APPENDIX I

TAILINGS CELL WATER BALANCE

APPENDIX I

TAILINGS CELL WATER BALANCE

A probabilistic water balance has been developed for the proposed tailings cells. Since three tailings cells (A,B,C) of approximately equal tailings storage volume and dimensions have been designed for the Piñon Ridge Project to meet a total capacity of approximately 7.3 million tons, the probabilistic water balance has been performed for Tailings Cell A only. The water balance for Tailings Cells B and C will be similar to that of Tailings Cell A. Each of the tailings cells is designed for 13.4 years based on a milling capacity of 500 tons per day (tpd) (with potential expansion capacity of 1,000 tpd) and a total mine life of 40 years.

MODEL DEVELOPMENT

For the purpose of developing the water balance for Tailings Cell A, the following water balance components were considered: (1) the amount of water entering Tailings Cell A from the mill (CH2M Hill, 2008); (2) water entering the system through meteoric precipitation; (3) the amount of water released to the atmosphere through evaporation; (4) the amount of water returning to the mill from Tailings Cell A (CH2M Hill, 2008); and (5) the excess water available to be pumped from the tailings cell. Precipitation values are likely to exhibit largest variations, and were therefore treated as stochastic inputs (i.e., probabilistic), while the other parameters were treated as deterministic variables. Water balance calculations were performed using the computer program *Goldsim*™. The water balance model was run for a time of operation of 7 years for a 1,000-tpd milling rate and 14 years for a 500-tpd milling rate.

The water balance model was based on the following equation:

$$\Delta S = (Q + P) - (E + RW + EW)$$

where:

ΔS	=	change in stored solution volume
Q	=	inflow from the mill
P	=	precipitation collected within the lined footprint of the tailings cell
E	=	evaporation from the tailings cell surface
RW	=	reclaimed water from the tailings cell pumped back to the mill
EW	=	excess water not required by the mill but available to be pumped from the tailings cell

AVAILABLE DATA

Water balance assumptions and sources of input data are summarized in Table I-1. The evaluation of climate data conducted by Golder for nearby weather stations indicates that the Uravan weather station is likely to provide reasonable precipitation estimates (See Appendix I-1). The average monthly precipitation values for the Uravan weather station are summarized in Table I-2.

The Hargreaves (1985) method was used to estimate monthly evaporation values at the Piñon Ridge site, using the available climate data from the Uravan weather station (i.e., precipitation, air temperature, etc.). The calculated evaporation values were scaled by a factor of 0.7 to represent tailings cell evaporation. Monthly evaporation values used for the water balance calculations are summarized in Table I-2.

Based on design-level process water balance information provided by CH2M Hill (2008) and summarized in Table I-1, the design mass of solids discharging from the mill to the tailings cell was estimated to range from approximately 46,976 lb/hr for a 500-tpd start-up milling rate to 93,952 lb/hr for a 1,000-tpd milling rate. As described in Table I-1, Tailing Cell A has been designed as essentially two ponds (Cells A1 and A2) within a pond (Figure I-1). For simplicity in modeling, the tailings cell water balance was developed assuming that Cell A2 will be filled first to its maximum storage capacity prior to initiating tailings slurry discharge flow to Cell A1. Once both sub-cells are filled to the mid-height bench level, tailings slurry will then be discharged into the entire tailings cell. Tailings slurry will be discharged from several positions around the perimeter of the tailings cells.

Per the design criteria, it was assumed that 3 ft of dry freeboard will be maintained at all times to avoid overflow of the tailings cell solution. Solution will only be reclaimed from the tailings cell pool and returned to the mill when water pool depth is 5 ft or greater.

DEVELOPMENT OF STOCHASTIC PRECIPITATION PARAMETERS

In order to develop stochastic precipitation input for the *Goldsim* model, continuous probability distributions were calibrated against the available monthly precipitation data from the Uravan weather station. The Weibull distribution was selected due to its flexibility to represent a wide range of values. The distribution is truncated at its lower end and has a long tail to the upper end, making it well-suited to modeling extreme positive values, such as precipitation events with longer return

periods. Separate Weibull distributions were fitted to non-zero precipitation records collected for each month. A moment estimation method was used to determine distribution parameters resulting in fitting coefficients summarized in Table I-3.

To verify the adopted probability distributions, a precipitation model was constructed in *Goldsim*™ and allowed to run for a 1-year period using Monte-Carlo sampling with 1,000 realizations. *Goldsim* results are compared against recorded values for the Uravan weather station in Figures I-2 to I-13 for the months of January through December, respectively, with annual totals in Figure I-14. *Goldsim* results show favorable agreement between the measured and calculated extreme values on both monthly and annual basis.

WATER BALANCE RESULTS

The adequate pool volume and additional volume of water available for reclaim were evaluated at different stages of the facility development assuming a maximum time of operation of 7 years for a 1,000-tpd milling rate and 14 years for a 500-tpd milling rate. *Goldsim* calculations were based on the stochastic monthly precipitation records generated by using Weibull's distribution parameters presented in Table I-3, and illustrated in Figures I-2 through I-13.

The 1 in 1,000 year reoccurrence storm event was modeled to estimate the pool volume and additional volume of water available for reclaim as follows:

$$Cumulative\ probability = 1 - (1 - p)^n ,$$

Where:

p = annual probability of occurrence
n = number of years to evaluate

Thus, the probability that the 1,000-year storm event will occur during the 7-year tailings disposal period for a 1,000-tpd milling rate is approximately 0.7%. The probability that the 1,000-year storm event will occur during the 14-year tailings disposal period for a 500-tpd milling rate is approximately 1.4%. The estimated pool volume capacity for Tailings Cell A was estimated for the 99.3rd percentile (100% minus 0.7%) for a 1,000-tpd milling rate and for the 98.6th percentile (100% minus 1.4%) for a 500-tpd milling rate. A Monte-Carlo simulation with 5,000 realizations (due to relatively high target

probabilities in Monte Carlo simulations) was used to evaluate the 99.3rd and the 98.6th percentile quantities after 1, 2, 5, 7 and 14 years of operation.

Results from the probabilistic analyses are summarized in Tables I-4 through I-6 and Figures I-15 through I-20.

SUMMARY

The stochastic water balance model for the 1,000-tpd milling rate indicates that a maximum tailings cell pool volume of approximately 8.38 million ft^3 (Mft^3) is obtained for the 99.3rd percentile (i.e., 1,000-year storm occurs during deposition), with a median pool volume of 7.31 Mft^3. For a 500-tpd milling rate, the required tailings cell pool volume reduces to 4.75 Mft^3 (98.6th percentile). At all times during operations, a minimum excess volume capacity of 3.94 Mft^3 of freeboard volume (corresponding to 3 ft of dry freeboard) will be available to prevent overtopping during tailings deposition.

As demonstrated on Figures I-18 and I-22, the volume of excess water available as make-up (in excess of the design return volume flow to the mill) is essentially negligible after approximately 3.5 years for the 500-tpd milling scenario and very small after 2 years for the 1,000-tpd milling scenario. The average excess pumping rates available to pump excess water from the tailings cell at different time intervals of the operation are summarized in Table I-6. Results were estimated assuming that the mill will have a pumping rate of 405 gpm for a 1,000-tpd milling rate and 203 gpm for a 500-tpd milling rate to pump back reclaimed water from the tailings cell to the mill (CH2M Hill, 2008), and that the available excess water can be: 1) pumped back to the mill where the water could be used as make-up water; or 2) discharged into the evaporation pond system. It should be noted that the design raffinate flow rate to the evaporation ponds (CH2M Hill, 2008), is an average value which already accounts for this potential excess flow from the tailings cells during discrete time intervals (per personal communication with Mike Blois of CH2M Hill).

As shown on Figures I-16 and I-20, a design return volume flow of 203 and 405 gpm (corresponding to a 500- and 1,000-tpd milling rate, respectively) will not be achievable at some time intervals over the design life of the tailings cell. The excess water available from the tailings cell during wet times, therefore, can be used to accommodate this need during the dry times.

REFERENCES

CH2M Hill. 2008. “Piñon Ridge Project, Tailings Stream Analysis (Rev. 2).” Memo issued by Brett Berg. 12 March 2008.

Hargreaves, G.L., Hargreaves, G.H., and Riley, J.P., 1985, "Agricultural benefits for Senegal River Basin", *Journal of Irrigation and Drainage Engineering*, ASCE 111:113-124.

TABLE I-1

WATER BALANCE MODEL ASSUMPTIONS

Property	Value	Source	Comment/Assumptions
Dimensions for Tailings Cell A	725 feet (ft) x 1,847 ft (maximum dimensions)	See Figure I-1	Designed as two cells within Tailings Cell A with a divider berm constructed at elevation 5,500 ft and with two independent leak detection systems (LDS) and tailings underdrain systems. Internal side slopes of 3H:1V with minimum base grade of one percent (%) and 3 ft of dry freeboard.
Watershed Area for Tailings Cell A	32.5 acres	Golder design	Golder design assumptions. The watershed area includes the lined area and the area for the access road.
Tailings Disposal Rate	1,000 tpd – ultimate; 500 tpd – start-up	CH2M Hill (2008)	Ultimate disposal rate of 1,000 tpd (design mass of solids of 93,952 pounds/hour (lb/hr)) and start-up disposal rate of 500 tpd (design mass of solids of 46,976 lb/hr)
Specific Gravity of Solids	2.69	CH2M Hill (2008)	
Solids Content	27.3%	CH2M Hill (2008)	
Average In-Place Tailings Dry Density	95 pounds per cubic foot (pcf)	Assumed	
Beach Slope	2 and 0.5 %	Assumed	Compound slope with 2 % for approximately 500 ft in the perimeter sand zone and 0.5% in the slimes zone.
Pumping Rate (from Tailings Cell A to mill)	405 gallons per minute (gpm) – ultimate; 203 gpm – start-up	CH2M Hill (2008)	Design return volume flow from Tailings Cell A to the mill
Percentage of Tailings Beach that is wet	20%	Assumed	
Climate Data	Varies	See Appendix I-1	Use climate date for Uravan (NCDC No. 058560)
Annual Pan Evaporation	55 to 60 inches	See Figure I-1-10 of Appendix I-1	Use pan factor of 0.7 to estimate Tailings Cell A evaporation

Notes:

1. Tailings stream analysis for project design provided by CH2M Hill (2008).

TABLE I-2

MONTHLY PRECIPITATION AND EVAPORATION VALUES

Month	Average* Precipitation (inches)	Minimum* Precipitation (inches)	Maximum* Precipitation (inches)	Tailings Cell A Evaporation (inches)
January	0.88	0	3.19	0.8
February	0.76	0	2.05	1.2
March	1.03	0	3.43	2.2
April	1.01	0.03	2.68	3.3
May	0.94	0	2.85	4.8
June	0.48	0	1.65	5.8
July	1.19	0.09	3.54	6.3
August	1.36	0.18	3.32	5.4
September	1.5	0.06	4.78	3.8
October	1.51	0	5.89	2.5
November	1.05	0	2.39	1.2
December	0.88	0.03	3.55	0.7

* Precipitation values obtained for Uravan weather station from 1961 to 2007

TABLE I-3

WEIBULL DISTRIBUTION PARAMETERS

Month	Slope Parameter (-)	Mean Minus Minimum* (inch/month)
January	1.49	0.78
February	1.35	0.71
March	1.27	0.97
April	1.32	0.93
May	1.13	0.89
June	0.98	0.44
July	1.57	1.09
August	1.51	1.28
September	1.28	1.39
October	1.25	1.46
November	1.75	0.98
December	1.48	0.76

*****Minimum monthly precipitation was set to 0.1 inches per month for all *Goldsim* simulations.

TABLE I-4

PROBABILISTIC TAILINGS CELL POOL VOLUMES

Probability	Milling Rate (tpd)	Tailings Cell Pool Volume at Different Times of Operation (ft^3)				
		Year 1	Year 2	Year 5	Year 7	Year 14
98.6th percentile	500	1,310,480	2,169,730	4,634,550	5,324,510	4,746,010
99.3rd Percentile	1,000	2,362,260	3,089,570	7,022,990	8,375,190	*
Median	500	1,310,480	1,990,430	2,931,960	2,906,630	1,532,810
	1,000	2,270,090	2,676,730	6,654,030	7,314,080	*

* The model was run for a time of operation of 7 years for a 1,000-tpd milling rate and 14 years for a 500-tpd milling rate.

TABLE I-5

PROBABILISTIC CUMULATIVE EXCESS WATER VOLUMES AVAILABLE FROM THE TAILINGS CELL

Probability	Milling Rate (tpd)	Probabilistic Cumulative Excess Water Volumes Available from the Tailings Cell at Different Times of Operation (ft^3)				
		Year 1	Year 2	Year 5	Year 7	Year 14
98.6th percentile	500	996,502	1,769,230	6,119,570	6,285,710	6,484,390
99.3rd Percentile	1,000	1,402,530	4,844,340	7,356,380	8,630,730	*
Median	500	517,423	878,480	3,980,010	3,980,010	3,980,010
	1,000	996,089	3,755,860	3,823,780	3,833,560	*

* The model was run for a time of operation of 7 years for a 1,000-tpd milling rate and 14 years for a 500-tpd milling rate.

TABLE I-6

PROBABILISTIC AVERAGE EXCESS PUMPING RATES

Probability	Milling Rate (tpd)	Probabilistic Average Excess Pumping Rates at Different Time Intervals of Operation (gpm)				
		Years 0-1	Years 0-2	Years 3-5	Years 6-7	Years 8-14
98.6th percentile	500	14.2	12.6	20.6	1.2	0.4
99.3rd Percentile	1,000	19.9	34.4	11.9	9.1	*
Median	500	7.4	6.3	14.7	0.0	0.0
	1,000	14.2	26.7	0.3	0.1	*

* The model was run for a time of operation of 7 years for a 1,000-tpd milling rate and 14 years for a 500-tpd milling rate.

N 1594000
N 1593500
N 1593000
N 1592500
E 2060500
E 2061000
E 2061500
E 2062000
E 2062500
E 2063000

ANCHOR TRENCH
UNDERDRAIN RISER PIPES
UNDERDRAIN RISER PIPES
TAILINGS CELL SLOPE LINER SYSTEM
LCRS RISER PIPES
LCRS RISER PIPES
SLOPE LINER TO BASE LINER TRANSITION
TAILINGS CELL BASE LINER SYSTEM
TAILINGS CELL BASE LINER SYSTEM
DIVIDER BERM
LCRS AND UNDERDRAIN SUMP
1% MIN.
TAILINGS CELL A2
1% MIN.
TAILINGS CELL A1
10 FT. BENCH (TYP.)
28 FT. PIPE CORRIDOR
15 FT. CREST
RUB SHEET
5H:1V
3H:1V
5540
5530
5520
5510
5500
5490
5480
5470
5460
Process Perimeter Fence

LEGEND

EXISTING GROUND TOPOGRAPHY

PROPOSED FINISHED GRADE TOPOGRAPHY

TOE — CREST SLOPE DIRECTION

UNDERDRAIN RISER PIPES

LCRS RISER PIPES

200 0 200
1" = 200' Feet

TYPICAL TAILINGS CELL LAYOUT

FIGURE I-1

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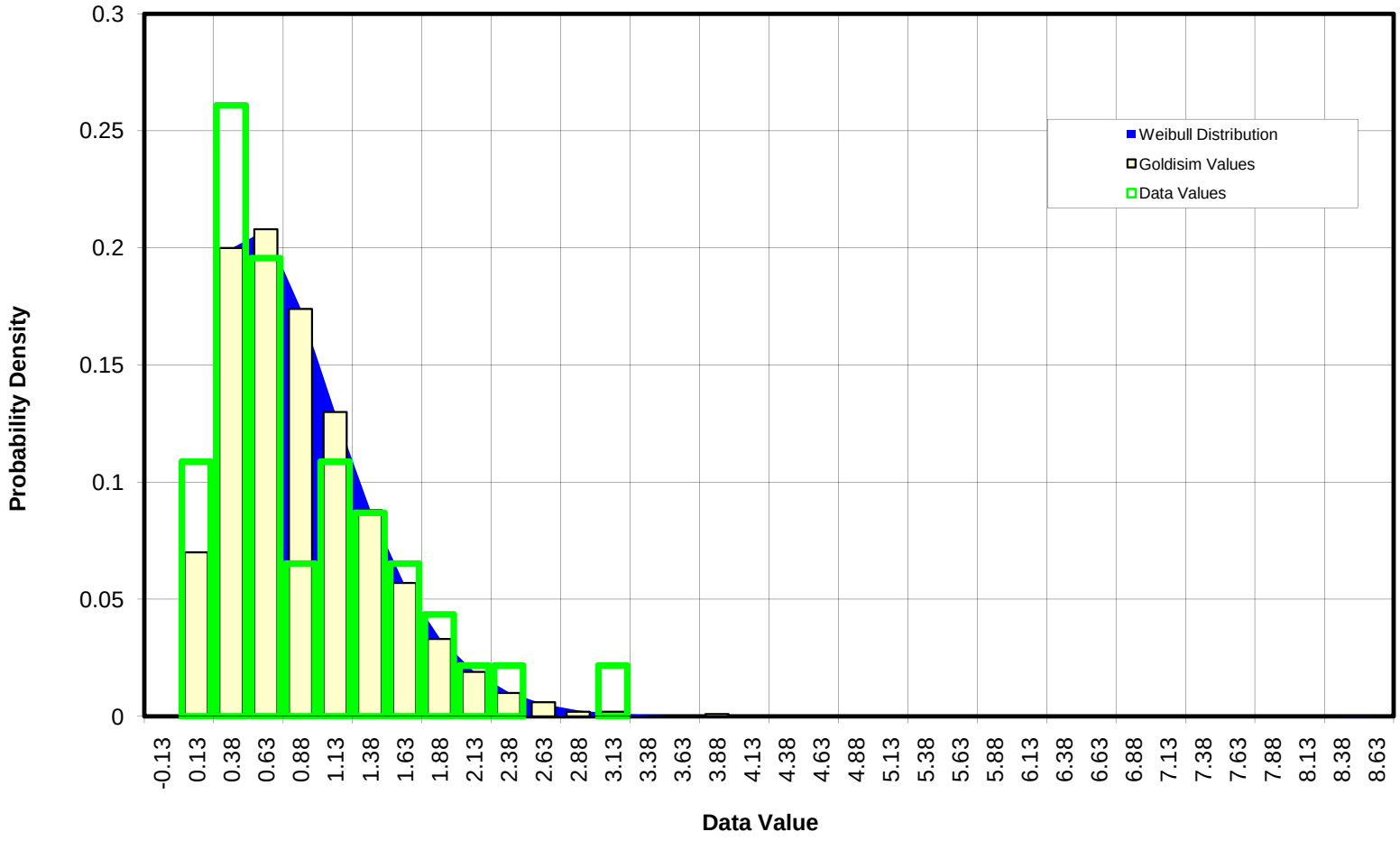

