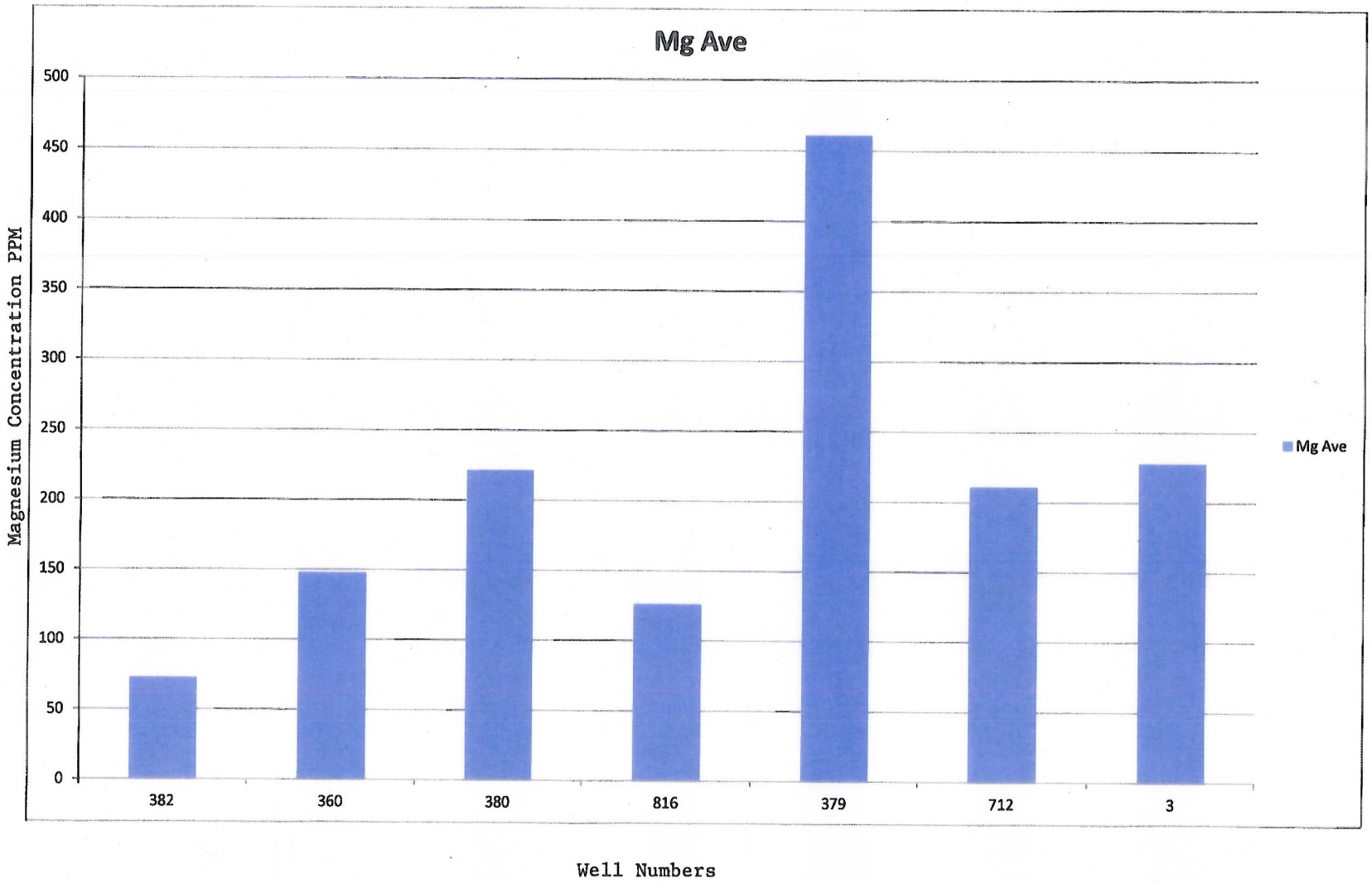

5540
5500
5520
5580
Primary
Impoundment
PW-2
5492.86 (D)
5478.9
5487.2
5478.70 (D)
5481.8
5484.35 (D)
5495.9
5554.6
5567.5
5567.3
5569.5
5554.8
5550.9
5564.1
5545.4
5537.5
5519.9
5619.1
5577.2
5567.3
5553.0
5568.7
5681.43(D)
5622.5
5586.6
5686.5
5682.7
5698.2
5696.5
5587.8
5669.0
5672.6
5692.6
5692.7

Figure 3


Mg Ave
Magnesium Concentration PPM
500
450
400
350
300
250
200
150
100
50
0
382
360
380
816
379
712
3
Mg Ave
Well Numbers