

# Site-Specific Water Management and Conservation Plan for an Exempt Mine

## Davis Quarry

[DRAFT – Until Oklahoma Water Resources Board Rules are Finalized]

### Introduction—

- Dolese Bros. Co. (Dolese) Davis Quarry has operated a limestone quarry in Murray County since the 1970's, and it has been permitted with the Oklahoma Department of Mines (ODOM) throughout this timeframe.
- The Davis Quarry consists of approximately 2,019 acres of land, owned or leased, in the immediate vicinity of our quarry.
- Considerable amounts of additional land are also owned by Dolese within the same Hydrologic Unit Code (HUC) in the Middle Washita Basin (Area #11130303), if additional water rights are ever needed.
- This quarry lies within the western lobe of the Arbuckle Simpson Aquifer (ASA).

### Monitoring Plan—

- A Monitoring Plan was developed that fully complies with all of the statutory requirements for monitoring for "exempt mines."
  - The Davis Quarry qualifies as an exempt mine because it has operated under a mining permit from the Oklahoma Department of Mines (ODOM) since the early 1970's.
- By law, the Monitoring Plan is not required to be submitted to the OWRB. However, the required monitoring as outlined in the statutes will be conducted each quarter beginning on 01 January 2013, and reports, both Quarterly and Annual, will be submitted to the OWRB as required.
- The applicable statute states, ***"The monitoring plan will provide for the measurement or reasonable estimation of groundwater and surface water volumes, separately stated, entering the pit, of the water diverted from the pit, of the disposition of the water from the pit, and of the consumptive use, as defined in this section, of the mine pit water by the mine operator."***
  - The Monitoring Plan for the Davis Quarry will fulfill all of these requirements.
  - We plan to use Attachment #3, or a slightly modified version of this form, to determine the consumptive use of pit groundwater.
  - We plan to use Attachment #4 to confirm that our consumptive use of pit groundwater is below the limits that we are allowed by law.
- Diagram #2 is a Site Map, and it identifies some of the important features of the site.
- We plan to use two (2) rain gauges at the facility to log the amount of precipitation.
  - These gauges were installed according to manufacturer's instructions, and they will be read and logged on a daily basis on every day the quarry operates.
  - If the quarry does not operate on a holiday or weekend, the cumulative amount of precipitation observed for the days the plant was closed will be entered for the period that the plant did not operate.
  - In cases when the rain gauges data cannot be properly obtained for some reason, the Sulphur, Oklahoma Mesonet precipitation data will be used instead. This quarry lies within 30 miles of this mesonet station; therefore, it qualifies as a suitable mesonet site.

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- At some time in the future, we may consider using another approved method to measure or reasonably estimate precipitation at the site.
- We plan to use the SCS Method (or other approved method) to estimate the amount of storm water runoff at the facility, specifically the amount that enters our ponds, lakes, or mine pit.
- We plan to use data from the Sulphur Mesonet site to estimate evaporation at the facility.
  - This quarry lies within 30 miles of this Mesonet station; therefore, it qualifies as a suitable Mesonet site.
    - At some time in the future, we may consider using another approved method to measure or reasonably estimate evaporation at the site.
- We plan to use generally accepted engineering formulas for calculating moisture content to estimate the material moisture content of any products that are sold.
  - We will then use the estimated moisture contents and the material sales tonnages to determine the amount of water that exited the facility.
- We used the “mass balance equation” similar to the one shown in the draft rules to calculate the amount of water recharged into the fresh water lake (at groundwater recharge point #1).
  - The equation that we used was modified to show the change in height of the lake’s water level as  $h_1-h_2$ , rather than  $h_2-h_1$  as shown in the draft rules. We think that the equation used in the draft rules is in error.
- Other than the captured storm water runoff and the groundwater sources already discussed in this Plan, we have no other sources of water that are used as a water supply at this facility.