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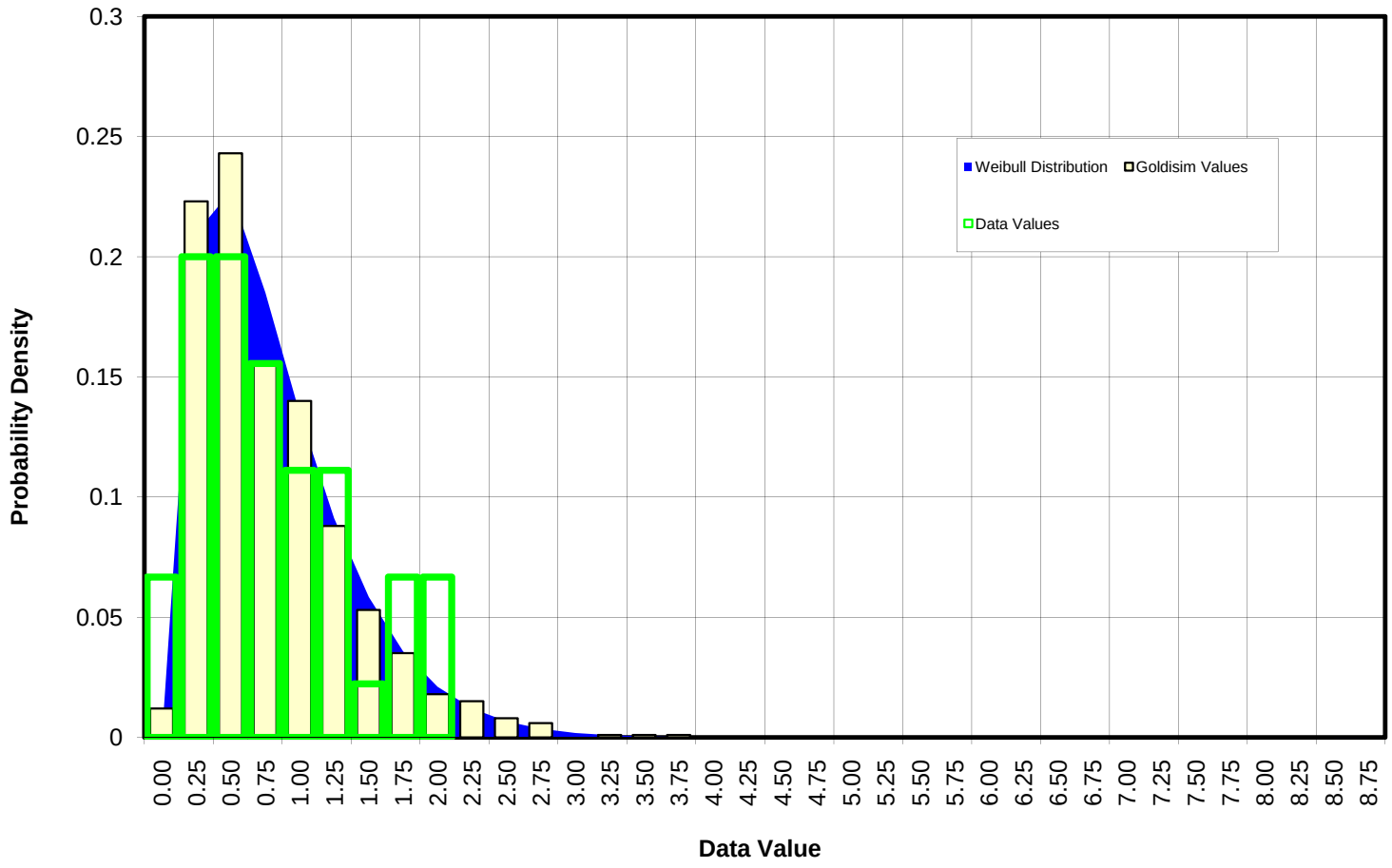

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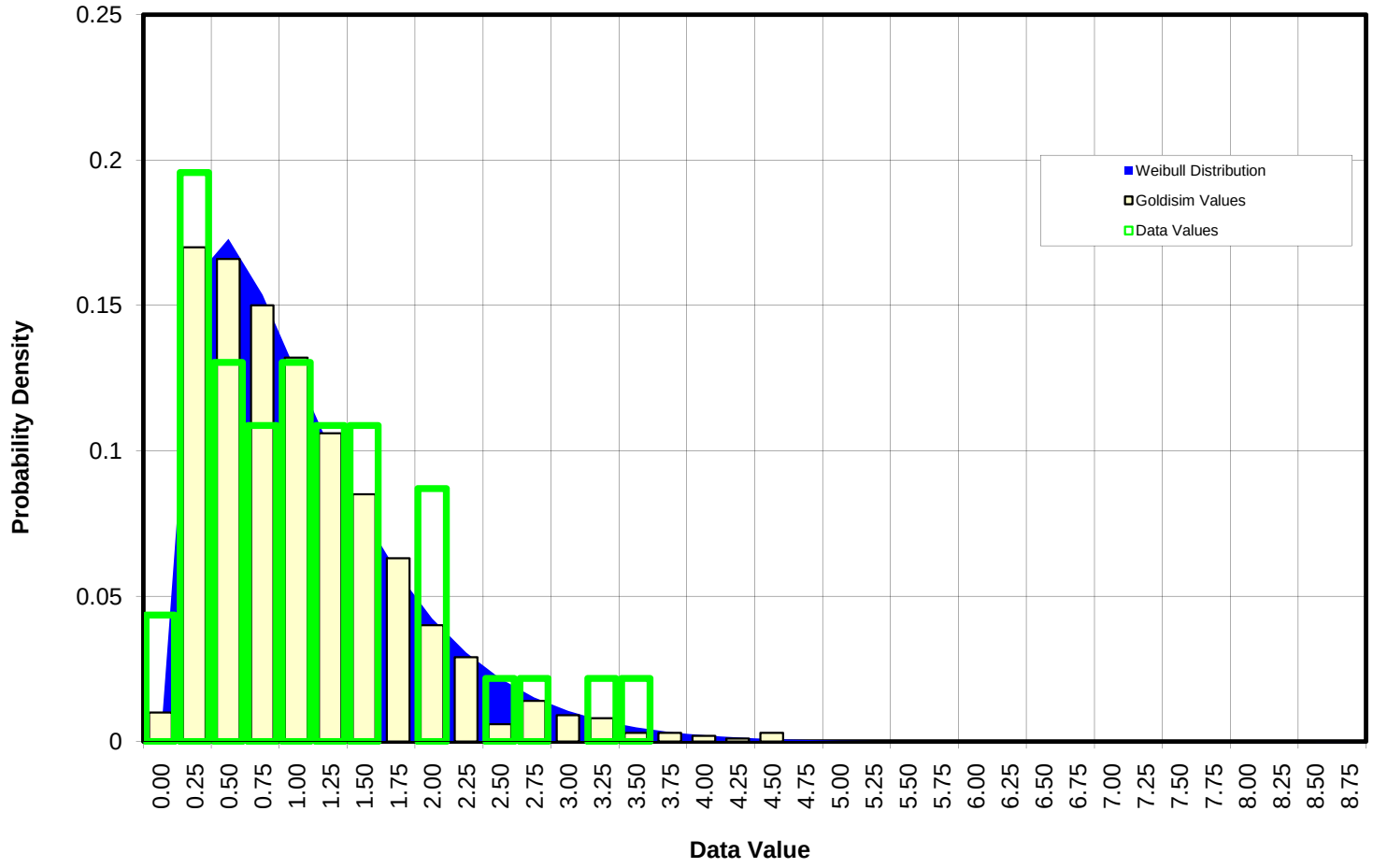

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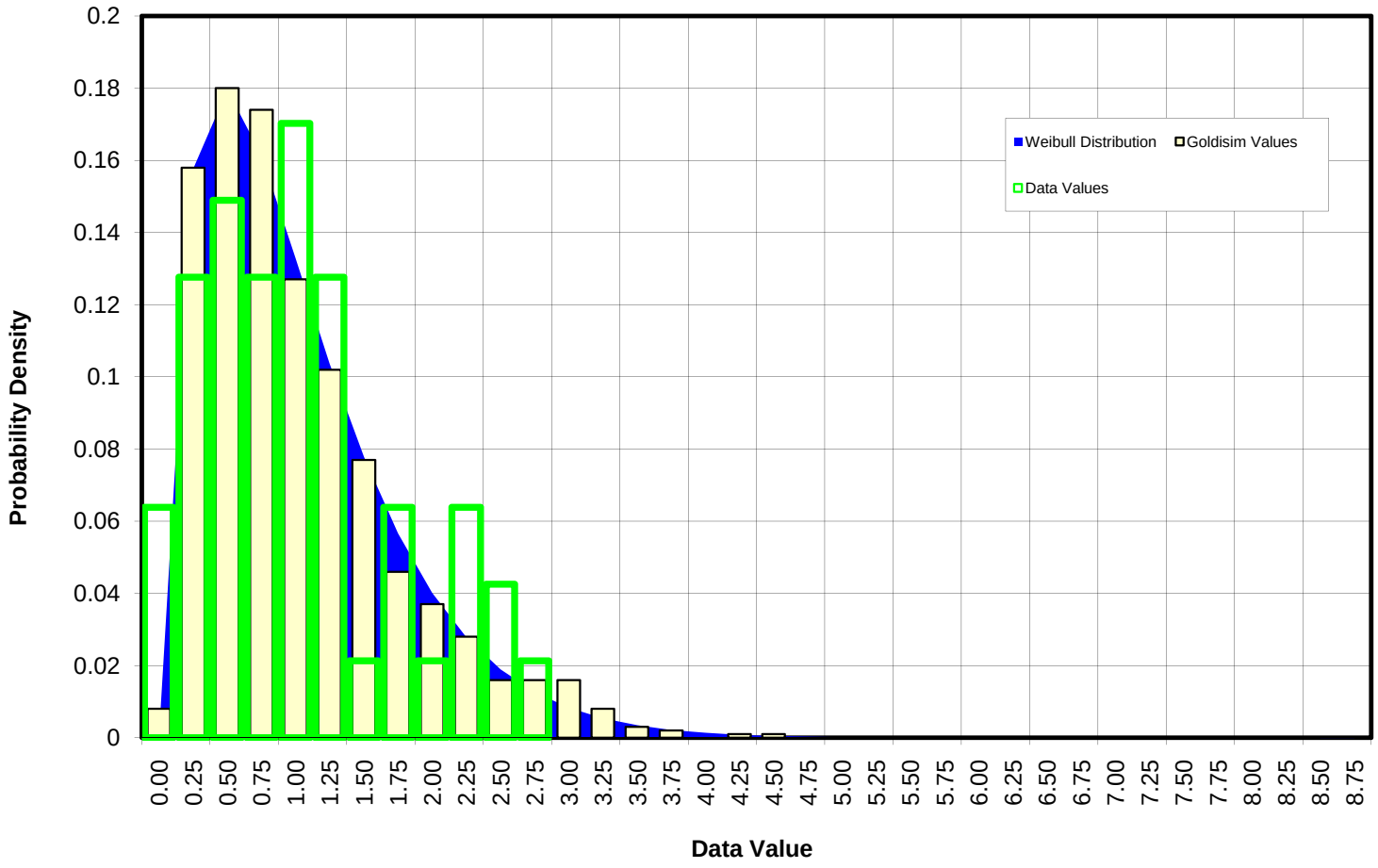

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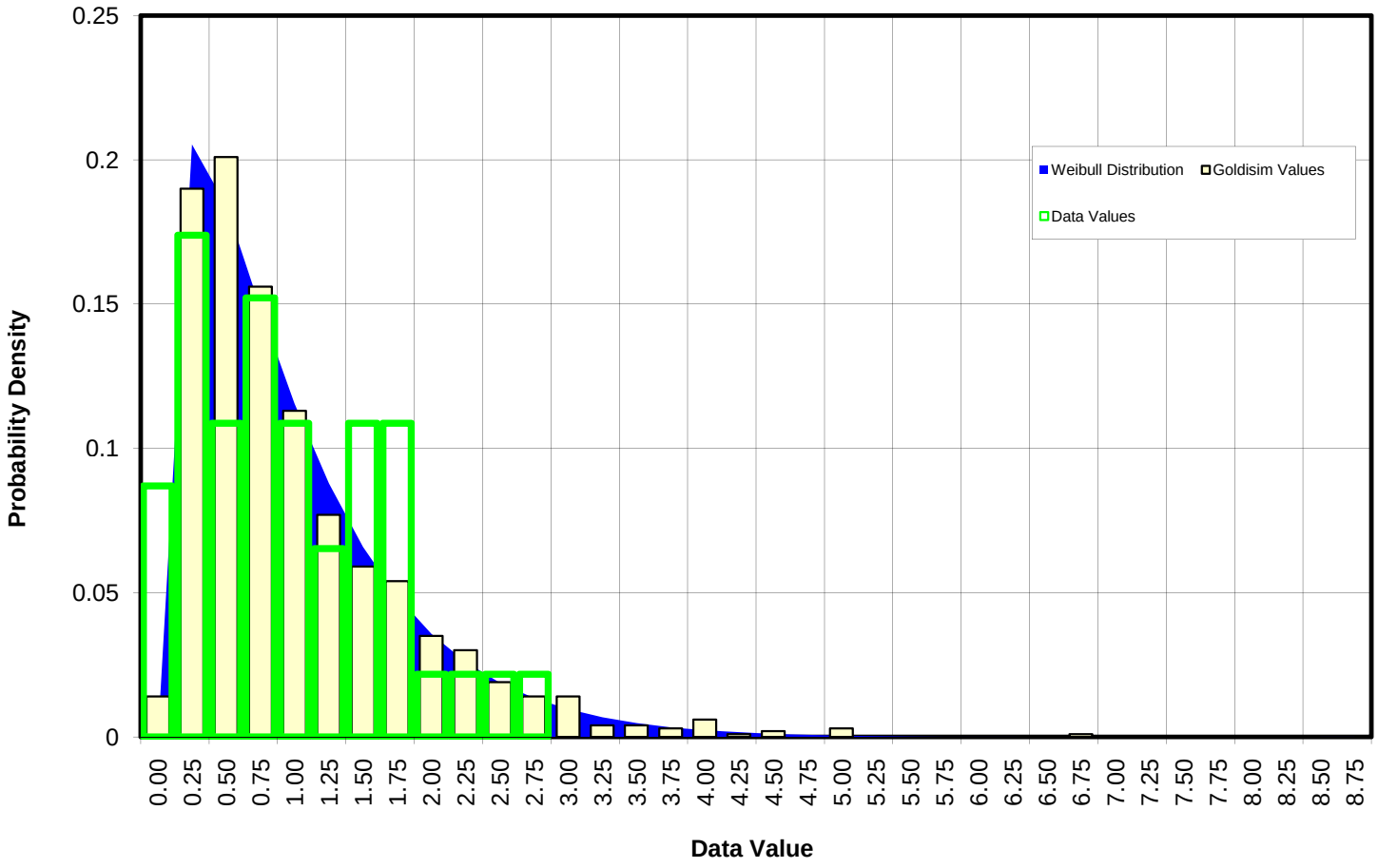

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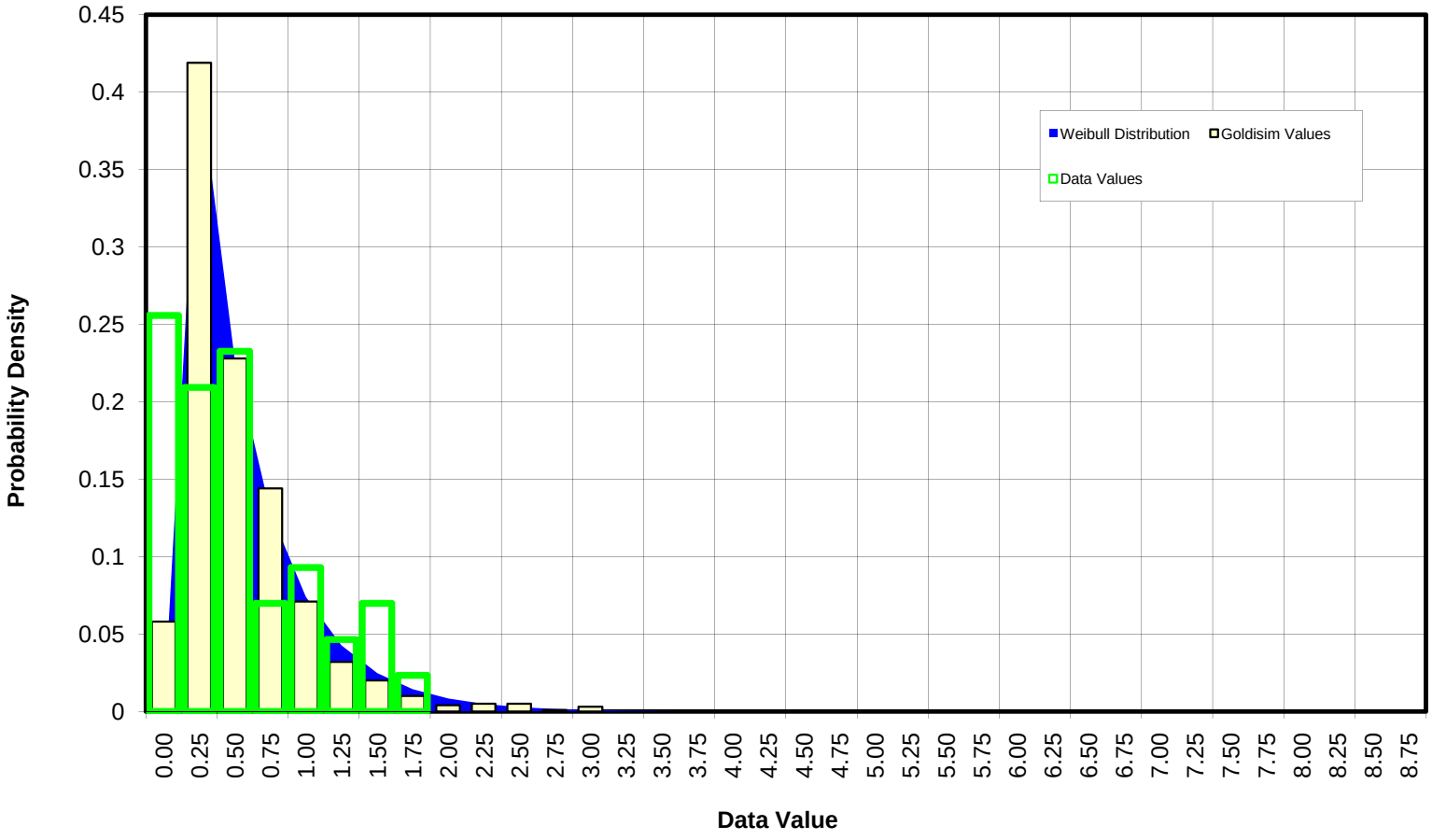

