ENVIRO CLEAN CARDINAL

September 21, 2018

Hillary Young
Chief Engineer
Land Protection Division
Oklahoma Department of Environmental Quality
P.O. Box 1677
Oklahoma City, OK 73162

Re: Solid Waste Tier II Permit Application
Existing Coal Combustion Residual (CCR) Surface Impoundment
Western Farmers Electric Cooperative – Hugo Power Station, Fort Towson, Oklahoma

Dear Ms. Young:

Please find attached three copies of the above referenced document.

If you have any questions or comments please contact me at 405-701-5058 or at Chris.Schaefer@eccgrp.com.

Sincerely,

Mr. Christopher Schaefer, PE
Project Engineer

RECEIVED
SEP 21 2018
LAND PROTECTION DIVISION
DEPARTMENT OF ENVIRONMENTAL QUALITY

SOLID WASTE
TIER II PERMIT APPLICATION

EXISTING COAL COMBUSTION RESIDUAL (CCR) SURFACE IMPOUNDMENT

WESTERN FARMERS ELECTRIC COOPERATIVE
HUGO POWER STATION
CHOCTAW COUNTY

Prepared by:

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3700 W. Robinson, Suite 200
Norman, OK 73072
405-701-5058

September 21, 2018

ENVIRO CLEAN CARDINAL

Table of Contents

FIGURES

ATTACHMENTS

ATTACHMENTS

ATTACHMENTS

I INTRODUCTION

Western Famers Electric Cooperative (WFEC) currently operates a Coal Combustion Residual (CCR) landfill and a CCR surface impoundment at its Hugo Power Station (HPS). Fly ash and economizer ash generated at the HPS are either beneficially reused or managed in the CCR landfill; which has an existing permit (Permit No. 3512008). Currently, bottom ash is sluiced to the CCR surface impoundment. Pursuant to the Environmental Protection Agency (EPA) final rule titled *Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments* in 40 CFR Part 257 Subpart D, published in the Federal Register on April 17, 2015 and the Oklahoma Department of Environmental Quality's (ODEQ's) counterpart rule, OAC 252:517, WFEC seeks to obtain a permit for the CCR surface impoundment. The CCR surface impoundment at the HPS is not a new CCR unit and WFEC does not seek an expansion of an existing permit boundary. Several requirements of OAC 252:517 do not appear to apply to existing surface impoundments. However, WFEC has included pertinent information where available. Dry handling of the bottom ash is scheduled for installation in fall of 2018.

II FILING OF APPLICATION /PUBLIC PATICIPAITION

1. Notice of Filing: In accordance with the notice requirements under the Uniform Environmental Permitting Act, 27A O.S. 2-14-301, upon filing of this application WFEC will publish legal notice of the filing in the "Hugo News" (128 E Jackson St. Hugo, OK 74743). **Attachment 1** contains a copy of the legal notice.

2. Notice of Draft: In accordance with the notice requirements under the Uniform Environmental Permitting Act, WFEC will publish legal notice in the "Hugo News" when a draft permit is issued. The notice will include information as per OAC 252:4-7-13(c), and a draft of the notice will be provided to ODEQ prior to publication.

3. Notice of Proposed: In accordance with the notice requirements of the Uniform Environmental Permitting Act, WFEC will publish legal notice in the "Hugo News" when a proposed permit is issued. The notice will include information as per as per OAC 252:4-7-13(c), and a draft of the notice will be provided to ODEQ prior to publication.

4. Proof of Publication: Affidavits of publication for the required notices as described in 1-3 above will be provided to ODEQ as they become available, as per OAC 252:4-7-13 (d).

5. Numbers of Copies and Placement: Three copies of the application have been filed with the ODEQ and one copy has been made available at "Choctaw County Public Library" (703 East Jackson Street Hugo, OK 74743) for public review in accordance with OAC 252:4-7-4(b).

III GENERAL REQUIREMENTS

1. Oath Required: In accordance with OAC 252:517-3-4, an application page signed by the applicant on forms as provided by ODEQ is included in **Attachment 2** of this application.