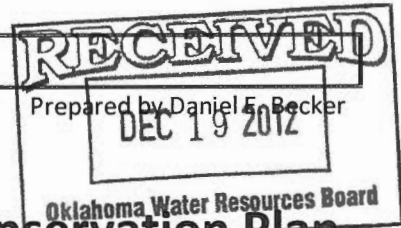
**Plan for Augmentation of Stream Water and Groundwater—**

- The Davis Quarry personnel understand that stream water augmentation and groundwater recharge within the ASA are both beneficial activities that can benefit the local communities if these activities are well planned.
  - While it is unlikely that the Davis Quarry will need any credits to offset the consumptive use of groundwater, Dolese has decided to nonetheless submit this Site-Specific Water Management and Conservation Plan for Exempt Mines to show our dedication to water management and conservation efforts that will help to benefit the region. If at some time we require credits to offset a consumptive use that exceeded the EPS, then we will use credits from our stream augmentation and groundwater recharge outlined in this Plan to offset the amounts that were excessively used.
  - We have analyzed Davis Quarry’s operations with respect to water needs, while also considering the water needs of our neighbors in the region when preparing this Plan for Augmentation of Stream Water and Ground Water.
    - Our Augmentation will benefit Dolese and those within this region.
    - Below is an explanation of how we plan to manage water at our site.
  - Davis Quarry uses water in its operations, but the water is used in a responsible manner.
  - We have designed and improved the site in ways that conserve, minimize, and recycle water in a very efficient manner, as outlined in Diagram #1 of the Appendix.
  - Most importantly, the site minimizes its “consumptive use” of water at every opportunity.

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- The required monitoring data that we will include in the Quarterly and Annual Reports will document and confirm the high-efficiency of water management at this facility.
- All excess water from the mine pit will be pumped to the “fresh water lake,” as shown in Diagram #1.
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  - The pumped excess water will be stored in the fresh water lake until it is either:
    - (1) Used by the Davis Quarry operations, or
    - (2) Until it is used to recharge the groundwater in the aquifer, or
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  - One reason includes the fact that this lake has been determined to be a “recharging pond” that beneficially recharges the Arbuckle Simpson Aquifer (ASA). Most of the water that enters this fresh water lake is comprised of storm water runoff that has been captured in our mine pit and pumped to the fresh water lake so that it can be detained on site to allow a continual recharge of the aquifer.
  - Maintaining near-full water conditions in our lake also allows us to have an adequate supply of water to operate our facility, which is highly dependent upon these waters.
  - And, our last reason for keeping this lake nearly full is to allow us to have sufficient water storage available to pump to downstream users in times of need, in the form of stream augmentation.
- Stream augmentation or offsite discharge typically occurs at this facility under two (2) circumstances.
  - (1) When heavy and/or prolonged rains occur at the facility, such that retention of storm water is no longer a feasible option because the recharge pond(s) would be full, the mine pit would be full, and we would have no additional storage capacity available at the site.
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- During the second circumstance mentioned above, it is also important to mention that during June 2010, we met with our three (3) immediate down-stream neighbors residing below Stream Augmentation Point #1 and informed them that Dolese is willing to pump water into the tributaries of Red Branch Creek during periods of drought, if water is available and allowable by law.
  - They were pleased to hear that we were willing to help them sustain their cattle operations.
- During either of the two (2) circumstances outlined above, we would pump water from the fresh water lake toward Stream Augmentation Point #1. The water discharged from the fresh water lake would enter an onsite channel that flows to our Oklahoma Department of Environmental Quality (ODEQ) Flow-through Impoundment #02, and then to ODEQ Process Water Outfall #001.
  - The volume of this water being discharged will be estimated using engineering calculations and these volumes will be listed in our Quarterly and Annual Reports.
- Water discharged offsite that exits the property at Stream Augmentation Point #1 enters an unnamed tributary before entering Red Branch Creek, then to Colbert Creek, and eventually entering the Washita River.
  - The attached topographic map, Diagram #4 in the Appendix, shows the water path from Stream Augmentation Point #1 to the Washita River.
  - It was mentioned earlier in this Section that the fresh water lake was determined to be a “recharging” lake. An analysis was performed on this lake to confirm that the recharge amount exceeds evaporation, as outlined in Attachment #1 & 2 of the Appendix.
    - Based on these findings, the fresh water lake is now considered Groundwater Recharge Point #1, as identified on Diagram #1 & 2 of the Appendix.
      - If additional recharge basins are added to the site as the mine continues operation, these recharge ponds will be added to the appropriate Diagrams, and additional Attachments will be added to show the rate of recharge and the mass balance of the pond(s).
      - If additional stream augmentation points are added in the future, they will also be shown on the appropriate Diagrams.
- Tentatively, the StreamStats program will be performed on the stream receiving discharge to determine which of the mine site’s discharges may qualify for augmentation credits based on stream flow conditions at the time of discharge.
  - There are no stream gauges that we are aware of on this stream network.
- It was agreed that full credit would be received for the entire amount of water recharged into a groundwater recharge basin during the year.