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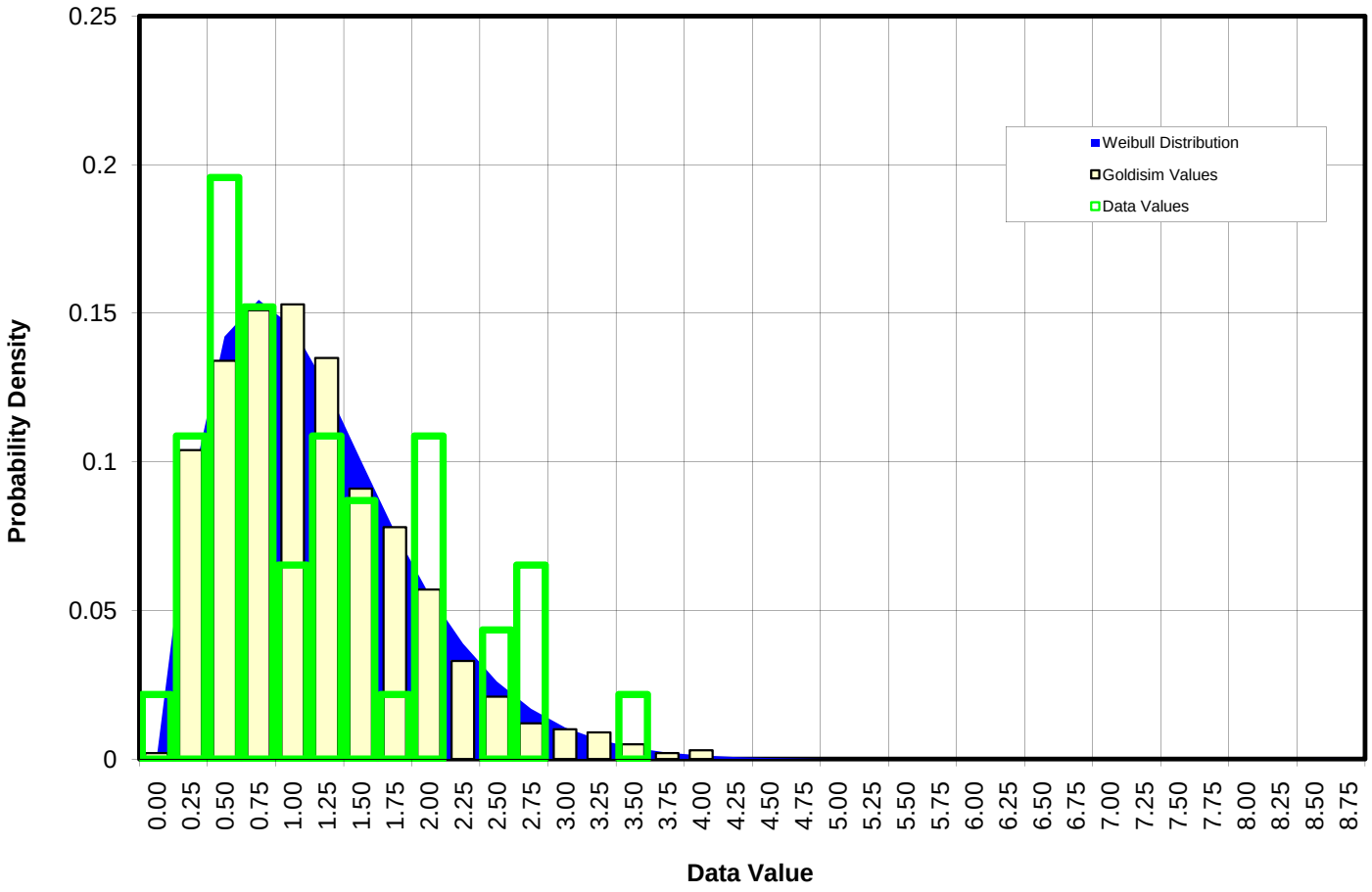

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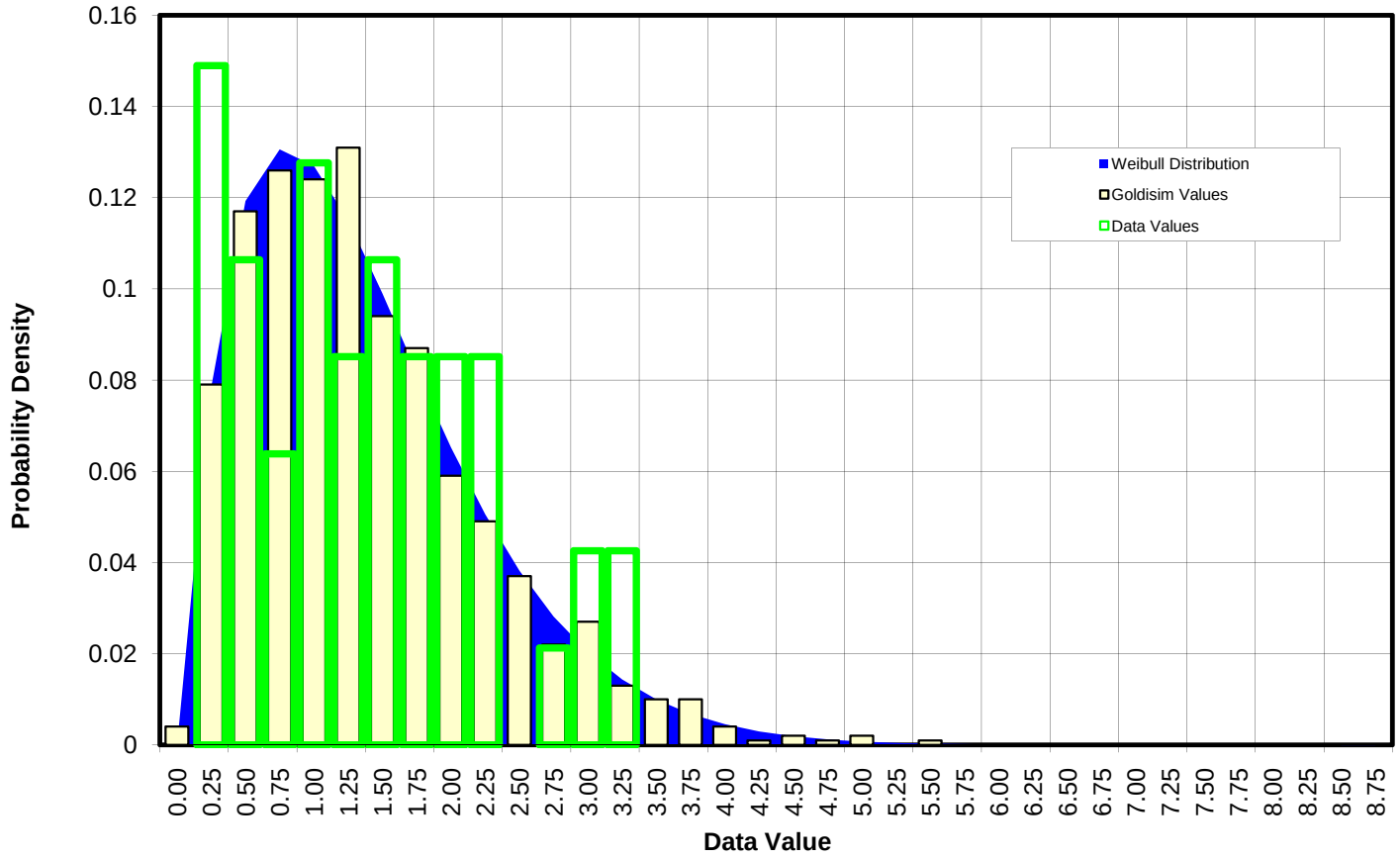

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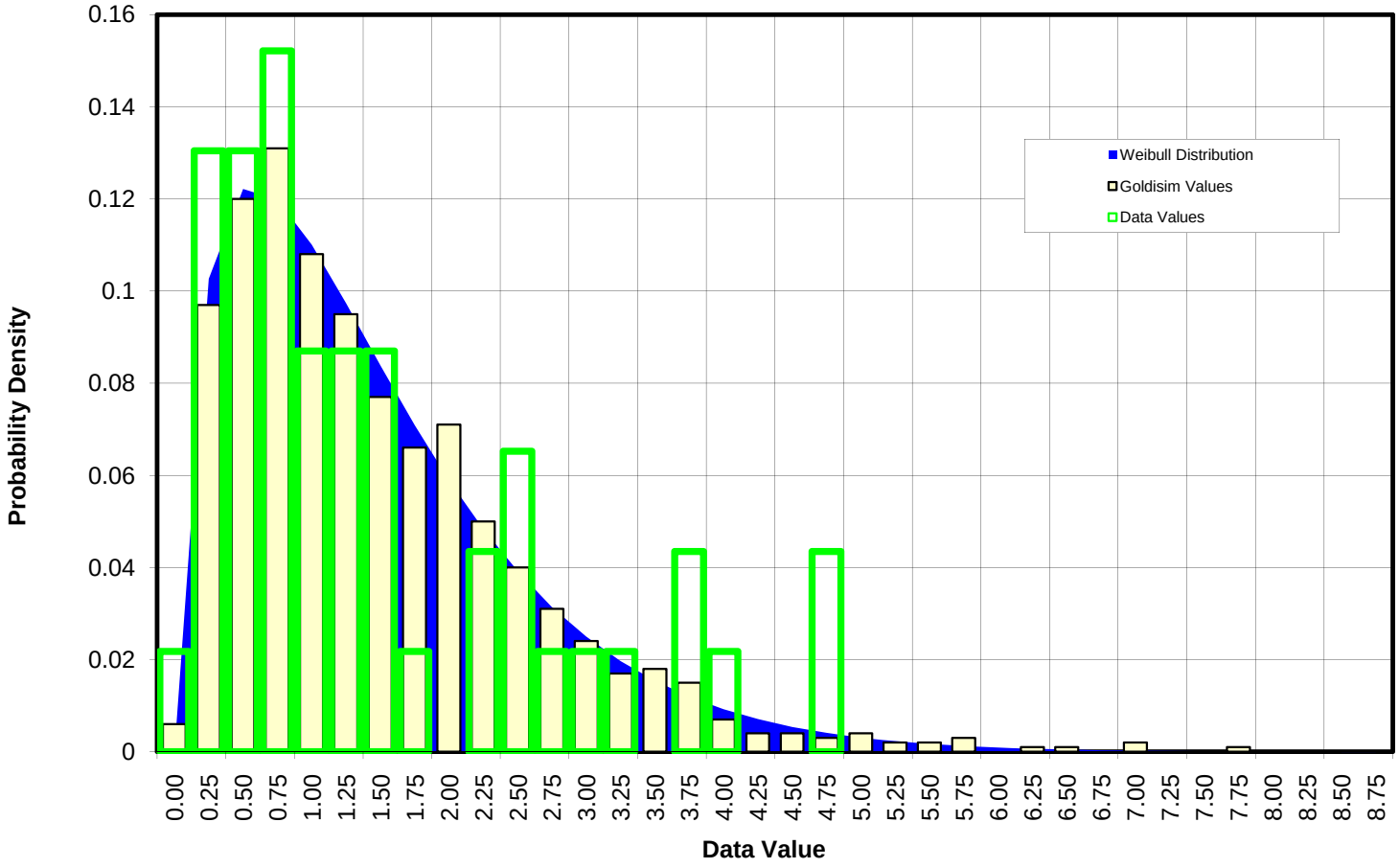

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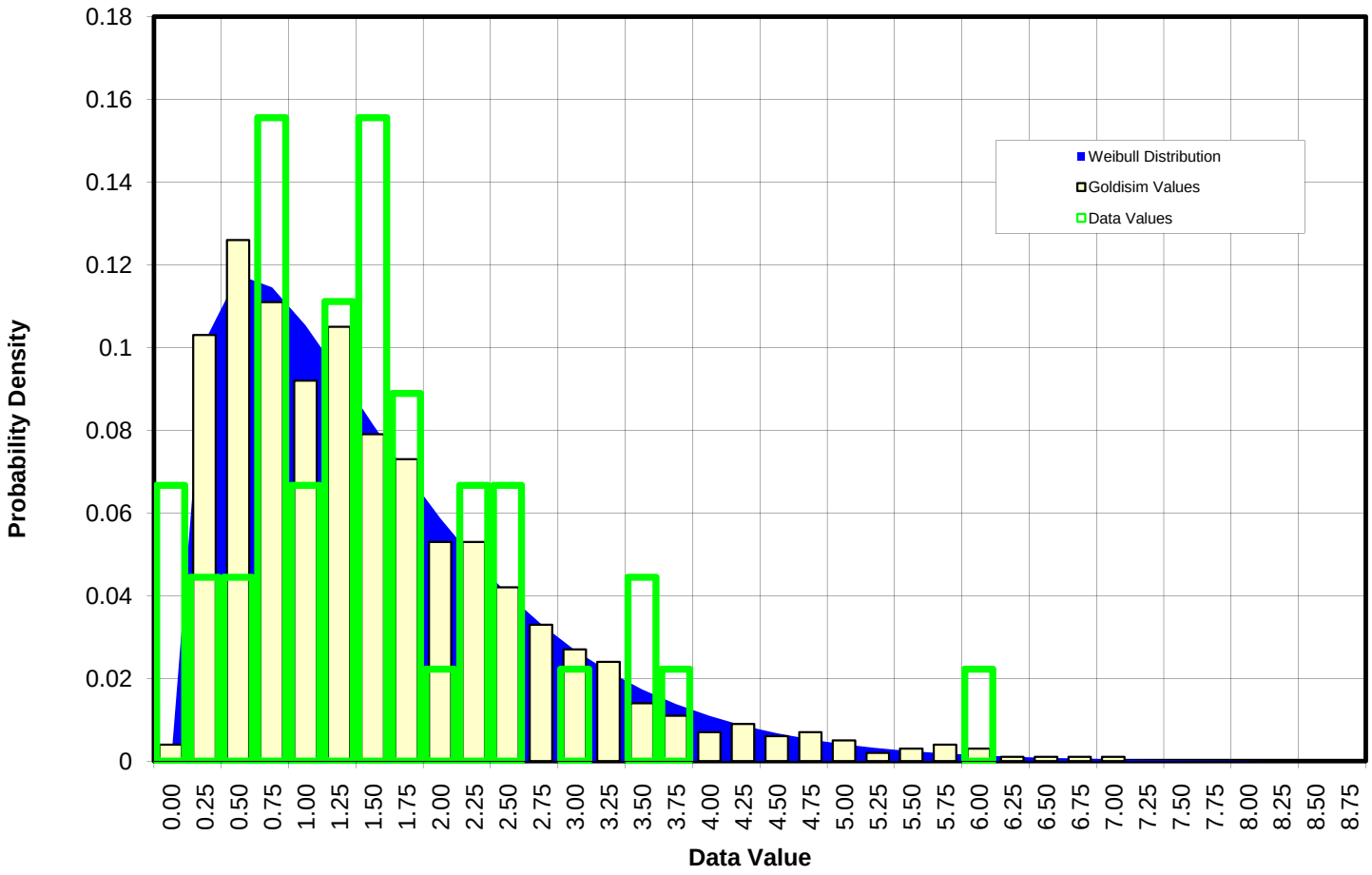

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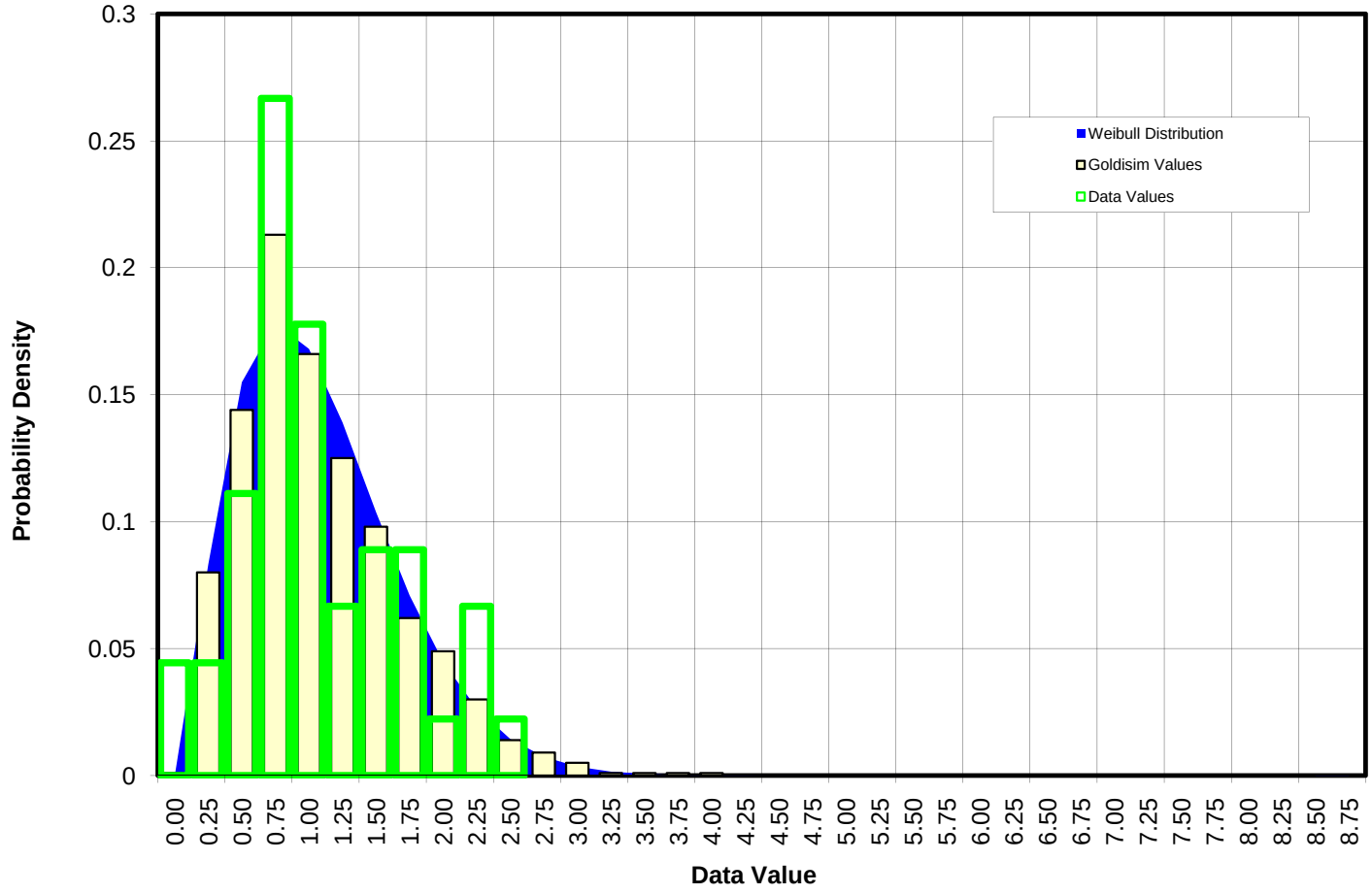