2. Legal Right to Property/Option for Use and Easement to ODEQ: In accordance with OAC 252:517-3-5, documents demonstrating that WFEC possesses legal right to access and use the property in a manner for which the permit is sought and a certification that WFEC owns the property is included in **Attachment 3** of this application. **Attachment 4** of this application includes a temporary easement agreement granting ODEQ the right to access the property to perform closure, post-closure monitoring, or corrective action in the event of default by the owner/operator, as per OAC 252:517-3-5(c). The easement will be recorded at the county land records office upon approval of the permit.

3. General Information for New Application

   a. Owner/operator's name, mailing address and phone number

Owners Name:	Western Farmers Electric Cooperative
Mailing Address:	P.O. Box 429 701 NE 7th Street Anadarko, Oklahoma 73005
Contact:	Kent Fletcher, Environmental Coordinator
Phone Number:	405-247-2498

   b. The name by which the facility will be known, the mailing address of the facility, the street address of the facility, and the facility phone number

Facility Name:	Western Farmers Electric Cooperative Hugo Power Station
Mailing Address:	P.O. Box 219 Fort Towson, Oklahoma 74735
Facility Address:	970 N 4335 Road Fort Towson, Oklahoma 74735
Facility Phone No:	580-873-2201

   c. Disclosure statement: As per OAC 252:517-3-3(g) and OAC 252:517-3-6(3), WFEC is providing a disclosure statement meeting the requirements of 27A O.S. 2-10-103 and 2-10-302. A disclosure statement is included in **Attachment 5**.

d. Legal Description: A legal description of the HPS Plant boundary is included in **Attachment 6** of this application. The surface impoundment and proposed permitted boundary are in the NE/4 of Section 28, Township 6 South, Range 19 East. The proposed permit boundary encompasses both cells of the existing surface impoundment and a 50-foot buffer around the impoundment. No other waste processing, disposal areas or soil borrow areas are proposed at the HPS. The CCR landfill is already permitted.

e. Latitude and longitude:

Coordinates for all corners of the proposed permit boundary are as follows:

1) Northwest corner: N 34° 00' 44" / W 95° 19' 18"
2) North corner on west side: N 34° 00' 44" / W 95° 19' 10"
3) North corner on east side: N 34° 00' 41" / W 95° 18' 52"
4) Northeast corner: N 34° 00' 36" / W 95° 18' 45"
5) Southeast corner: N 34° 00' 25" / W 95° 18' 48"
6) South corner: N 34° 00' 30" / W 95° 19' 04"
7) Southwest corner: N 34° 00' 38" / W 95° 19' 18"

Coordinates for facility entrance: N 34°1' 34.96'' / W 95°18' 48.65''

Coordinates for facility gate: N 34° 0'57.05'' / W 95° 18'59.81''

f. The location of the site from the nearest town/city: The nearest town/city to WFEC HPS is Fort Towson, Oklahoma. At its nearest point, the eastern property boundary of HPS is approximately 1.7 miles west of downtown Fort Towson. The northern boundary of HPS extends to U.S. Highway 70. The entrance to the facility is approximately one mile south of U.S. Highway 70 on N 4340 Road, which intersects U.S. Highway 70 approximately 2.8 miles west of downtown Fort Towson. The proposed permit boundary for the existing surface impoundment is in the south-central portion of the HPS property, approximately 2.7 miles southwest of downtown Fort Towson and approximately 1.2 miles south of U.S. Highway 70.

g. Description of processing, storage, and disposal operations / units: The HPS is a 450 MW, coal-fired, electric generation plant. Most facility operations occur on the western portions of the property, with the approximate eastern half and southern quarter of the property largely undeveloped. The HPS facility is bounded by U.S. Highway 70 to the north, followed by largely undeveloped property. Adjacent properties to the east, south and west are also largely undeveloped.

A railroad spur encircles the facility's coal supply pile and is used during coal unloading operations. These operations occur in the western-central portion of the property

The facility generates CCR solid waste in the form of fly ash, economizer ash and bottom ash. The fly ash and economizer ash are either beneficially reused or managed in the permitted CCR landfill (Permit No 3512008). The permitted landfill is in the southwestern portion of the property and covers approximately 35.2 acres.