**Classification of Water in the Mine Pit—**

- It is important to address the classification of water in the mine pit. While some of the mining operations within the central region may have confirmed that they are mining within the waters of the ASA; the Davis Quarry, located in the western region, has not confirmed this fact.



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- To date, the depth of the deepest mining excavation at the Davis Quarry facility is slightly below the lowest elevation found at the entire site.
  - See Diagram #3 for a cross-sectional drawing of the three (3) primary bodies of water at the site.
- As mentioned earlier, pumps are used to dewater the mine pit when there is excess water after a storm event.
  - However, plant personnel have turned off these pumps for days at a time, and sometimes for nearly two (2) weeks at a time during the last year or so. If we were truly mining within the waters of the ASA, it would not seem possible to discontinue the dewatering of the mine pit for these extended periods of time without encountering seepage.
- In an attempt to gain some additional insight as to the classification of the water(s) in our mine pit, we referenced the Oklahoma Geological Survey’s Circular 91 showing the Potentiometric Map of the Arbuckle Mountains.
  - Unfortunately, very little data was available in the region near our quarry. The study seemed to focus on the region lying east and south of Sulphur, Oklahoma.
  - Please see Diagram #5, Oklahoma Geological Survey, Circular 91, titled the Potentiometric Map of the Arbuckle Mountains.
- As information and data become available, we will try to distinguish between ground water and storm water so that we can make more informed decisions on this topic in the future.

**Water Rights Information—**

- A Limited Quantity Groundwater Permit for 10 acre-feet per year is pending for two (2) small side-by-side water wells located southwest of office/scale house.
  - Maximum pumping rate = 16 gallons per minute per well.

**Appendix—**

- Attachment #1—Recharge and Evaporation Rates of Fresh Water Lake
- Attachment #2—Mass Balance of Fresh Water Lake
- Attachment #3—Table 1, Guidelines to Estimate Consumptive Use of Pit Water
- Attachment #4—Determination of Maximum Groundwater Use Allowable

- Diagram #1—Water Flow Diagram
- Diagram #2—Site Map
- Diagram #3—Cross-Section of Water Bodies near Mine Pit
- Diagram #4—Topographic Map showing Stream Water Path
- Diagram #5—Oklahoma Geological Survey, Circular 91, Potentiometric Map of the Arbuckle Mountains

###



**ATTACHMENT #1  
RECHARGE AND EVAPORATION RATES  
OF FRESH WATER LAKE**

Davis Quarry  
Water Monitoring Plan  
20 November 2012  
Daniel E. Becker

**Recharge and Evaporation Rates of Fresh Water Lake**

**Personnel performing lake readings:**

*Daniel E. Becker, P.E., and Arthur Faulkner, Quarry Superintendent*

**Lake Measurements:**

- A staff gauge was used to determine the rate of drop in the fresh water lake during a 62.5 hour timeframe. The measurements on the gauge could be read to the nearest 1/16 of an inch.
- The monitoring period began on 16 November 2012 at 3:30 PM, and ended on 19 November 2012 at 6:00 AM.
- No Inflows or Outflows were observed from the fresh water lake during the monitoring period, and the conditions were calm while gauge readings were taken.
- We measured a drop in water elevation of 7/16" (equating to 0.4375").