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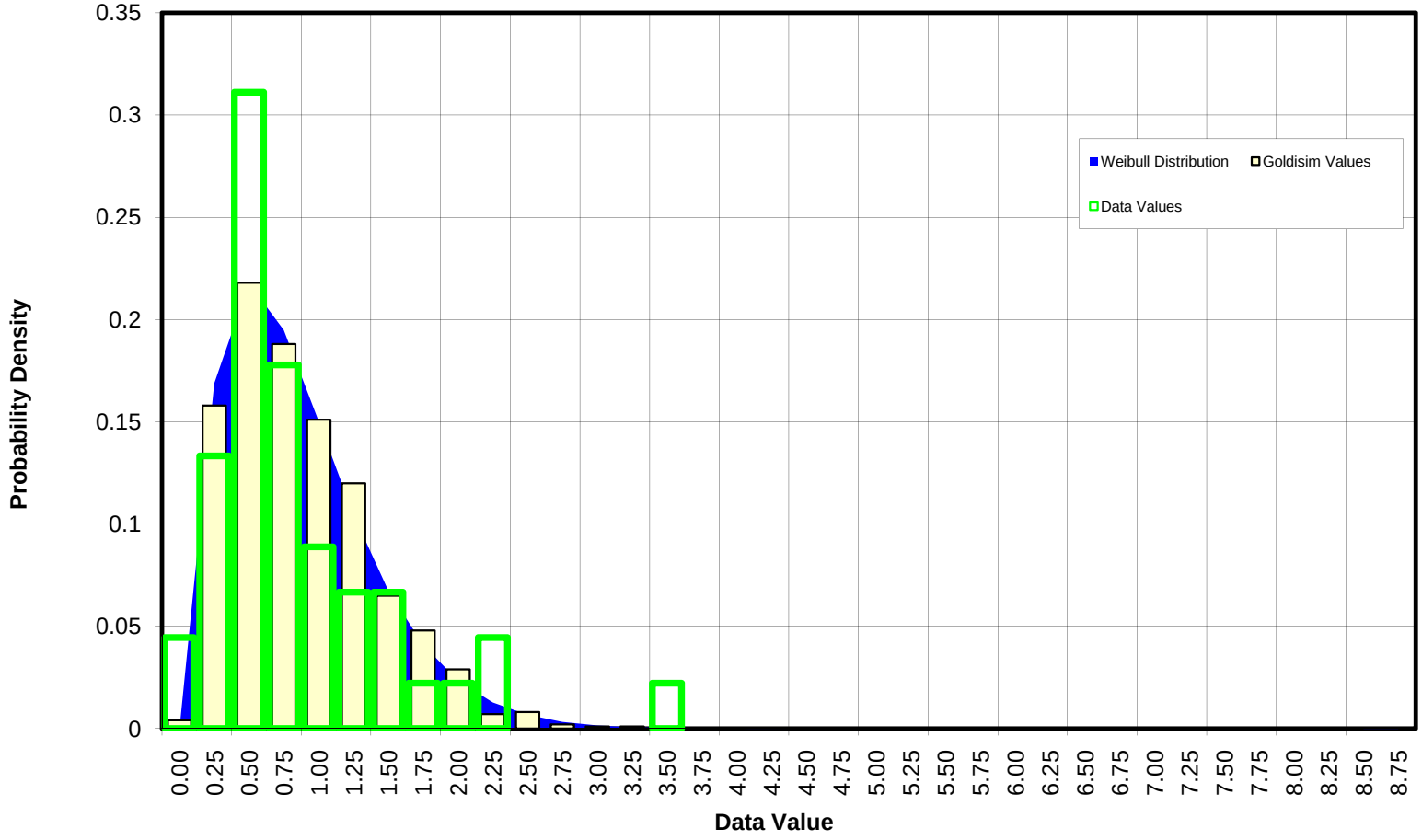

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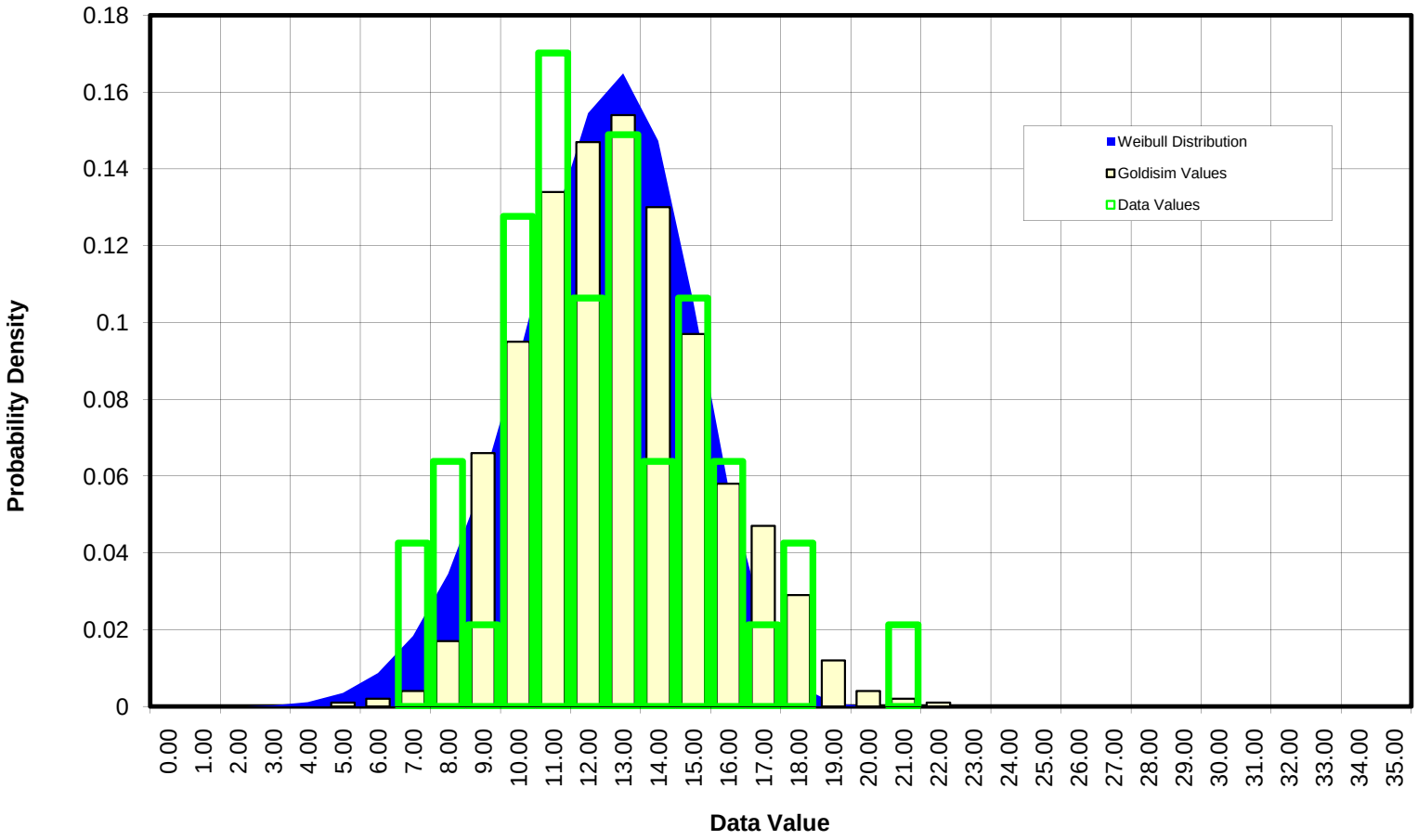

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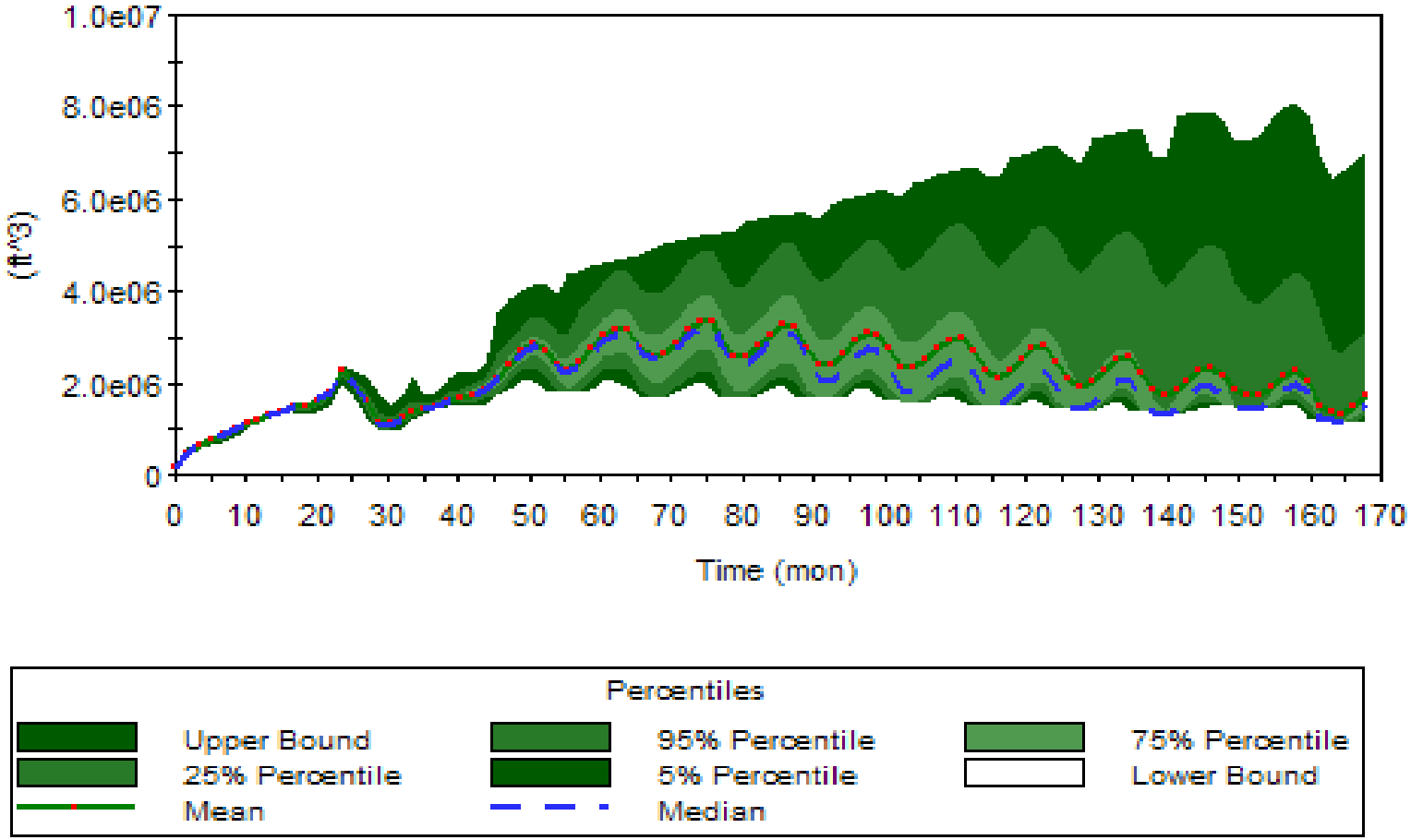

Golder Associates

Denver, Colorado

TITLE

TAILINGS CELL POOL VOLUME FOR 500-TPD MILLING RATE

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION
PIÑON RIDGE PROJECT

DRAWN	GIA	DATE	Oct-08	JOB NO.	073-81694
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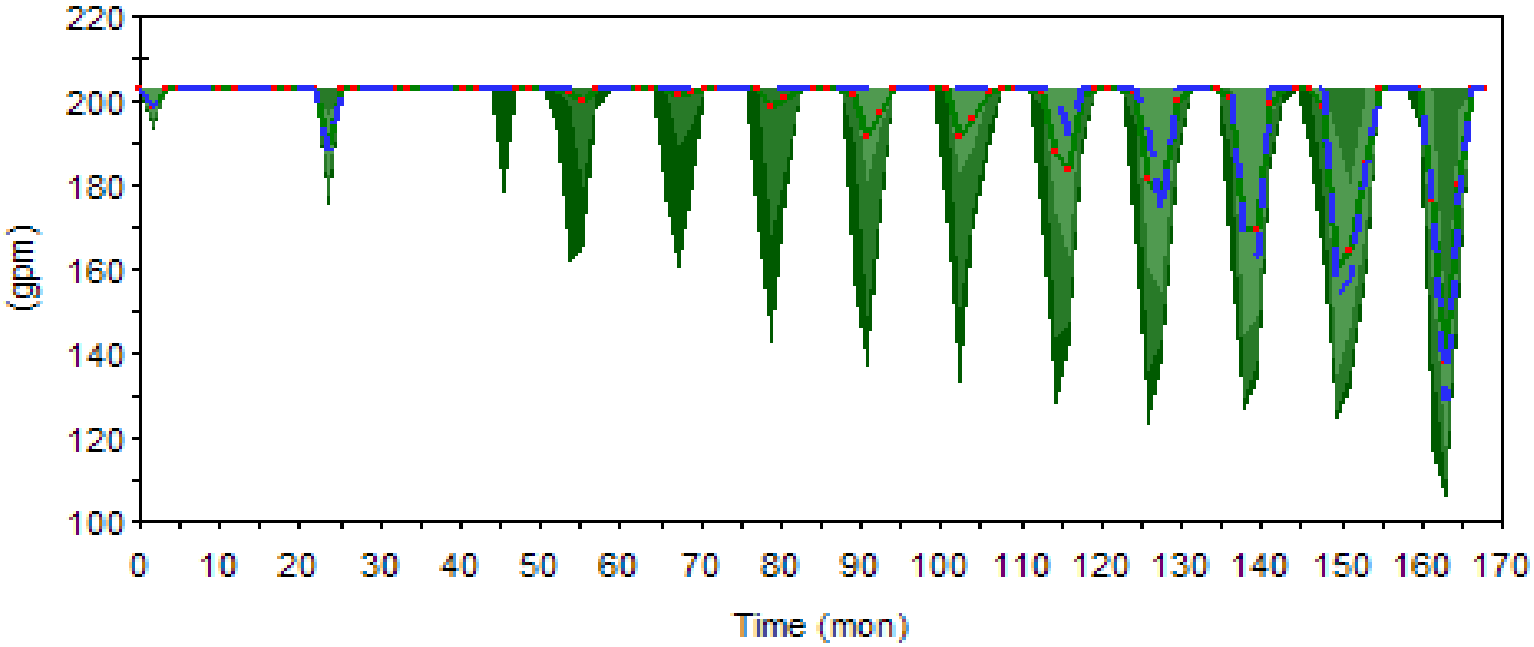

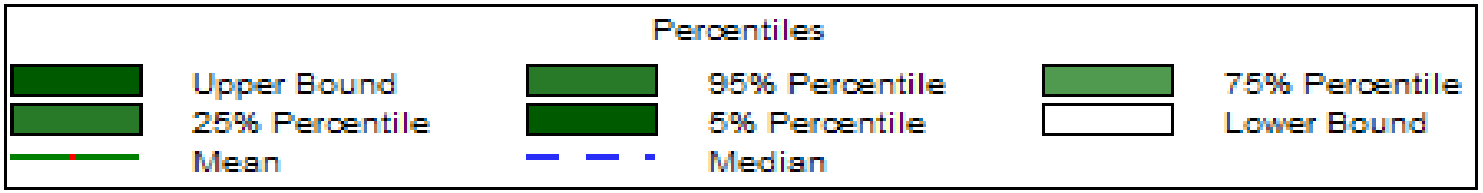

Golder Associates

Denver, Colorado

TITLE

PUMPING RATE AVAILABLE TO RETURN RECLAIMED WATER TO MILL FOR 500-TPD MILLING RATE

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION
PIÑON RIDGE PROJECT

DRAWN	GIA	DATE	Oct-08	JOB NO.	073-81694
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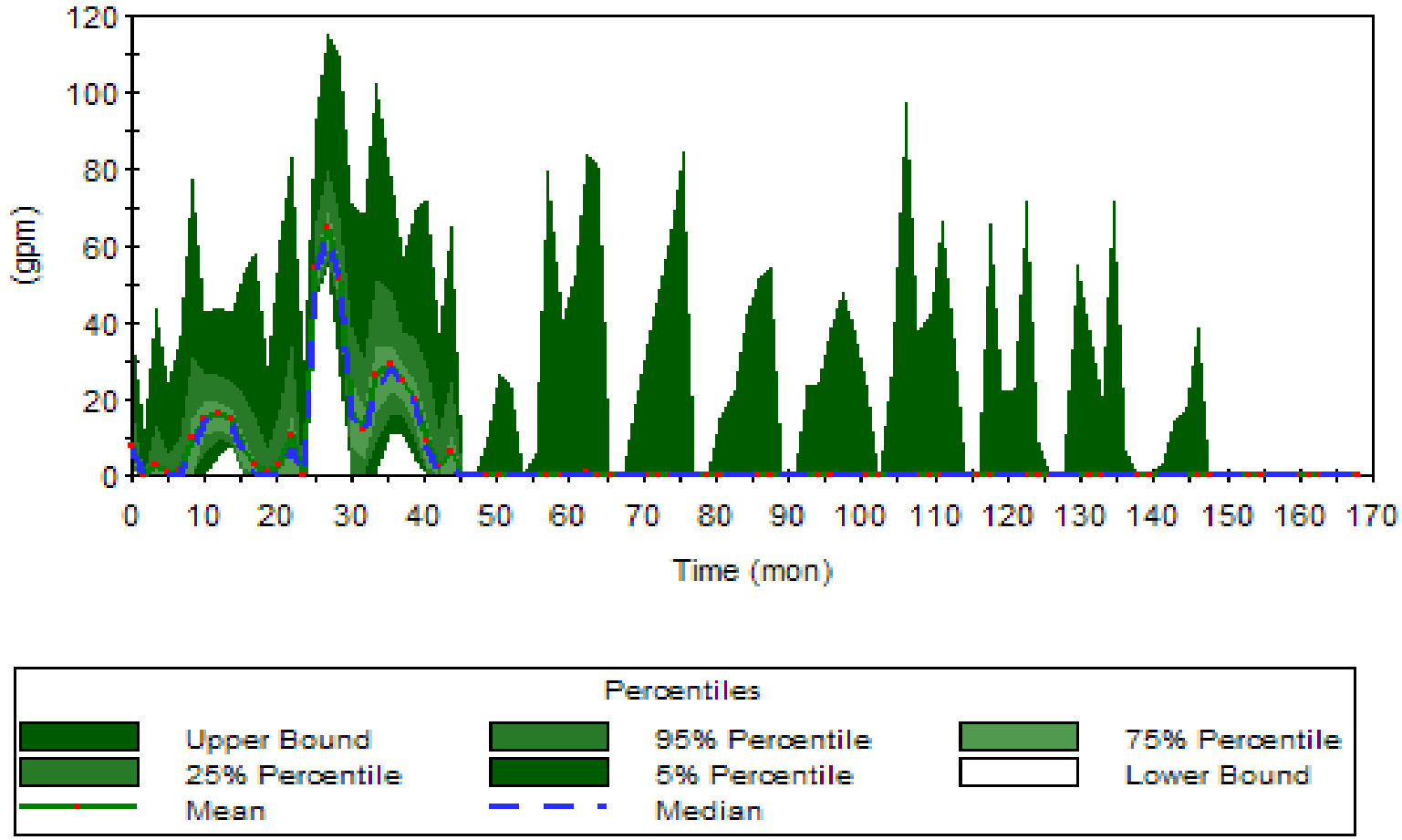