Currently, the bottom ash is sluiced to the existing surface impoundment, located in the south-central portion of the property. However, dry handling of bottom ash is scheduled for installation in fall of 2018.

The surface impoundment is configured to also store discharges from the water treatment plant, plant drain discharge, cooling tower blowdown, coal pile runoff overflow, storm drain discharge and oil separator pond effluent. The surface impoundment is divided into two cells (north and south cell) which cover an area of approximately 68 acres and have a combined storage capacity of approximately 1,640,000 cubic yards. A divider berm separates the cells. The embankments at the surface impoundment are up to 11 feet in height and are constructed with native site soils to a crest elevation of 446 feet, MSL. Water level in the surface impoundment is maintained at a normal operating surface elevation of 443 feet, MSL by way of an ash water recycle structure which drains excess water to a process waste pond located directly east of the surface impoundment. The process waste pond is not used to store CCR wastes and CCR cannot enter this pond based on configuration of the surface impoundment and the bottom ash water recycle structure.

h. Access Roads: Access to the facility is from N 4340 Road; approximately one mile south of U.S. Highway 70. Access to the western portion of the surface impoundment is approximately one-half mile from the facility entrance via approximately 0.4 miles on a paved road (N 4340 Road) and by approximately 0.1 miles on a paved access road that intersects N 4340 Road and continues to the western side of the surface impoundment. Access to the eastern portion of the surface impoundment is approximately 0.6 miles from the facility entrance via approximately 0.15 miles on paved road (N 4340 Road) and by approximately 0.45 miles on a gravel surfaced access road that intersects N 4340 Road and continues to the eastern side of the surface impoundment. An earthen road is located along the southern perimeter of the surface impoundment. The unpaved roads at HPS used to access the surface impoundment are maintained such that they are passable by normal vehicular traffic during inclement weather.

i. List of anticipated heavy equipment: Equipment used at the facility may consist of a bulldozer, front end loader, backhoe, grader and a water truck. All equipment will be maintained in good working condition and will be adequate to perform duties required of the site.

j. Maps and drawings: Maps and drawings included in this application are listed in Section IV of this application.

k. Data, plans, and specifications: Pertinent data, plans, and/or specs demonstrating compliance with location restrictions are discussed in Section V of this application. Operational requirements and how compliance with storm water management requirements will be achieved are discussed in Section IX of this application. Plans for closure and post closure care of the facility are discussed in Section X of this application. A plan for achieving compliance with aesthetic enhancement requirements is discussed below. Establishment of financial assurance is discussed in Section XI of this application.

4. Aesthetic Enhancement: OAC 252:517-3-7 states that applications for new permits or expansions of an existing permit boundary, shall include plans to enhance the visual harmony of the new CCR unit or the expansion area with the surrounding area, and reduce the transmission of dust and noise from the facility. Such plans may include placements of berms, fences, shrubbery, trees, or other such materials to achieve the desired result. Because of the setting, the surface impoundment is not visible from the nearest highway or other areas accessible by the public. The existing surface impoundment is centrally located on approximately 2,700 acres of land owned by WFEC and the adjacent properties in all directions are largely undeveloped. The areas around the surface impoundment to the south and east are wooded. Also, the WFEC HPS northern property boundary along U.S. Highway 70 is wooded such that the surface impoundment is not visible from the road. The impoundment is operated as a wet impoundment and does not generate dust. Heavy equipment or other mechanical sources of noise are not associated with operation of the impoundment. The buffer area between the HPS boundary and the impoundment, the absence of dust or noise resulting from operation of the impoundment, and the existing, mature wooded areas surrounding the impoundment accomplish the intent of OAC 252:517-3-7.