*Mesonet.org shows the Daily Pan Evaporation (in.) for the Sulphur, OK location. These figures can be converted to Lake Evaporation using a multiplication factor of 0.7.*

**Calculation of Pan Evaporation at Sulphur, Oklahoma Mesonet Site**

- 16 November 2012 indicates a pan evaporation of 0.08 inches for the day. Since 8.5 hours of the day remained, this equates to 0.3542 days, or 0.0283 inches of evaporation.
- 17 November 2012 indicates a pan evaporation of 0.11 inches for the day.
- 18 November 2012 indicates a pan evaporation of 0.18 inches for the day.
- 19 November 2012 indicates a pan evaporation of 0.14 for the day. Since 6 hours of the day had elapsed, this equates to 0.25 days, or 0.035 inches of evaporation.

**Calculation of Lake Evaporation at Sulphur, Oklahoma Mesonet Site**

- 16 November 2012: (0.0283 inches of pan evaporation reduced for partial day)(0.7) = 0.0198 inches of lake evaporation for 8.5 hours of the day.
- 17 November 2012: (0.11 inches of pan evaporation)(0.7) = 0.077 inches of lake evaporation
- 18 November 2012: (0.18 inches of pan evaporation)(0.7) = 0.126 inches of lake evaporation
- 19 November 2012: (0.035 inches of pan evaporation reduced for partial day)(0.7) = 0.0245 inches of lake evaporation

**TOTAL LAKE EVAPORATION = 0.0198" + 0.077" + 0.126" + 0.0245 = 0.2473 inches of lake evaporation for the 62.5 hour testing period.**

**Conclusions:**

The 23.02-acre Fresh Water Lake dropped 0.4375" during the 62.5 hour testing period; whereas, the evaporation for the same period was only 0.2473". These measurements show

that this lake actually recharges the aquifer, as opposed to groundwater entering this impoundment.

By rule, specifically 785:30-15-5 Augmentation, if the recharge from a groundwater augmentation basin exceeds evaporation, then no accounting for evaporation or vegetative losses will be required.



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Evapotranspiration

- [Short Crop \(Etos\) ET Map](#)
- [Tall Crop \(Etrs\) ET Map](#)
- [Seasonal Single Site ET Table](#)
- [Statewide Single Day ET Table](#)

Seasonal Single Site ET Table

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Date	Reference ET, Short [in]	Reference ET, Tall [in]	Cool Season Grass ET [in]	Warm Season Grass ET [in]	Pan Evaporation [in]
2012-11-19	0.11	0.16	0.10	0.07	0.14
2012-11-18	0.13	0.20	0.12	0.08	0.18
2012-11-17	0.09	0.13	0.08	0.05	0.11
2012-11-16	0.06	0.09	0.06	0.04	0.08
2012-11-15	0.08	0.12	0.07	0.05	0.10
2012-11-14	0.08	0.11	0.07	0.05	0.10
2012-11-13	0.06	0.09	0.06	0.04	0.08
2012-11-12	0.05	0.07	0.05	0.03	0.07
2012-11-11	0.07	0.11	0.07	0.05	0.10
2012-11-10	0.17	0.26	0.15	0.10	0.25
2012-11-09	0.15	0.23	0.14	0.09	0.22
2012-11-08	0.19	0.30	0.18	0.12	0.28
2012-11-07	0.09	0.13	0.08	0.06	0.12
2012-11-06	0.08	0.12	0.08	0.05	0.10
2012-11-05	0.12	0.19	0.12	0.08	0.16
2012-11-04	0.09	0.13	0.09	0.06	0.12
2012-11-03	0.12	0.17	0.11	0.07	0.16
2012-11-02	0.16	0.23	0.14	0.10	0.21



120 David L. Boren Blvd., Suite 2900  
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 fax, 405 325.2550

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**ATTACHMENT #2  
MASS BALANCE OF FRESH WATER  
LAKE**

Davis Quarry  
Water Monitoring Plan  
28 November 2012  
Daniel E. Becker

I reversed these two variables.