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TITLE

AVAILABLE EXCESS PUMPING RATE FOR 500-TPD MILLING RATE

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION
PIÑON RIDGE PROJECT

DRAWN	GIA	DATE	Oct-08	JOB NO.	073-81694
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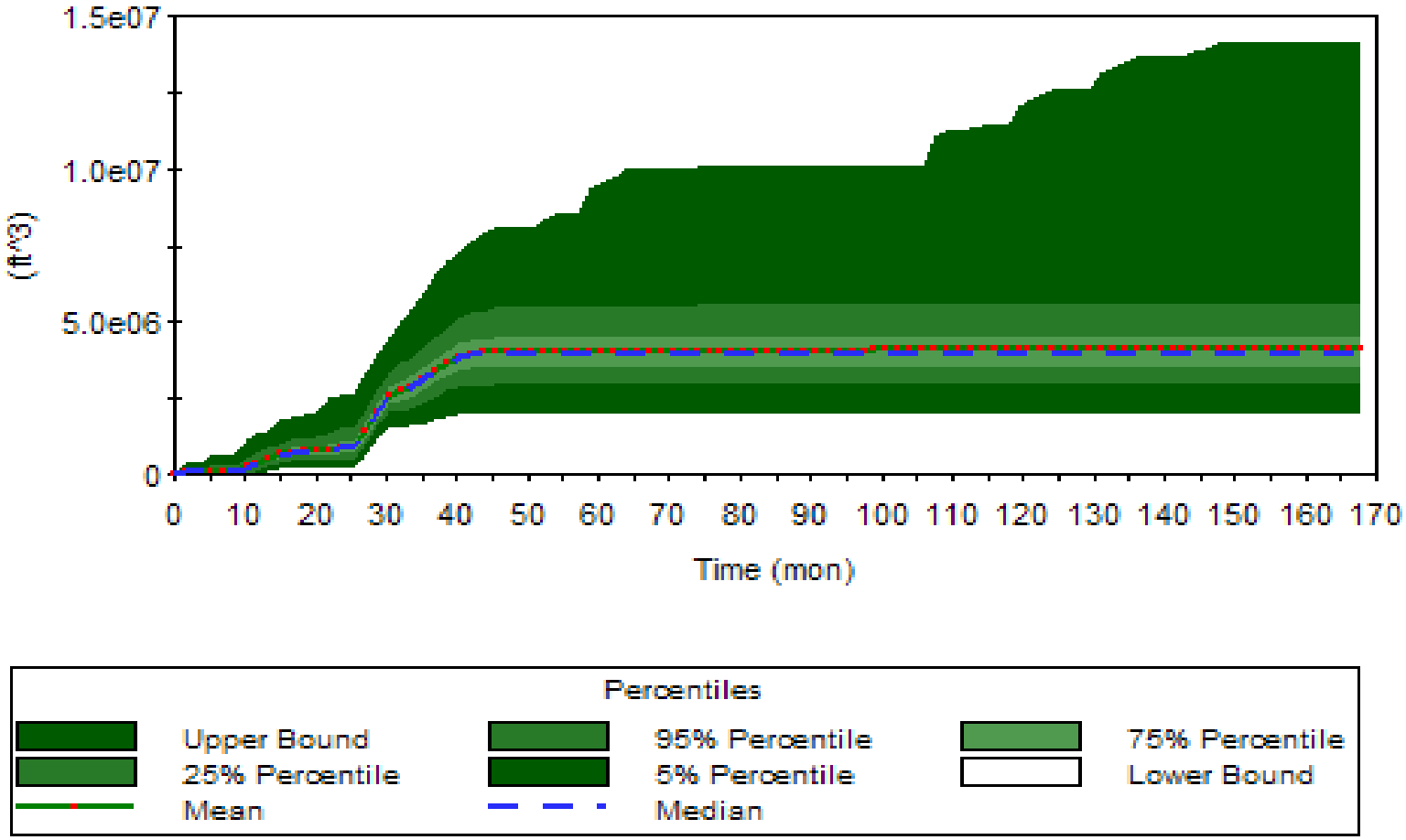

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Denver, Colorado

TITLE

AVAILABLE EXCESS MAKE-UP WATER VOLUME FOR 500-TPD MILLING RATE

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION
PIÑON RIDGE PROJECT

DRAWN	GIA	DATE	Oct-08	JOB NO.	073-81694
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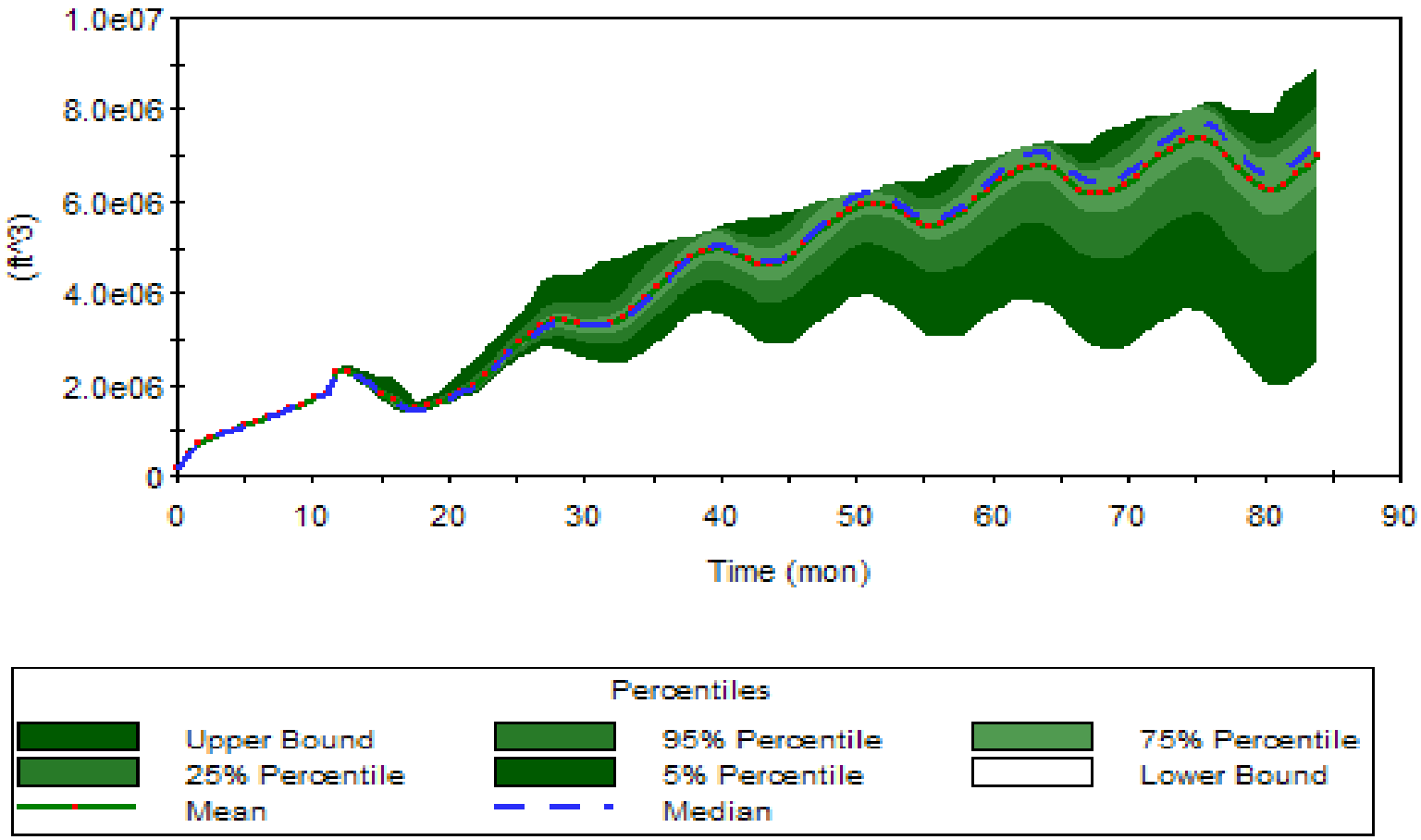

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Denver, Colorado

TITLE

TAILINGS CELL POOL VOLUME FOR 1,000-TPD MILLING RATE

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION
PIÑON RIDGE PROJECT

DRAWN	GIA	DATE	Oct-08	JOB NO.	073-81694
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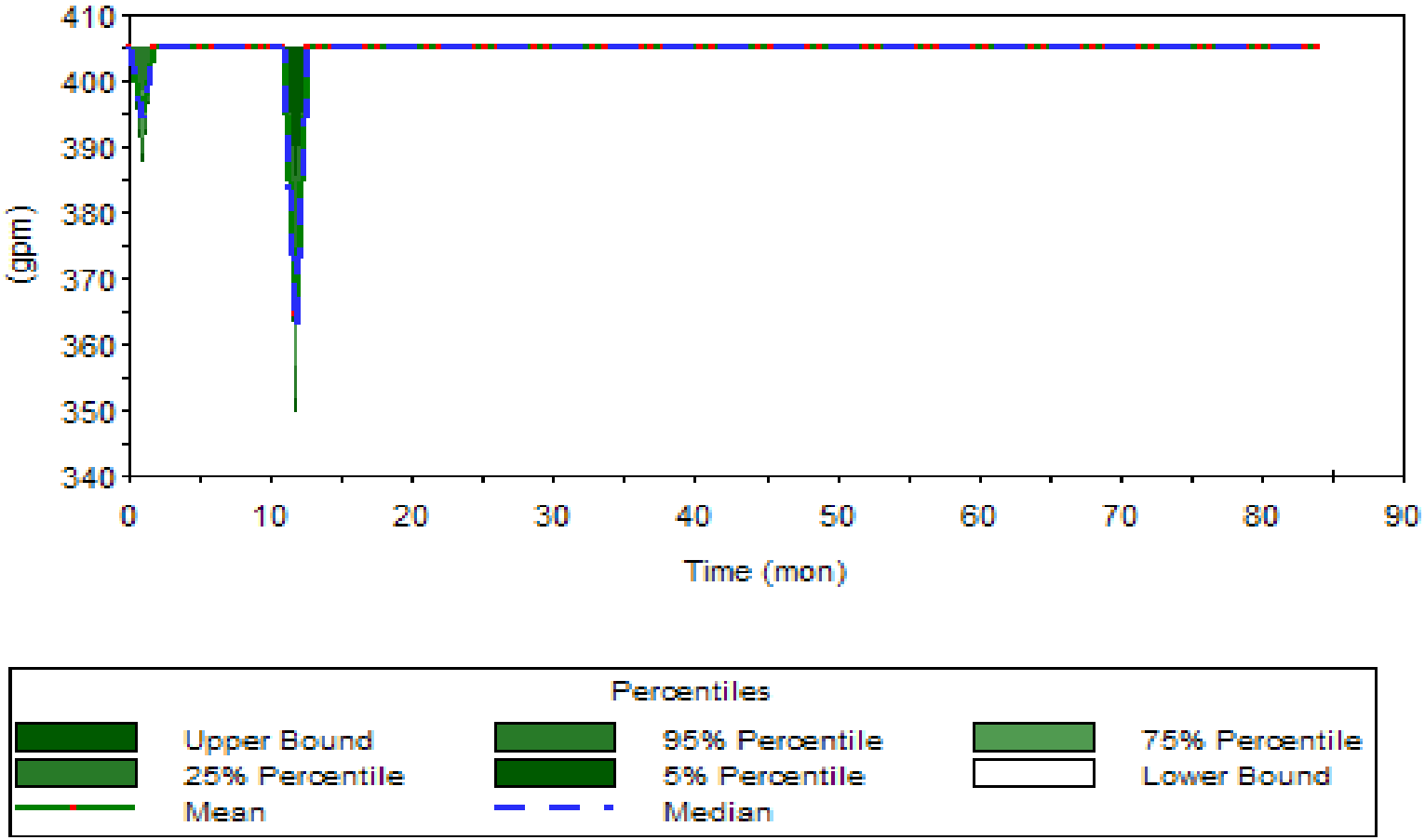

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Denver, Colorado

TITLE

PUMPING RATE AVAILABLE TO RETURN RECLAIMED WATER TO MILL FOR 1,000-TPD MILLING RATE

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION
PIÑON RIDGE PROJECT

DRAWN	GIA	DATE	Oct-08	JOB NO.	073-81694
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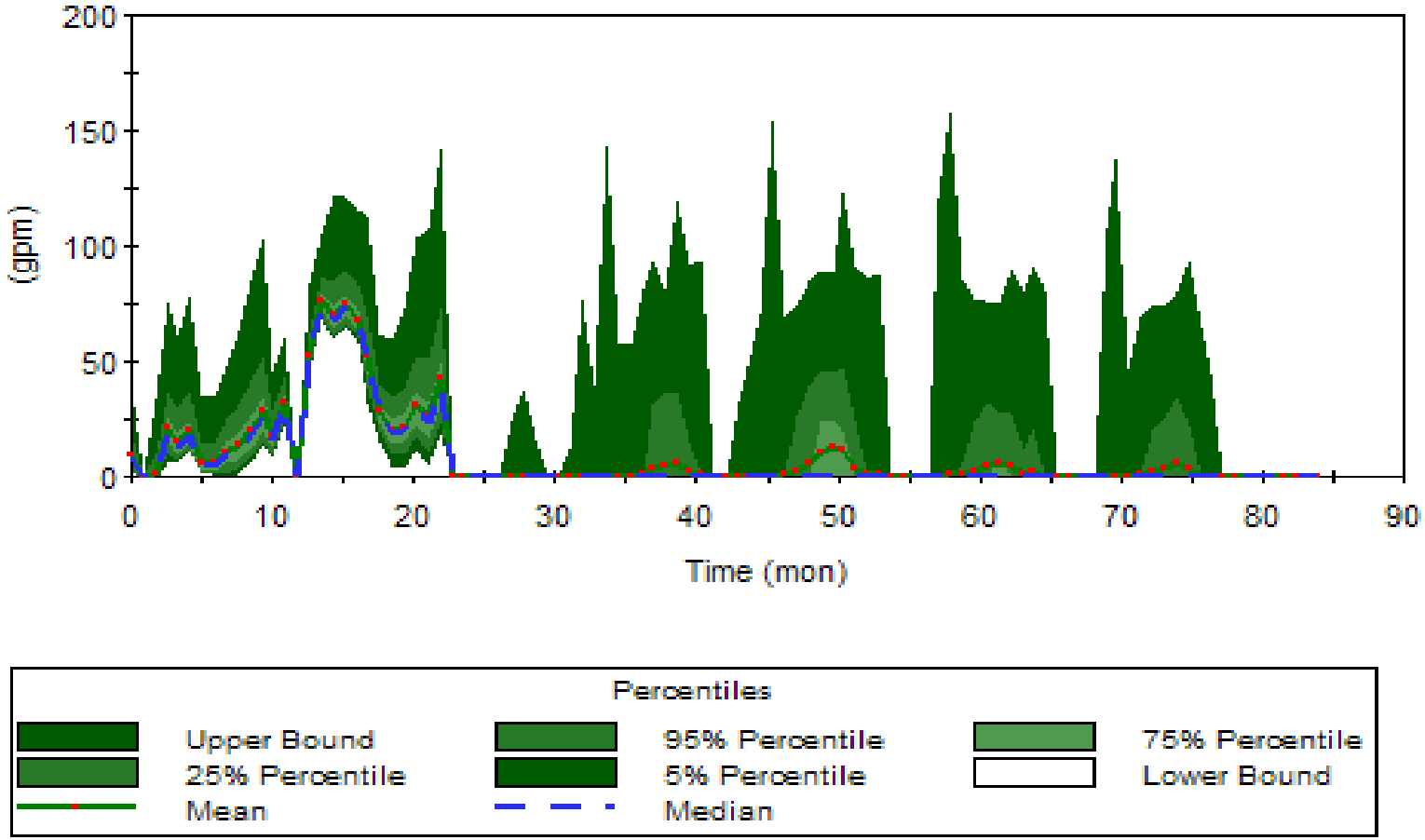

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Denver, Colorado

TITLE

AVAILABLE EXCESS PUMPING RATE FOR 1,000-TPD MILLING RATE

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION
PIÑON RIDGE PROJECT

DRAWN	GIA	DATE	Oct-08	JOB NO.	073-81694
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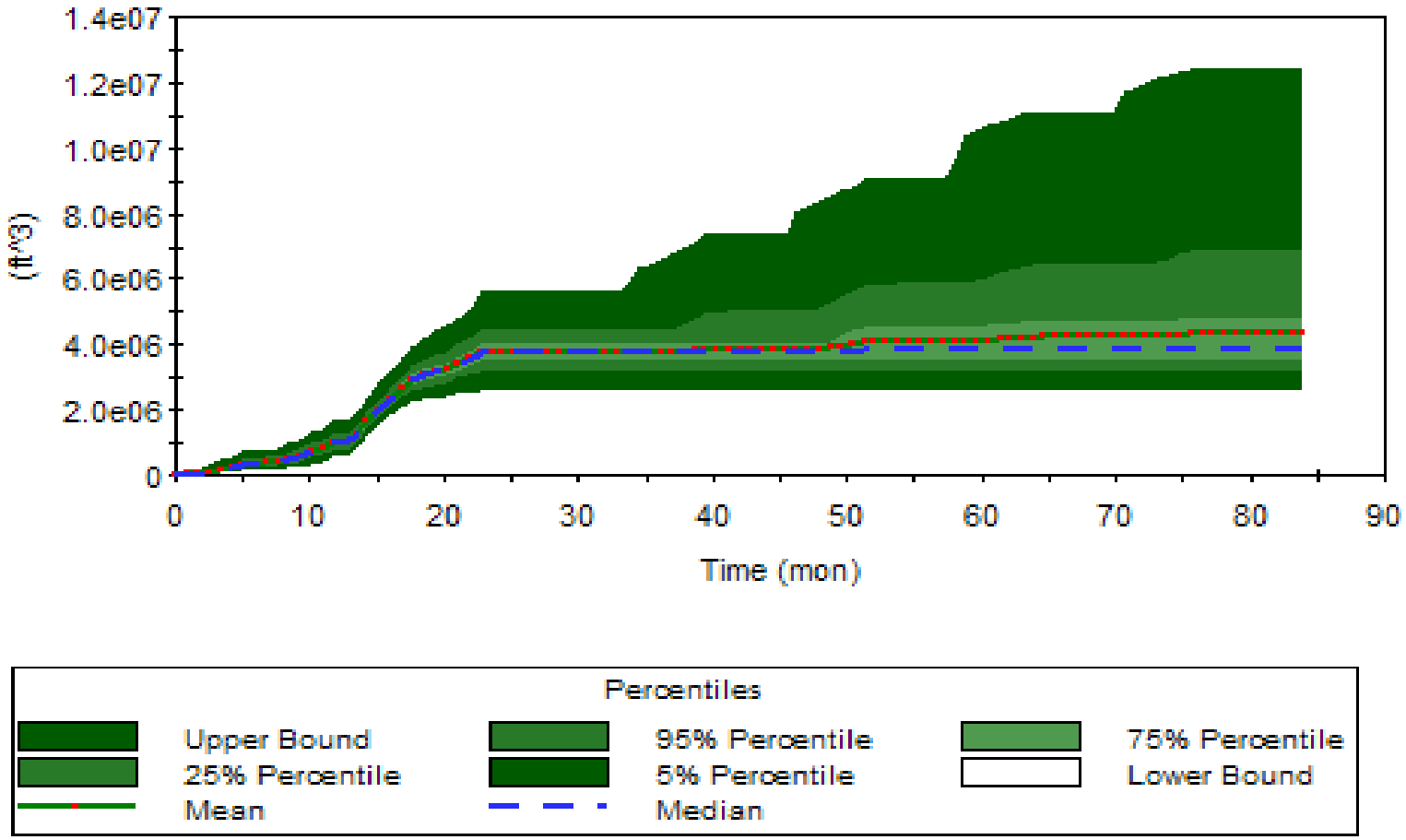

Golder Associates

Denver, Colorado

TITLE

AVAILABLE EXCESS MAKE-UP WATER VOLUME FOR 1,000-TPD MILLING RATE

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION
PIÑON RIDGE PROJECT

DRAWN	GIA	DATE	Oct-08	JOB NO.	073-81694
CHECKED	GG	SCALE	AS SHOWN	DWG. NO.	N/A
REVIEWED	DPH	FILE NO.	Figures2-22_05May08.xls	FIGURE NO.	FIGURE I-22

APPENDIX I-1

CLIMATIC DATA ANALYSIS

OBJECTIVE:

Evaluate the available weather data for the Piñon Ridge site and select a data set to be used in the design of facilities for the project.