IV MAPS / DRAWINGS

As per OAC:517-3-31(a), maps and designs shall be submitted in permit applications for all new CCR units, expansions of permit boundaries of existing CCR units, lateral expansion of CCR units, and any other modification to an existing permit where the data originally submitted would be made ambiguous, inaccurate, or out of date by a proposed modification. Not all maps and drawings listed under OAC 252:517 Part 3 appear to be applicable to existing surface impoundment or are available or easily created from existing information. Pertinent maps/drawings that are available, or for which sufficient information exists to create such maps/drawings, are listed below and are included in this application. Map sequence is generally as identified in OAC 252:517 Part 3.

- General Location Map – Figure 1
- Flood Plain Map – Figure 2
- Quadrangle Topographic Map – Figure 3
- Existing Contour Map – Figure 4: The location and quantities of surface drainage are detailed in **Attachment 7** of this application; Hugo CCR Surface Impoundment Inflow Design Flood Control (Burns and McDonnell, 10/14/16).
- Site Map – Figure 4: The Site Map is combined with Existing Contour Map.
- Design Drawings – **Attachment 8**: Initial design drawings for the surface impoundment were prepared in 1978 as part of construction packets. As such, electronic design files are not readily available. Also, several design drawings listed under OAC 252:517-3-37 do not exist, are not available and/or cannot be easily created from existing information. Partitioning of the design files into singular maps/drawings is not practicable. All available drawings relative to design of the surface impoundment are included in an **Attachment 8-A** of this application. Drawings pertaining to 2017 repairs of the eastern berm of the impoundment are included in **Attachment 8-B**. Boring logs/well logs are included in **Attachment 8-C** of this application. **Attachment 8-D** of this application contains construction records for monitoring wells at the HPS. Geologic cross sections for the HPS are included in **Attachment 8-E** of this application. Tables containing results of depth to water/water table elevation measurements conducted at the HPS are included in **Attachment 8-F** of this application.
- Groundwater Resource and Usage Map – Figure 5
- Surface Geologic Map – Figure 6
- Highest Groundwater Contour Map - Figure 7: Prepared using highest groundwater data as measured during background sampling of monitoring wells comprising the surface impoundment monitoring network

- Potentiometric Surface Map – Figure 8: Prepared using the highest average groundwater elevation as measured during background sampling of monitoring wells comprising the surface impoundment monitoring network.
- Site-specific Cross Sections – Site specific cross sections for the area of the surface impoundment (as created by Dames and Moore and as created by Burns and McDonnell) are contained in **Attachment 8-E** of this application.
- Fill Cross Section Map: Available drawings relative to design of the surface impoundment are included in an **Attachment 8-A** of this application.
- Excavation Contour Map: Available drawings relative to design of the surface impoundment are included in an **Attachment 8-A** of this application.
- Top of Liner Contour Map: Available drawings relative to design of the surface impoundment are included in an **Attachment 8-A** of this application.
- Completion Map: A completion map for the existing surface impoundment is not available. Details of the final cover system are included in the ODEQ approved closure plan. The closure plan is included as **Attachment 9** of this application; Hugo CCR Surface Impoundment CCR Unit Closure Plan (Burns & McDonnell, October 14, 2016).

V LOCATION RESTRICTIONS

1. Placement Above the Uppermost Aquifer: OAC 252:517-5-1 prohibits existing CCR surface impoundments from being less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer. Alternately, a demonstration can be made that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations. WFEC is currently evaluating groundwater separation and fluctuation at the surface impoundment and will provide findings of the evaluation to ODEQ by October 17th, 2018.
2. Wetlands: OAC 252:517-5-2 prohibits existing CCR surface impoundments from being in a wetland unless meeting requirements as specified under OAC 252:517-5-2(a)(1) through (5). Findings from a wetland delineation are included in **Attachment 10** of this application; Wetland Location Restriction Compliance (Burns & McDonnell, June 15, 2018). Based on these, the CCR surface impoundment is not located in a wetland.
3. Fault Areas: OAC 252:517-5-3 prohibits existing CCR surface impoundments from being within 60 meters (200 feet) of the outermost damage zone of a fault that has displacement in Holocene time unless the owner or operator demonstrates that an alternative setback

distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR unit. Findings from a fault demonstration are included in **Attachment 11** of this application; Fault Area Demonstration Report (Burns & McDonnell, June 19, 2018). Based on these, the CCR surface impoundment is not located within 60 meters of the outermost damage zone of a fault that has displacement in Holocene time. As reported, the nearest Holocene era fault is approximately 175 miles away.