**Mass Balance of Fresh Water Lake**

According to 785:30-15-5(b)(4), the amount of water recharged to the aquifer from a groundwater augmentation basin shall be calculated on a mass balance basis. The applicable equation is:

$$GW_a = B_a [(h_1 - h_2) - (E)(0.7)] + (I - O)$$

Where:

$GW_a$  is the volume of water exiting the bottom and sides of the augmentation basin;

$B_a$  is the surface area of the augmentation basin (assumes vertical sides);

$h_1$  is the elevation of the water level in the basin at the beginning of the applicable time period determined using the installed staff gage;

$h_2$  is the elevation of the water level in the basin at the end of the applicable time period;

0.7 is the lake evaporation coefficient applied to pan evaporation;

E is the calculated pan evaporation rate determined at the nearest Mesonet station determined as the sum of daily values for the applicable time period;

I is the total inflow volume of water to the basin from all sources (including rainfall) for the applicable time period (it may be zero (0)) determined by measurement or reasonable estimation; and

O is the total outflow volume of water from the basin by all pathways except evaporation for the applicable time period (it may be zero (0)) determined by measurement or reasonable estimation.

**Entering the applicable data from the Davis Quarry into the above formula yields the following volume of water exiting the bottom and sides:**

$$GW_a = B_a [(h_1 - h_2) - (E)(0.7)] + (I - O)$$

$$GW_a = 23.02 \text{ acres} [(12.00 \text{ inches} - 11.5625 \text{ inches}) - (0.3533 \text{ inches})(0.7)] + (0 - 0)$$

$$GW_a = 23.02 \text{ acres} [(0.4375 \text{ inches}/62.5 \text{ hours})(1 \text{ foot}/12 \text{ inches}) - (0.2473 \text{ inches}/62.5 \text{ hours})(1 \text{ foot}/12 \text{ inches})] - (0)$$

$$GW_a = 23.02 \text{ acres} [0.0006 \text{ ft./hr.} - 0.0003 \text{ ft./hr.}]$$

$$GW_a = 23.02 \text{ acres} [(0.0003 \text{ ft./hr.})(24 \text{ hours}/1 \text{ day})$$

$$GW_a = 0.14 \text{ acre-feet/day}(365 \text{ days/year})$$

**$GW_a = 51.14 \text{ acre-feet/year}$**

**- DRAFT -**

**Table 1. Guidelines to Estimate Consumptive Use of Pit Water**

<b>PIT GROUNDWATER VOLUME</b>	
1	Total volume of water pumped from the producing mine pit(s)
2	Volume of precipitation that falls onto the surface of water in the producing mining pit(s)
3	Portion of total precipitation that flows over the land surface that drains into the mine pit water
4	Other non-pit waters pumped from the producing mine pit
5	Add lines 2 through 4
6	<b>Pit Groundwater Volume</b> Line 1 minus Line 5
<b>DEFINED ELEMENTS OF CONSUMPTIVE USE</b>	
7	Volume of pit groundwater that is driven off (by drying) the mined material transported off the mine site
8	Volume of pit groundwater that is carried away with the mined material transported off the mining site (shipped)
9	Volume of pit groundwater that evaporates from the producing mine pit, process water ponds, and lined ponds (Excluding structures used for augmentation)
10	Volume of pit groundwater that is used for other beneficial uses off the mine site
11	<b>Defined Elements of Consumptive Use of Pit Groundwater</b> Add Lines 7 through 10
<b>PIT GROUNDWATER BALANCE</b>	
12	Line 6 minus Line 11
13	<b>Groundwater Augmentation</b> Volume of pit groundwater returned to the groundwater basin or subbasin
14	<b>Stream Augmentation</b> Volume of pit groundwater discharged to a definite stream, during flow conditions that are less than or equal to 50% exceedance or median historic flows
15	<b>Precipitation &amp; Run-off</b> Volume of precipitation and surface run-off into a recharge pit or holding pond used for augmentation
16	<b>Additional Discharge</b> Volume of pit groundwater discharged to a definite stream, not meeting stream augmentation credit criteria
17	<b>Recycled Pit Groundwater</b> Volume of pit groundwater returned to a mine pit or holding basin (not included on lines 7 through 10)
18	<b>Other Non-Consumptive Losses</b> Including pit groundwater returned to the land surface from which surface runoff flows into a mine pit, and other losses (not included in lines 7 through 10)
19	Add lines 13 through 18
20	<b>Other Consumptive Use (adjusted)</b> Line 12 minus Line 19
<b>TOTAL REPORTED CONSUMPTIVE USE OF PIT</b>	
21	<b>Total Net Reported Consumptive Use</b> Line 11 plus Line 20