GIVEN:

- Daily weather data obtained from the Western Regional Climate Center from the following locations:
  - Uravan
  - Nucla
  - Grand Junction
  - Montrose

ANALYSIS:

Site-Specific Data

Piñon Ridge site is located at 38°15' latitude, 108°45' longitude, elevation 5,480 feet. The site rests in the middle of a narrow valley near Monogram Mesa (see Figure I-1-1). Due to the limitations of obtaining site specific weather data, nearby weather stations are used to estimate or approximate the climatic conditions for the Piñon Ridge site.

Regional Data

The weather data from the following weather stations are considered due to proximity to the investigated site, and the available data inventory:

- *Uravan* (NCDC No. 058560)
- *Nucla* (NCDC No. 053807)
- *Grand Junction* (NCDC No. 053488)
- *Grand Junction 6 ESE* (NCDC No. 053489)
- *Montrose 1* (NCDC No. 055717)
- *Montrose 2* (NCDC No. 055722)

Data for above sites were obtained from the Western Regional Climate Center. The locations of the nearby weather stations and the Piñon Ridge site are illustrated in Figure I-1-2. In the following section, a brief description is presented for each weather station.

Uravan

Uravan is located at 38°22' latitude 108°45' longitude, elevation 5,010 feet, about 8.5 miles North of the Piñon Ridge site. The difference in elevation between the sites is 470 feet. This weather station provides the following daily weather data between the years of 1960 to 2007:

- Precipitation
- Air temperature
- Snow cover

The average total annual precipitation is equal to 12.6 inches. The months of September and October are generally the wettest months of the year. The maximum total annual precipitation of 21.4 in was recorded in 1965. The driest year was 1989 with a total annual rainfall equal to 7.3 inches. The average annual temperature is equal to 53.1 °F, and the average total annual snowfall is equal to 9.4 inches. The maximum snowfall was recorded during 1978-1979 with a total 40.4 in. Table I-1-1 shows the average monthly and annual data for this weather station.

Nucla

Nucla is located at 38°13' latitude 108°33' longitude, elevation 5,860 feet, about 11 miles East of the Piñon Ridge site. The difference in elevation between the sites is 380 feet. This weather station provides the following daily weather data for the years 1999 to 2007:

- Air temperature
- Solar radiation
- Wind velocity
- Relative humidity
- Precipitation

The average annual temperature at the Nucla site is 53 °F. The solar radiation has been increasing during the period of record (i.e., 1999 to 2007) from 746 langleys (ly) in 1999 to 827 ly in 2007. The maximum solar radiation was collected during June 2007 at 828 ly. The average relative humidity (RH) for this site is equal to 42%, where the driest season corresponds to summer time (RH =31 %) . The average total annual precipitation for this location is 9.3 inches. The wettest month is September with an average accumulated precipitation of 1.8 inches. The driest month corresponds to January with 0.3 inches of precipitation. The wettest year correspond to 2006 with a total accumulated precipitation equal to 10.4 inches. Table I-1-2 shows the average monthly and annual data for this weather station.

Grand Junction Airport

Grand Junction Airport is located at 39° 8' latitude 108°32' longitude, elevation 4,840 feet, about 62 miles North of the Piñon Ridge site. The difference in elevation between the sites is 640 feet. This weather station provides the following daily weather data for the years 1900 to 2007:

- Air temperature
- Precipitation
- Snow cover
- PAN evaporation
- Relative humidity
- Cloud cover
- Wind velocity

PAN evaporation data is available only for years 1948 to 1960 for this location, with an average total annual PAN evaporation equal to 82.4 inches. The annual average relative humidity is equal to 53.1%. An annual average of 22 inches of snowfall was recorded at Grand Junction airport, with a maximum snowfall of 6.3 inches recorded in December of 1998. The wettest year was in 1957 with 15.7 in of total precipitation. Grand Junction airport average annual precipitation is 8.8 in. The average cloud cover is 6%. The average annual data for Grand Junction are summarized in Table I-1-3.

Grand Junction 6ESE

Grand Junction 6ESE weather station is located at 39° 2' latitude 108°27' longitude, and elevation of 4,760 feet. The weather station is located 7.8 miles south of the Grand Junction Airport weather station. This weather station complements the data provided by the Grand Junction airport weather station. The Grand Junction 6ESE weather station provides the following daily weather data for the years 1962 to 2007:

- Air temperature
- Precipitation
- PAN evaporation
- Snow cover

The total average annual PAN evaporation is equal to 57.9 inches. The average annual precipitation is equal to 8.9 inches. The wettest year was in 1957 with 16 inches of total precipitation. The average annual snowfall for this station is 12.3 inches with a maximum snow fall recorded in December of 1978. Table I-1-4 shows the average annual data for this weather station.

Montrose

Two weather stations are used to obtain climate data for this location: one located at 38°28' latitude 107°52' longitude, elevation 5,786 feet and the second located at 38°29' latitude 107°52' longitude, elevation 5,785 feet. The first weather station provides data from 1905 to 1982; the second weather station provides data from 1895 to 2007. Montrose is located 50 miles southeast from the Piñon Ridge site. These weather stations provide the following daily weather data:

- Air temperature
- Precipitation
- Snow cover
- Average monthly PAN evaporation

The average total annual snowfall recorded at this location is 25.9 inches. With a maximum snowfall of 72 inches recorded in 1918. Montrose records show that the average annual precipitation is 9.6 in. The maximum precipitation was in 1941 with 17 inches of rainfall. The annual average PAN evaporation is 55.8 inches. Table I-1-5 shows the average monthly annual data for this weather station.

Data Analysis

Precipitation Data

Figure I-1-3 shows a comparison in total annual precipitation for years 1999 through 2007. Note that the Uravan weather station exhibits higher average annual precipitation than the rest of the sites. Table 1 compares the accumulated precipitation from 1999 to 2007 for all sites. Uravan weather station, which is the closest station to the Piñon Ridge site, provides the maximum precipitation. Also, historical data shows that the Uravan weather station provides the most critical rainfall event (year 1965). For reference purposes, Figure I-1-4 presents the annual precipitation as a function of station elevation for all regional stations considered in this report. Note that there is no clear correlation between elevation and precipitation for the considered weather stations. Figure I-1-5 shows the monthly precipitation for the driest and wettest years for the Uravan weather station. A comparison of monthly precipitation between Uravan and Grand Junction airport weather stations for the years 1965 (wettest year) and 1989 (driest year), show that these sites present different precipitation events (Figure I-1-6 and Figure I-1-7).

Table 1. General statistics for selected weather stations.

	Elevation (ft)	Difference in Elevation (ft)[1]	Distance to Piñon Ridge (miles)	Accumulated Precipitation (in) from 1999-2007	Average Max. Temp (°F)	Average Min. Temp (°F)
Uravan	5010	-470	8.5	100	69	37
Nucla	5860	380	11	74	68	39
Grand Junction	4840	-640	62	81	67	41
Montrose	5786	306	49.5	87	63	35

[1]Compared to Piñon Ridge site, EL. 5,480 ft

Temperature Data

A comparison between different weather stations is shown is Figure I-1-8. Correlation between elevation and temperature is shown in Figure I-1-9. A summary of temperature data is presented in Table 1.

Evaporation/Evapotranspiration data

Due to the limitation of weather data, the potential evapotranspiration (PET) for the Uravan weather station was calculated using the Hargreaves (1985) method as discussed by Allen et al. (1998). The estimated PET was then scaled by a factor of 0.7, to meet the average annual evaporation from shallow lakes for the Piñon Ridge site (Figure I-1-10). Figure I-1-11 shows a comparison between PAN evaporation and analytical PET estimates for different sites. Table 2 summarizes the scaled monthly PET for the Uravan weather station.

Table 2. Scaled Average monthly PET evaporation for the Uravan weather station

	Avg. PET (in)
January	0.8
February	1.2
March	2.2
April	3.2
May	4.6
June	5.5
July	5.9
August	5.0
September	3.7
October	2.5
November	1.2
December	0.7
Total Annual	35.8

Wind data

Table I-1-6 shows the maximum annual wind speed for various years for the Grand Junction airport and Nucla weather stations. The maximum wind speed was recorded in Grand Junction weather station at 23.4 miles per hour (mph) in the year 2007. The average wind speed for this weather station is 7.8 mph. The prevalent wind direction is ESE for Grand Junction, SE for Montrose and E for the Nucla station.

CONCLUSIONS:

A review of available climate records for nearby weather stations indicates that Uravan weather station is likely to represent conservative precipitation estimates for the Piñon Ridge site.

REFERENCES:

Western Regional Climate Center online data source: http://www.raws.dri.edu/cgi-bin/rawMAIN.pl?coCNUC

Kleinfelder (2007). "Climatological Report, Piñon Ridge Mill Site Montrose County, Colorado." Kleinfelder project no. 83088

Allen, R. G., Pereira, L. S., Raes, D., and Smith, M. (1998). "Crop evapotranspiration - Guidelines for computing crop water requirements." Irrigation and drainage paper 56, FAO, Rome.

TABLES

TABLE I-1-1. Uravan weather station data

Period of record : 11/17/1960 to 6/30/2007

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	42.7	49.9	58.7	67.6	78.6	89.4	95.4	92.2	83.5	71.4	54.7	43.4	69
Average Min. Temperature (F)	15.6	22.4	29.2	35.7	44.5	52.4	59.3	58.1	48.3	36.9	26.5	17.8	37.2
Average Total Precipitation (in.)	0.88	0.76	1.03	1.01	0.94	0.48	1.2	1.35	1.5	1.51	1.05	0.88	12.6
Average Total SnowFall (in.)	3.8	0.8	0.5	0.2	0	0	0	0	0	0.1	0.6	3.5	9.4

TABLE I-1-2. Nucla weather station data

Period of Record : 1/ 1/1999 to 12/31/2007

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	44.8	48.5	57.4	65.3	76.5	87.3	93.5	88.4	79.8	67.7	54.2	43.3	67.4
Average Min. Temperature (F)	19.7	23.2	29.6	37.1	45.3	53.7	60.6	58.0	18.6	38.3	26.9	18.6	38.4
Average Total Precipitation (in.)	0.3	0.5	0.6	0.8	0.5	0.4	0.8	1.1	1.8	1.5	0.4	0.5	9.3

TABLE I-1-3. Grand Junction weather station data

Period of Record : 1/ 1/1900 to 12/31/2007

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	36.7	44.7	55.1	65.2	75.6	86.9	92.8	89.4	80.5	67.3	51.2	38.9	65.5
Average Min. Temperature (F)	16.0	23.3	31.2	39.3	4826.0	54.2	64.1	62.0	53.0	41.1	28.3	18.7	40.4
Average Total Precipitation (in.)	0.6	0.6	0.8	0.8	0.8	0.4	0.6	1.0	1.0	0.9	0.7	0.6	8.8
Average Total SnowFall (in.)	6.1	4.0	3.2	0.9	0.1	0.0	0.0	0.0	0.0	0.4	2.5	4.9	22.0

TABLE I-1-4. Grand Junction 6ESE weather station data

Period of Record : 3/26/1962 to 6/30/2007

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	38.6	46.3	56.6	65.6	75.9	86.8	92.7	89.7	80.7	67.8	51.9	40.4	66.1
Average Min. Temperature (F)	17.5	23.9	32.3	39.5	48.4	57.2	63.5	61.3	52.4	40.8	29.2	19.7	40.5
Average Total Precipitation (in.)	0.48	0.45	0.87	0.84	0.94	0.5	0.75	0.83	0.97	0.98	0.76	0.55	8.93
Average Total SnowFall (in.)	3.4	1.8	1.6	0.3	0.1	0	0	0	0	0.3	1.4	3.5	12.3

TABLE I-1-5. Montrose weather station data

Period of Record : 1/ 1/1895 to 6/30/2007

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	38	43.9	52.9	62.4	72.4	83.1	88.6	85.7	77.9	65.7	50.3	39.3	63.3
Average Min. Temperature (F)	13.7	19.7	26.6	34	42.1	49.7	55.6	53.9	45.6	35	23.9	15.3	34.6
Average Total Precipitation (in.)	0.57	0.48	0.7	0.86	0.88	0.53	0.86	1.26	1.1	1.04	0.66	0.62	9.56
Average Total SnowFall (in.)	6.5	4.3	3.5	1.8	0.1	0	0	0	0	0.6	2.7	6.4	25.9

TABLE I-1-6. Maximum annual wind speed

	Grand Junction Airport	Nucla
year	wind speed (mph)	
1984	16.3	-
1985	18.3	-
1986	22.0	-
1987	14.8	-
1988	18.6	-
1989	17.3	-
1990	17.8	-
1991	18.1	-
1992	17.1	-
1993	17.2	-
1994	19.4	-
1995	16.8	-
1996	17.7	-
1997	18.1	-
1998	18.0	16.4
1999	17.1	18.2
2000	18.8	18.6
2001	19.7	14.6
2002	21.2	17.2
2003	19.8	16.8
2004	19.9	14.3
2005	18.0	14.0
2006	21.9	14.8
2007	23.4	15.1
Maximum W(mph)	**23.4**	**18.6**

FIGURES

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TITLE

SITE VIEW PIÑON RIDGE

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION PIÑON RIDGE PROJECT

DRAWN	EF	DATE	1/16/2008	JOB NO.	073-81694
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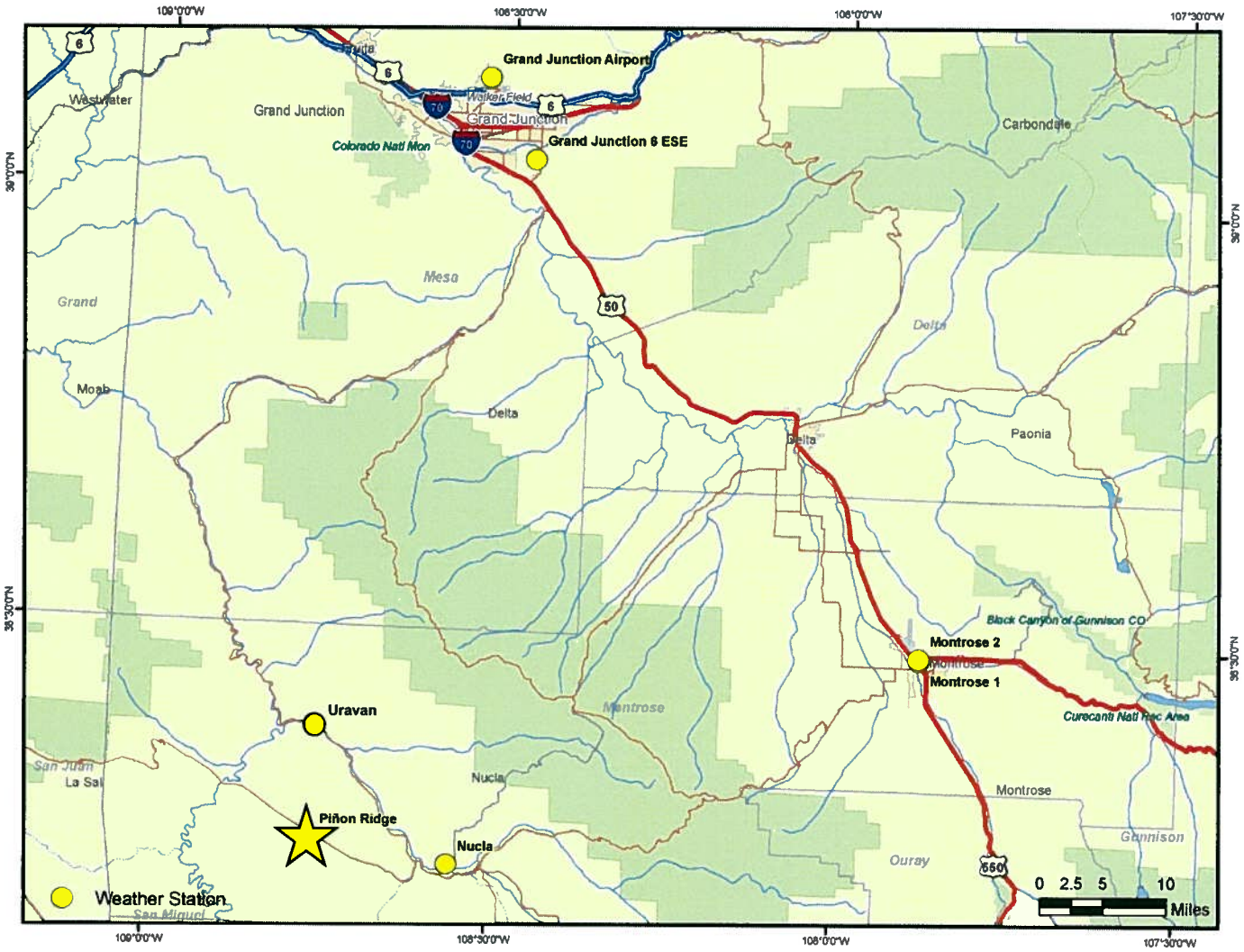

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Denver, Colorado

TITLE

WEATHER STATION LOCATIONS

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION PIÑON RIDGE PROJECT

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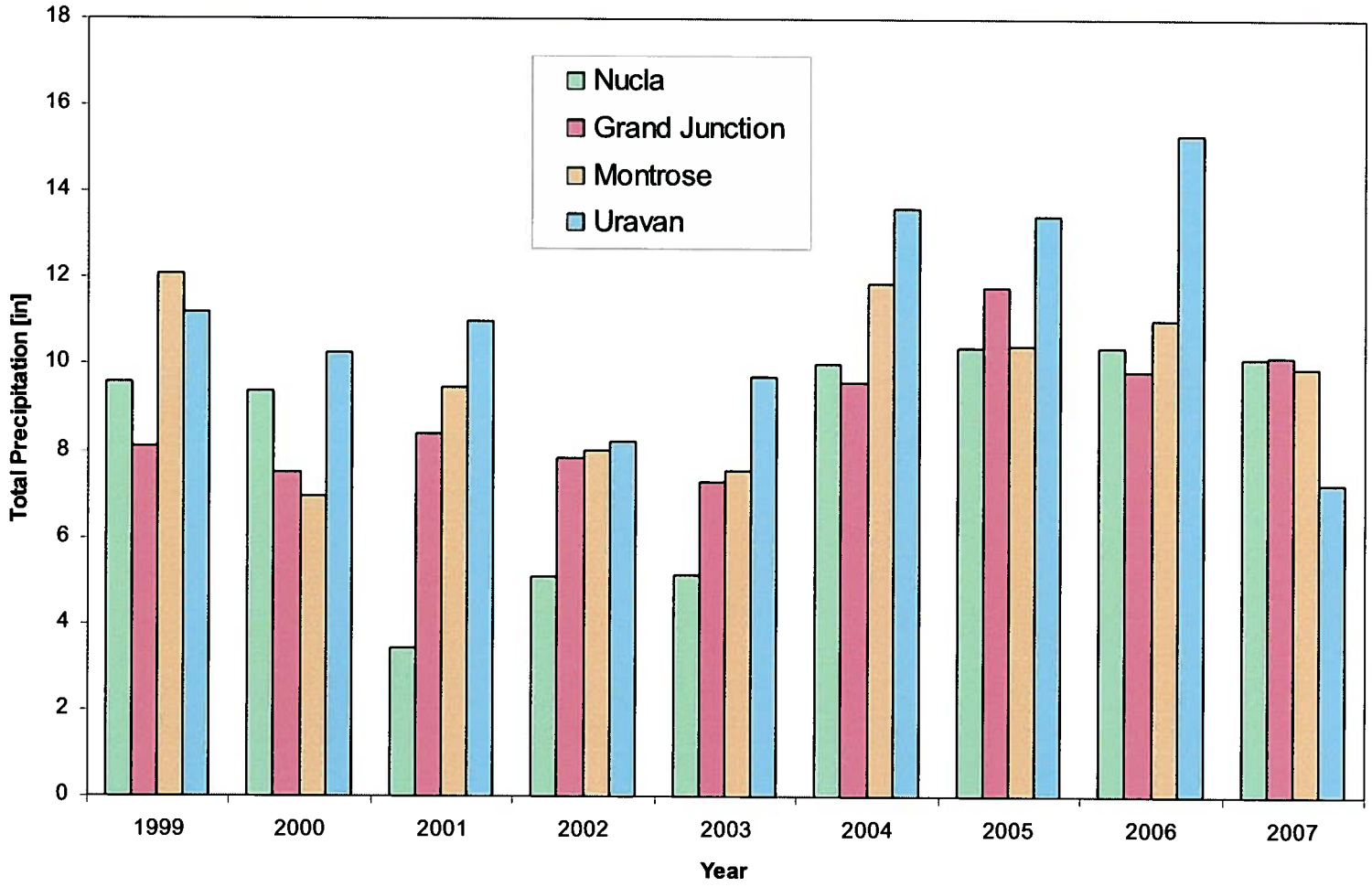

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TITLE

TOTAL ANNUAL PRECIPITATION

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION PIÑON RIDGE PROJECT

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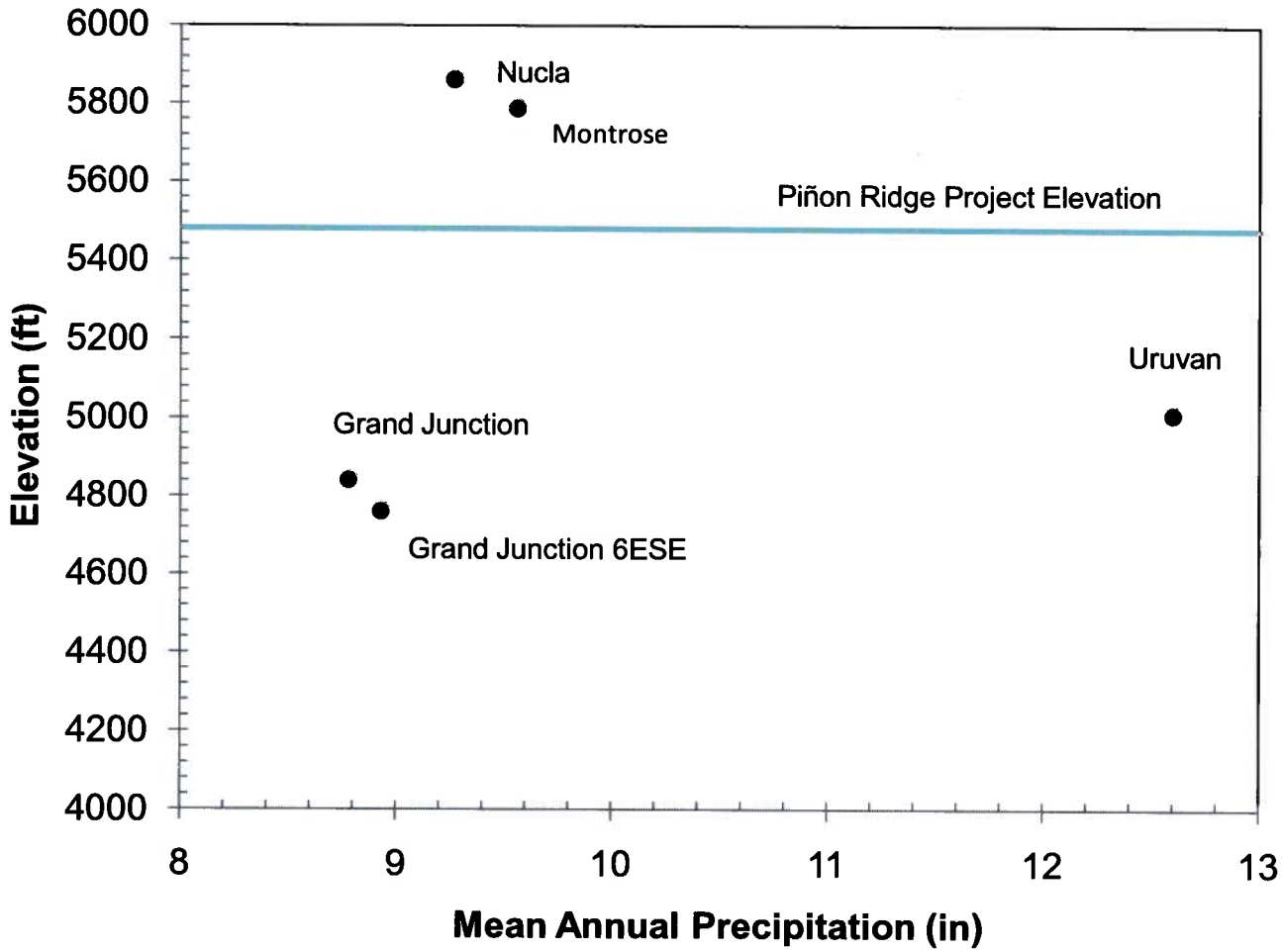

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Denver, Colorado

TITLE

VARIATION IN ANNUAL PRECIPITATION vs. ELEVATION FOR REGIONAL METEOROLOGICLA STATIONS

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION PIÑON RIDGE PROJECT

DRAWN	EF	DATE	1/16/2008	JOB NO.	073-81694
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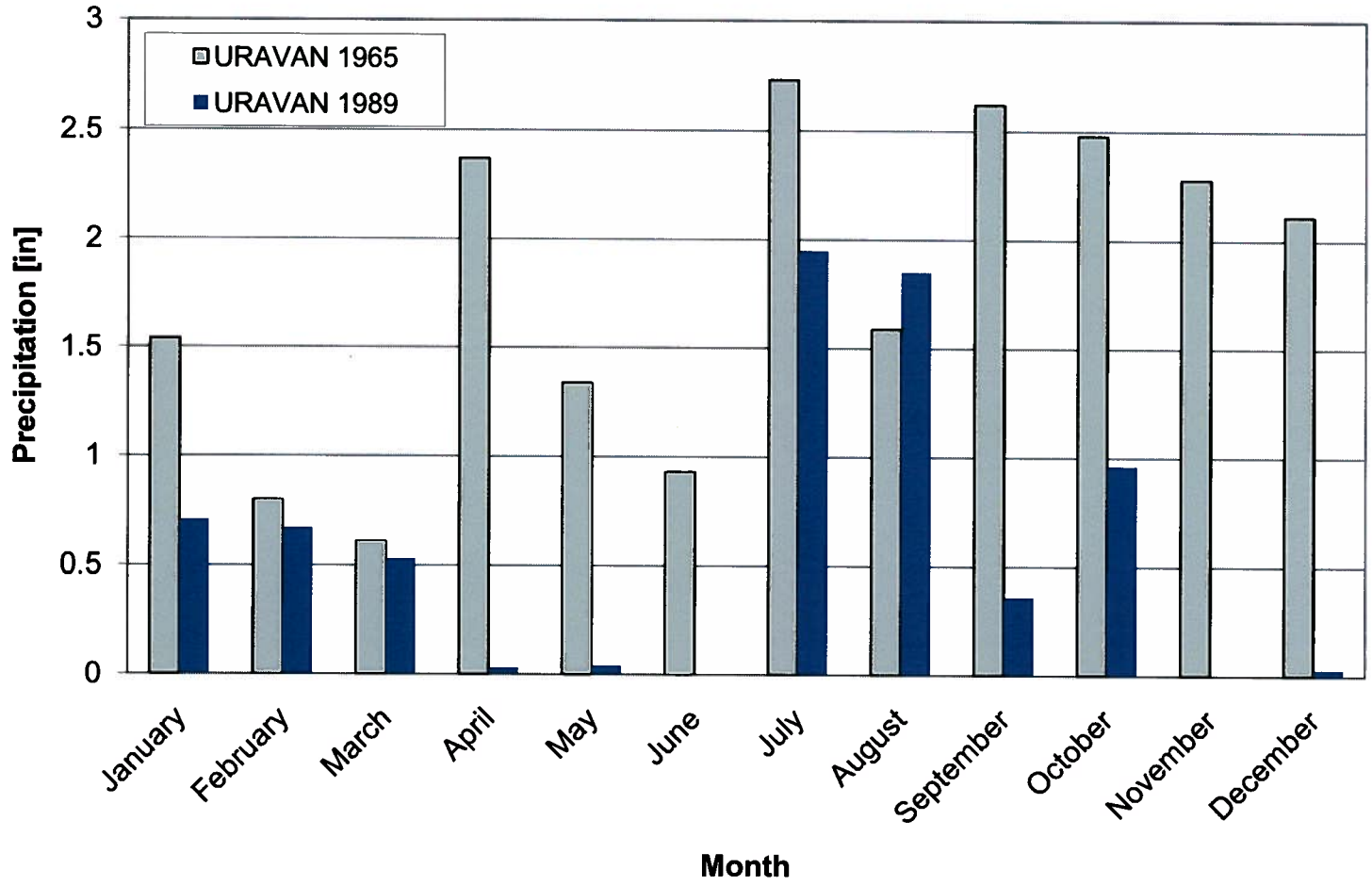

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TITLE

MONTLY PRECIPITATION FOR DRIEST AND WETTEST YEAR FOR URAVAN SITE

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION PIÑON RIDGE PROJECT

DRAWN	EF	DATE	1/16/2008	JOB NO.	073-81694
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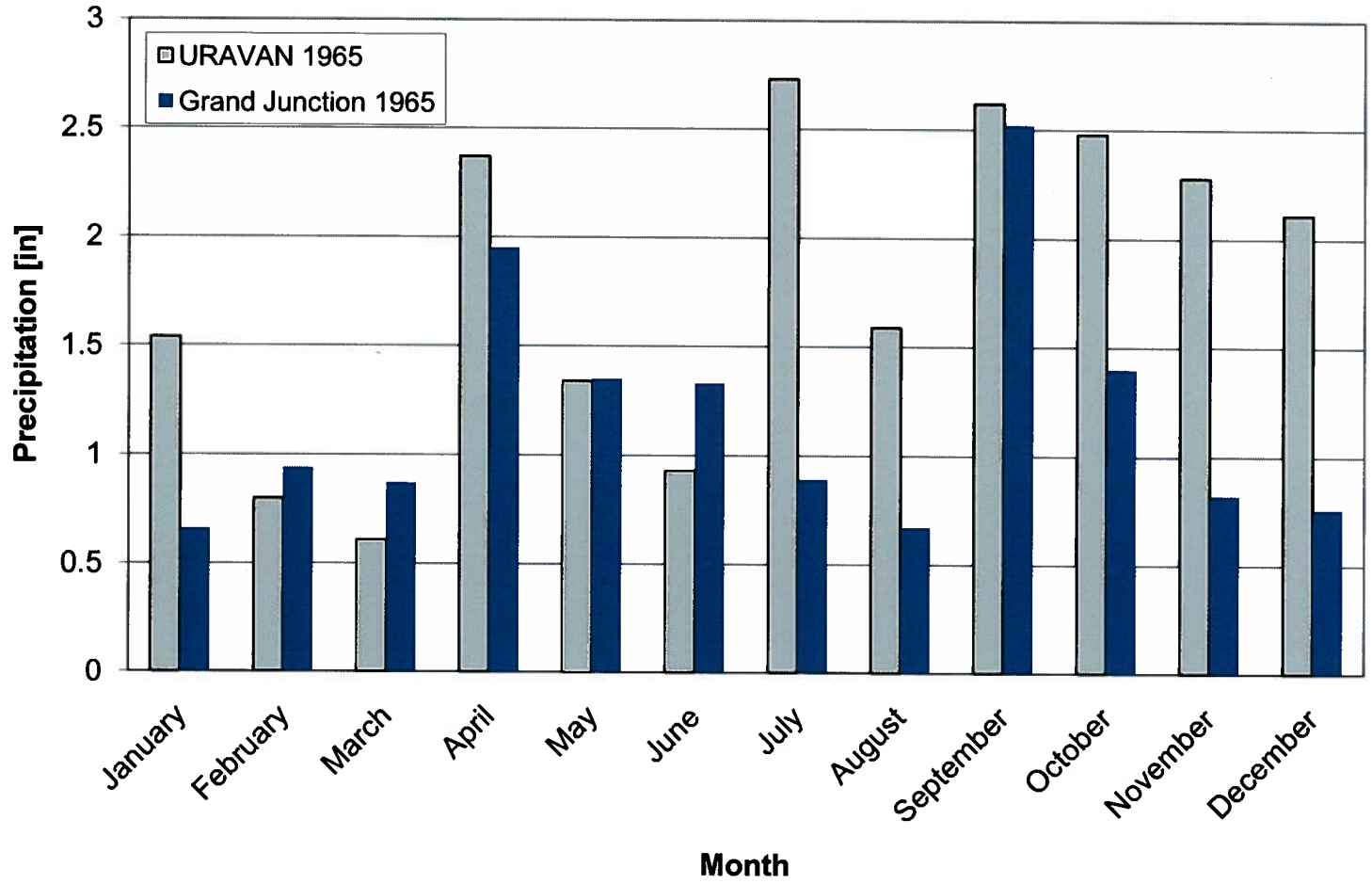

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TITLE
ANNUAL PRECIPITATION URAVAN AND GRAND JUNCTION FOR YEAR 1965

CLIENT/PROJECT
ENERGY FUELS RESOURCES CORPORATION PIÑON RIDGE PROJECT

DRAWN	EF	DATE	1/16/2008	JOB NO.	073-81694
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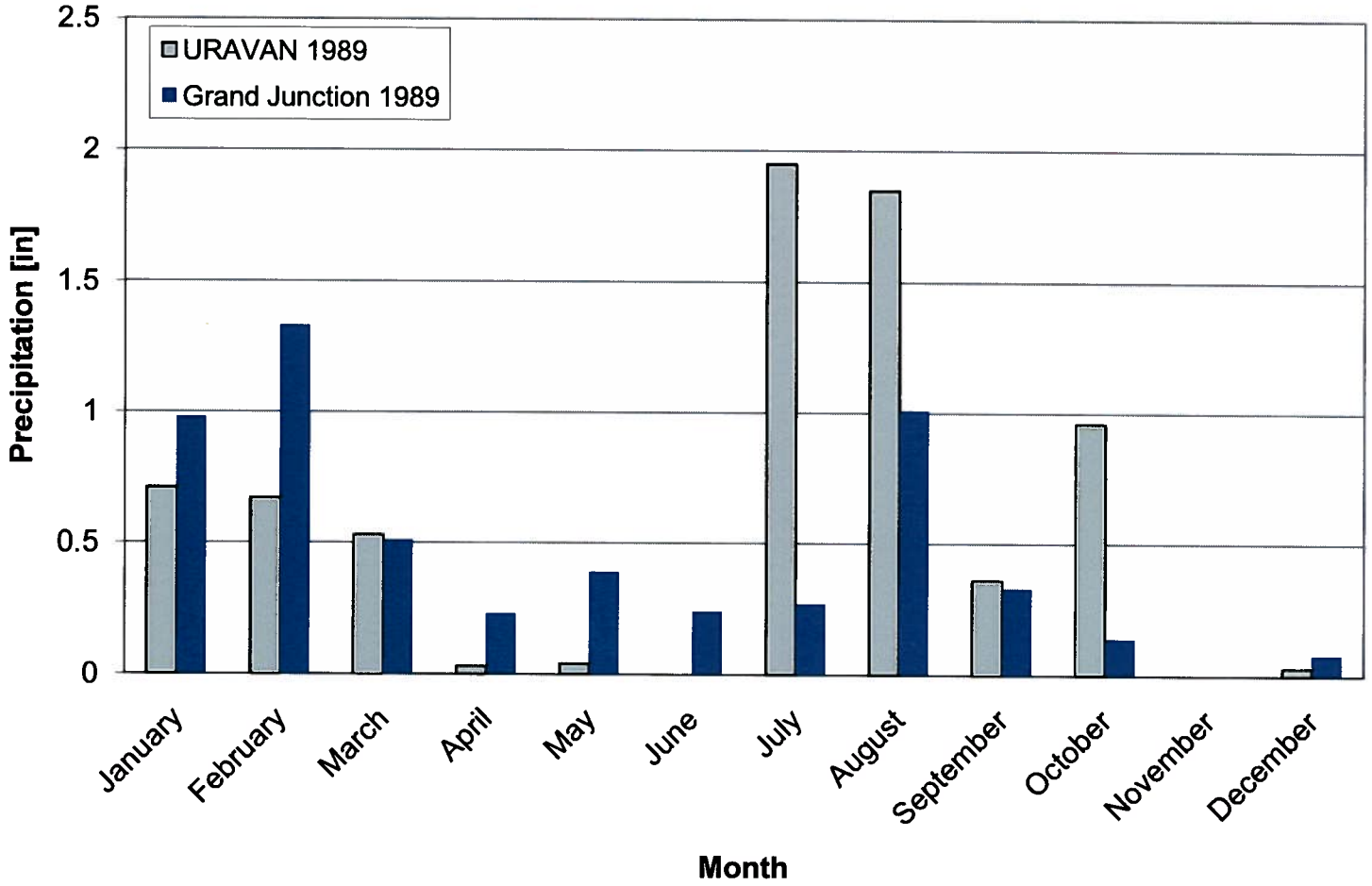
REVIEWED	KFM	FILE NO.	FIGURE.PPT	FIGURE NO.	I-1-6