**ATTACHMENT #4  
DETERMINATION OF MAXIMUM  
GROUNDWATER USE ALLOWABLE**

**Davis Quarry**  
**Water Monitoring Plan**  
27 November 2012  
Daniel E. Becker

**Determination of Maximum Groundwater Use Allowable**

The maximum amount of groundwater allowed to be consumptively used at the Dolese Bros. Co. Davis Quarry is based on the acreage of land owned or leased within the Hydrologic Unit Code (HUC). Dolese Bros. Co. owns and leases land at or near the property known as the Dolese Bros. Co. Davis Quarry, and some additional land is owned just east of Dougherty, Oklahoma. All of these above-described lands are located in the same HUC.

**Acreage of Land Owned or Leased by Dolese Bros. Co. at Davis Quarry**

*All land near Davis Quarry is located in the Middle Washita Watershed (HUC 11130303)*

- Dolese owns or leases land in the immediate vicinity of the Davis Quarry totaling approximately 2,019 acres.
- The land at Davis Quarry is located in parts of Sections 5, 6, 8, 9, 16 & 17; Township 1 South, Range 1 East, Murray County, Oklahoma.
- The Equal Proportionate Share (EPS) of the Maximum Annual Yield (MAY) for this portion of the aquifer is [REDACTED] acre-feet per acre per year.

**Acreage of Additional Land Owned or Leased by Dolese Bros. Co. at Future Enterprises**

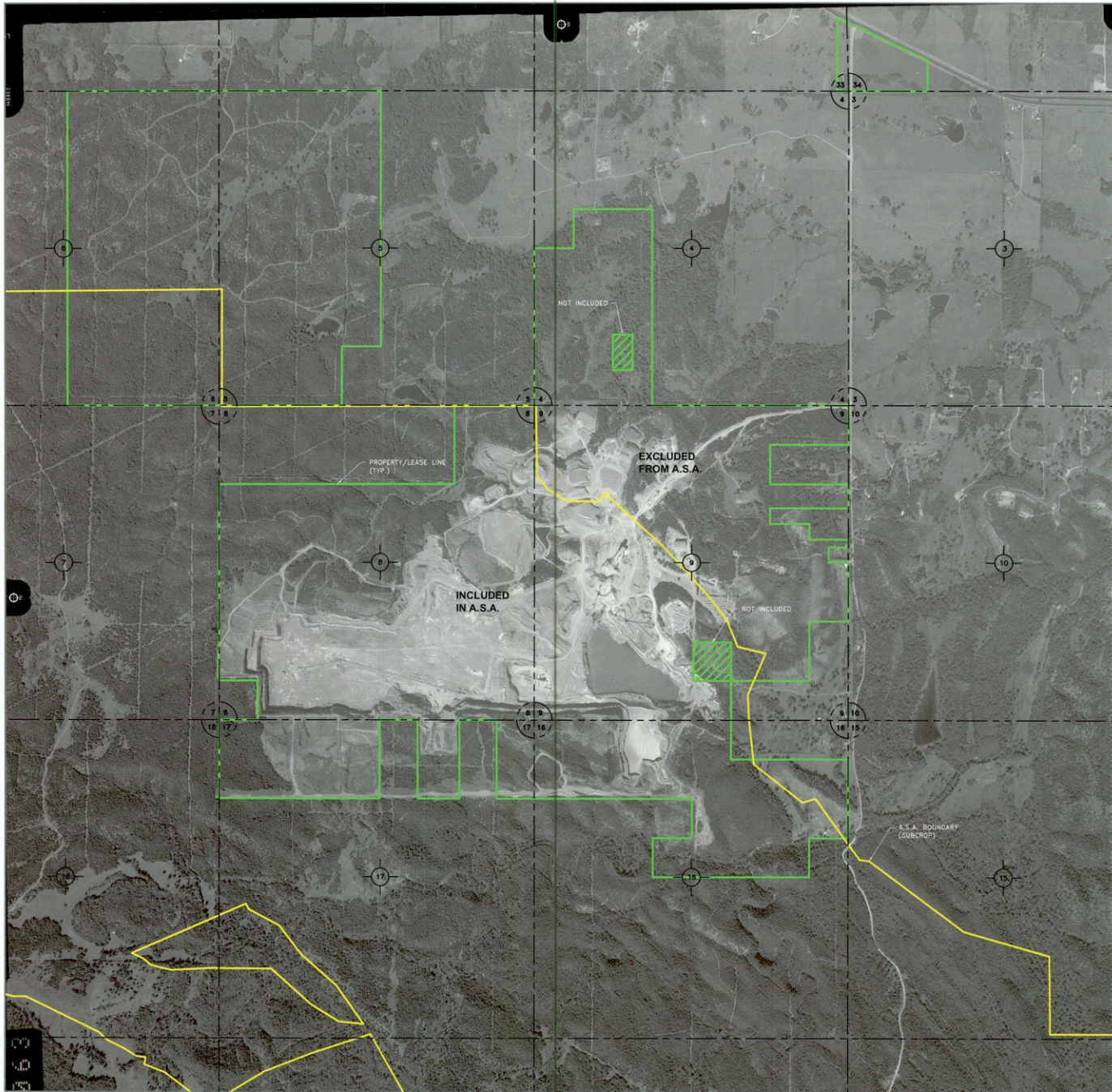
*All land at Future Enterprises is also located in the Middle Washita Watershed (HUC 11130303)*

- Dolese owns land at Future Enterprises totaling at least 1,500 acres.
- The land at Future Enterprises is located in parts of Sections 5, 6, 7, 8, 17 & 18, Township 2 South, Range 3 East, Murray County, Oklahoma.
- The Equal Proportionate Share (EPS) of the Maximum Annual Yield (MAY) for this portion of the aquifer is [REDACTED] acre-feet per acre per year.

**Conclusion:**

The combination of the two lands described above will total at least 3,519 acres. The EPS for this region was determined to be [REDACTED] acre-feet of groundwater per acre per year.

In conclusion, the Dolese Bros. Co. Davis Quarry is entitled to consumptively use up to [REDACTED] acre-feet of groundwater per year.



ACREAGE	
INCLUDED IN A.S.A.	1083
EXCLUDED FROM A.S.A.	937
TOTAL	2020

A.S.A. = ARBUCKLE-SIMPSON AQUIFER

- NOTES:
1. ALL LINES AS SHOWN ARE APPROXIMATE
  2. PROPERTY OWNED OR LEASED BY DOLESE, BROS. CO.
  3. ACREAGE IS APPROXIMATE

LEGEND:  
 PROPERTY/LEASE LINE ———  
 SECTION LINE - - - - -  
 A.S.A. BOUNDARY ———

**DOLESE BROS. CO.**

DAVIS QUARRY  
 LOCATION OF A.S.A. BOUNDARY  
 SUBCROP

AERIAL FLOWN OCT 2011

DESIGNED	DATE	SCALE: 1"=600'
DESIGN CHECKED	DATE	PROJECT NO.
DRAWN	DATE 27JUN13	SHEET 1 of 1
CHECKED	DATE	DRAWING NO. 107-1-286

REVISIONS BY DATE  
 RELEASE NO.