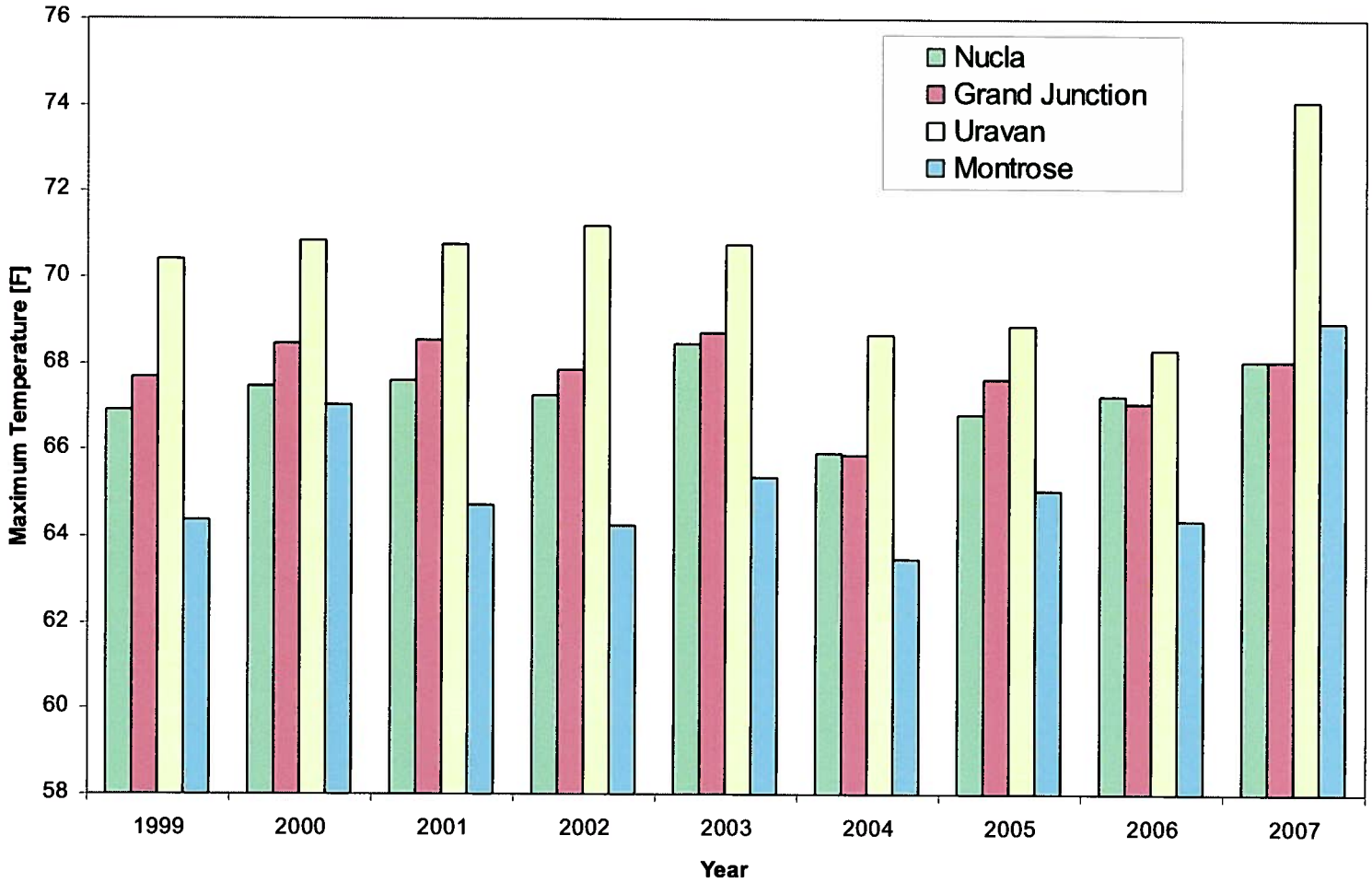


Golder Associates
Denver, Colorado

TITLE
MONTHLY MAXIMUM TEMPERATURE FOR URAVAN AND GRAND JUNCTION

CLIENT/PROJECT
ENERGY FUELS RESOURCES CORPORATION PIÑON RIDGE PROJECT

DRAWN	EF	DATE	1/16/2008	JOB NO.	073-81694
CHECKED	GG	SCALE	N.T.S	DWG. NO.	N/A
REVIEWED	KFM	FILE NO.	FIGURE.PPT	FIGURE NO.	I-1-7



Golder Associates

Denver, Colorado

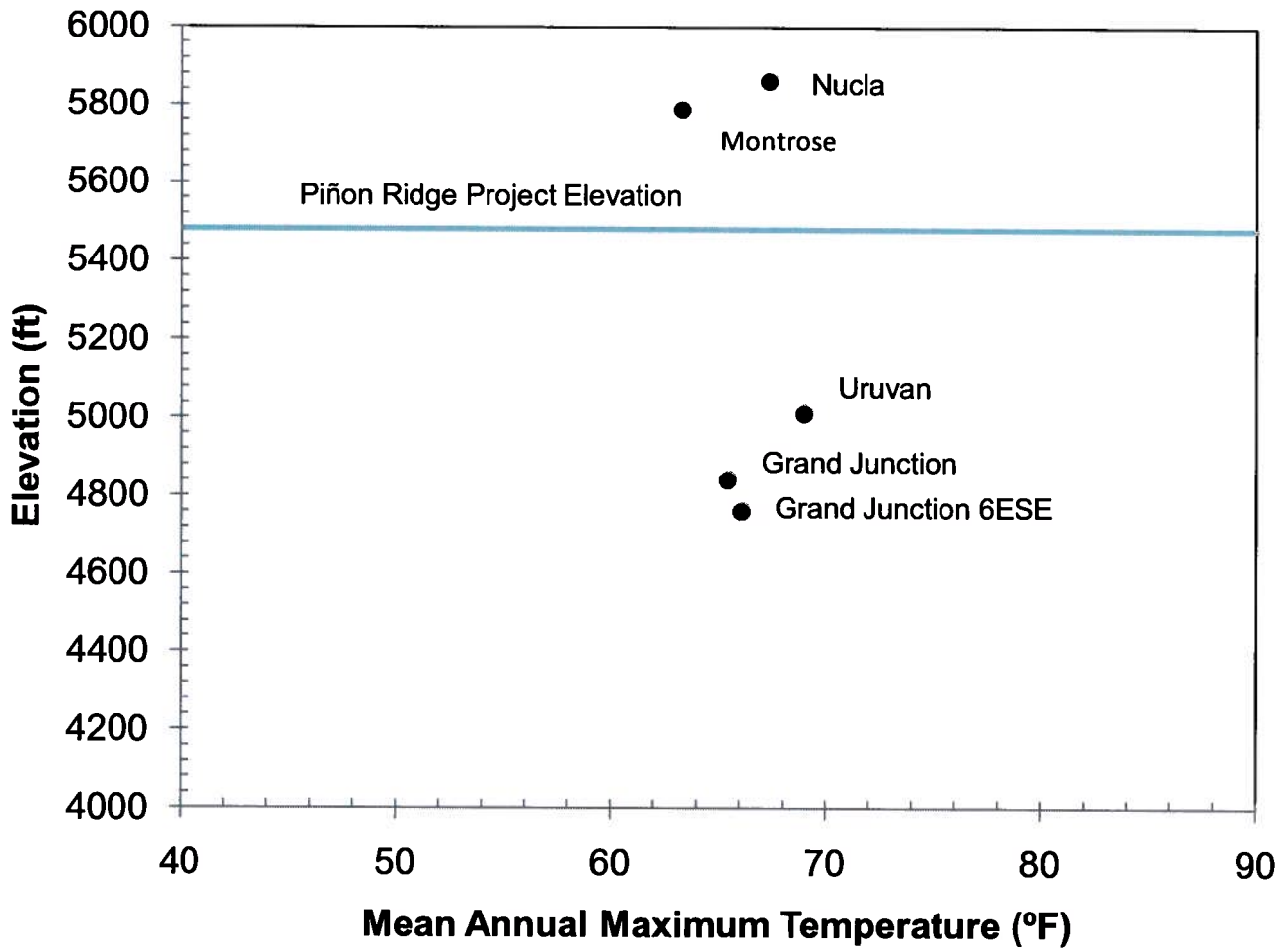
TITLE

ANNUAL MAXIMUM TEMPERATURE

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION PIÑON RIDGE PROJECT

DRAWN	EF	DATE	1/16/2008	JOB NO.	073-81694
CHECKED	GG	SCALE	N.T.S	DWG. NO.	N/A
REVIEWED	KFM	FILE NO.	FIGURE.PPT	FIGURE NO.	I-1-8



Golder Associates

Denver, Colorado

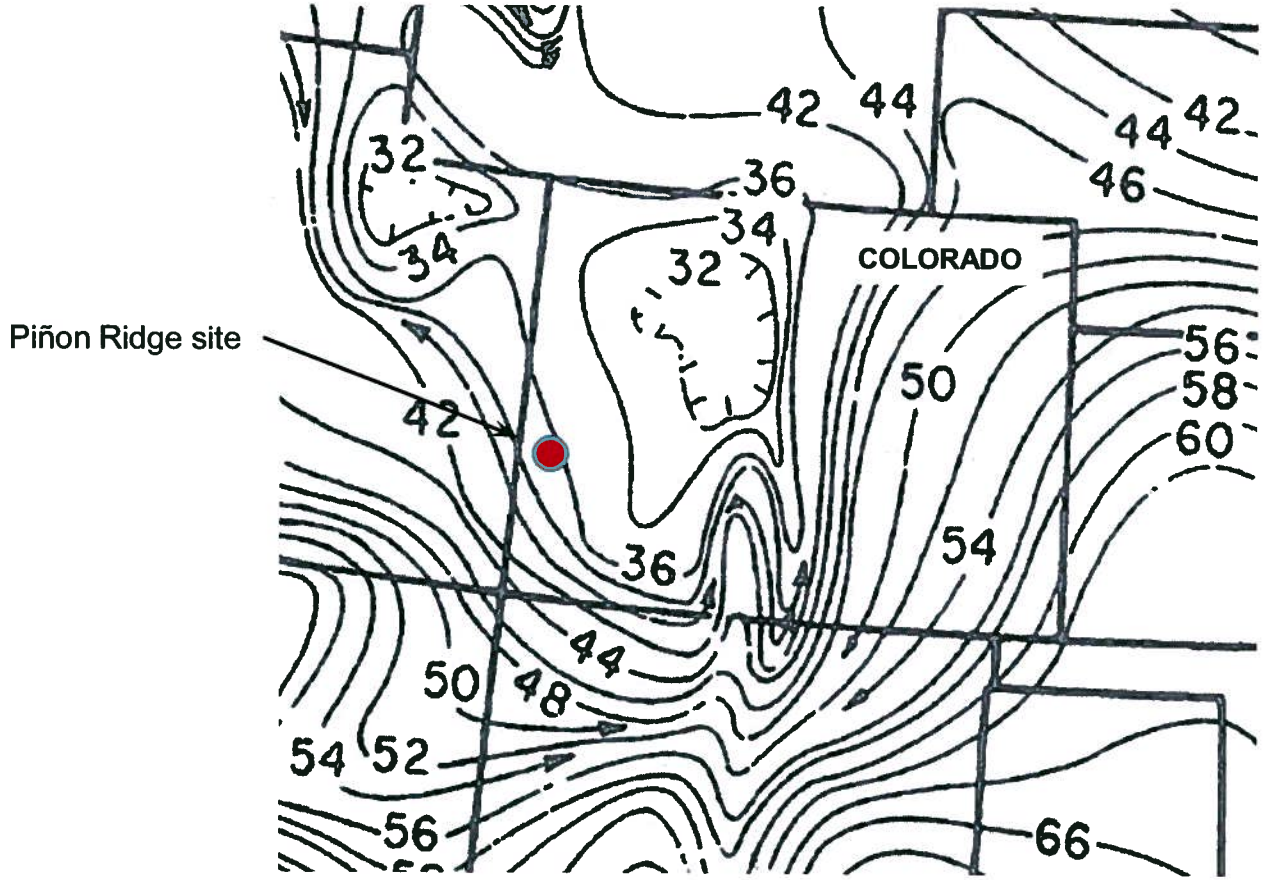
TITLE

VARIATION IN ANNUAL MAX. TEMPERATURE vs. ELEVATION FOR REGIONAL METEOROLOGICAL STATIONS

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION PIÑON RIDGE PROJECT

DRAWN	EF	DATE	1/16/2008	JOB NO.	073-81694
CHECKED	GG	SCALE	N.T.S	DWG. NO.	N/A
REVIEWED	KFM	FILE NO.	FIGURE.PPT	FIGURE NO.	I-1-9



Golder Associates

Denver, Colorado

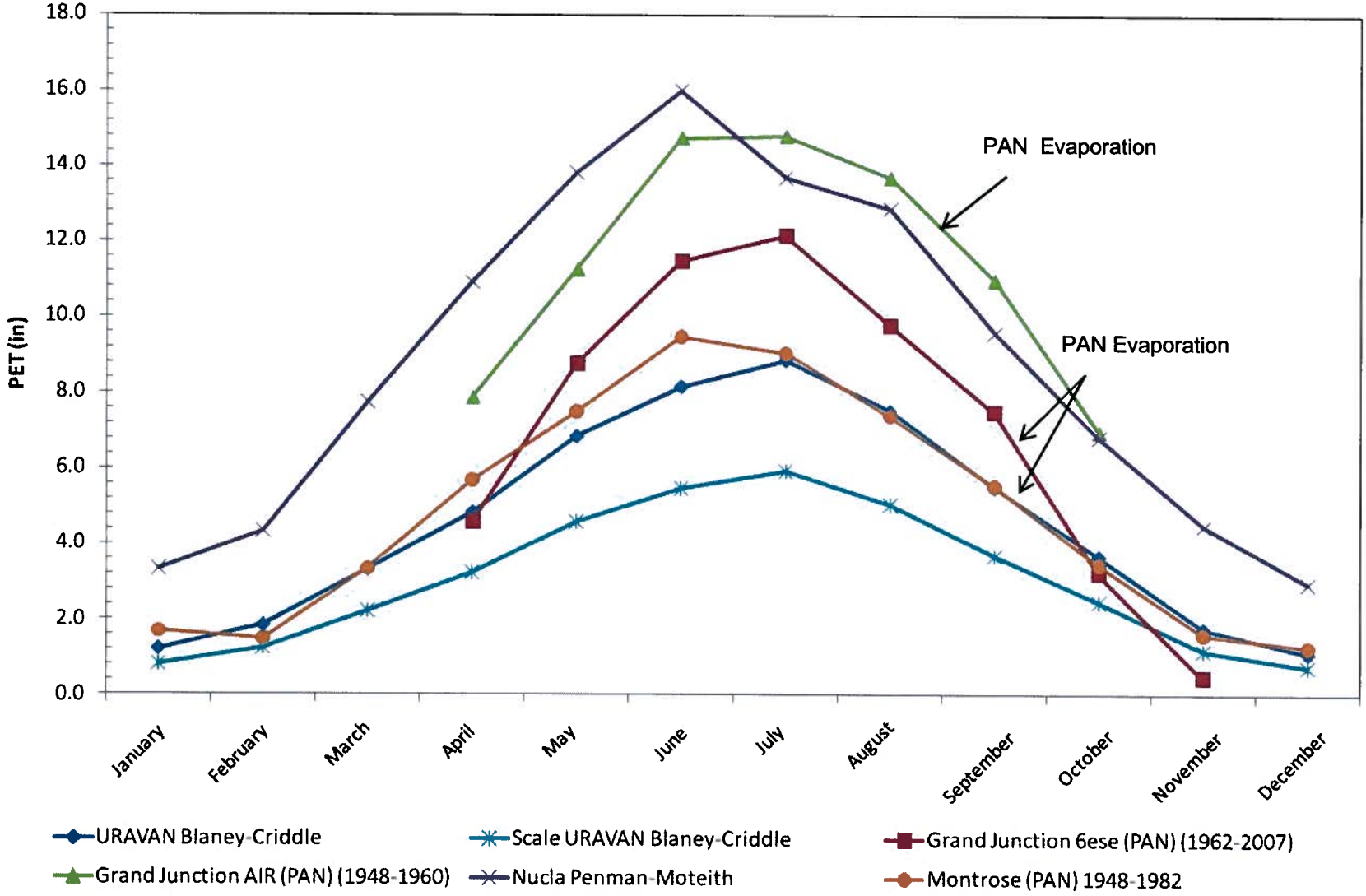
TITLE

AVERAGE ANNUAL EVAPORATION (INCHES) FROM SHALLOW LAKES

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION PIÑON RIDGE PROJECT

DRAWN	EF	DATE	1/16/2008	JOB NO.	073-81694
CHECKED	GG	SCALE	N.T.S	DWG. NO.	N/A
REVIEWED	KFM	FILE NO.	FIGURE.PPT	FIGURE NO.	I-1-10



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TITLE

MONTHLY EVAPOTRANSPITATION

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION PIÑON RIDGE PROJECT

DRAWN	EF	DATE	1/16/2008	JOB NO.	073-81694
CHECKED	GG	SCALE	N.T.S	DWG. NO.	N/A
REVIEWED	KFM	FILE NO.	FIGURE.PPT	FIGURE NO.	I-1-11