4. Seismic Impact Zones: OAC 252:517-5-4 prohibits existing CCR surface impoundments from being in seismic impact zones unless the owner or operator demonstrates that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.

   Findings from a seismic impact zone demonstration are included in **Attachment 12** of this application; Seismic Impact Zone Demonstration Report (Burns & McDonnell, June 15, 2018). Based on these, the maximum expected horizontal acceleration at the facility is 0.06-0.08 g which is below the 0.10 g requirement. Therefore, the CCR surface impoundment is not located in a seismic impact zone.

5. Unstable areas: OAC 252:517-5-5 prohibits existing CCR surface impoundments from being in an unstable area unless the owner or operator demonstrates that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted. A structural stability report is included in **Attachment 13-A** of this application; Combined Initial Hazard Potential Classification, Structural Stability, and Safety Factor Assessment Report (Guernsey, October 17, 2016). Based on this report, the foundation and abutments of the surface impoundment are a native fat clay and weathered shale which form a stable foundation and this was apparent based on review of reports, site inspections and review of documentation. Additionally, boring logs documenting subsurface geology at HPS are included in **Attachment 8-C** of this application.

6. Scenic Rivers: OAC 252:517-5-6 prohibits, with exception, the permit boundary of a new CCR unit or expansion of the permit boundary of an existing CCR unit from being located within the drainage basin of any river designated under the Oklahoma Scenic Rivers Commissions Act. It is not believed that this location restriction applies to the CCR surface impoundment at the HPS since the impoundment is an existing unit (not a new CCR unit) and since WFEC is not seeking to expand an existing permit boundary. However, as indicated from review of the ODEQ data viewer available at the ODEQ website (and as presented in **Attachment 14-A** of this application), the permit boundary is within the drainage basin of the Kiamichi River; which is not designated under the Oklahoma Scenic Rivers Commissions Act.

7. Recreation or Preservation Areas: OAC 252:517-5-7 prohibits, with exception, the permit boundary of a new CCR unit or expansion of the permit boundary of an existing CCR unit from being located within one-half mile of any area formally dedicated and managed for the public recreation or natural preservation by a federal, state, or local government agency. It is not believed that this location restriction applies to the CCR surface impoundment at the HPS since the impoundment is an existing unit (not a new CCR unit) and since WFEC is not seeking to expand an existing permit boundary. However, in general, the land within one half mile of the permit boundary is owned by WFEC and is not dedicated and managed for public recreation or as a natural preservation area.

8. Endangered or Threatened Species: OAC 252:517-5-8 requires for a new CCR unit or expansion of the permit boundary of an existing CCR unit that a statement from the Oklahoma Department of Wildlife Conservation (ODWC) and from the Oklahoma Biological Survey (OBS) be submitted regarding current information about endangered or threatened wildlife or plant species listed in state and federal laws, that exist within one mile of the permit boundary or expansion area. It is not believed that this location restriction applies to the CCR surface impoundment at the HPS since the impoundment is an existing unit (not a new CCR unit) and since WFEC is not seeking to expand an existing permit boundary.

9. 100-year Floodplain: OAC 252:517-5-9 prohibits the location of waste management or disposal areas of a CCR unit within the 100-year floodplain, except as provided below.

   a. For areas of CCR units that received waste before April 9, 1994 and are in the 100-year floodplain, the owner and operator must maintain in the operating record that the waste disposal area will not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain; or result in the disturbance and/or carrying away of CCR by water so as to pose a hazard to human health or the environment.

   b. The DEQ may grant a variance from the 100-year flood plain restriction for waste management or disposal areas of new CCR units, or expansions of waste management or disposal areas of existing CCR units, provided the variance is conditioned upon the subsequent redefinition of the flood plain to not include the land area proposed by the variance.

The available Floodplain Insurance Rate (FIRM) map was developed prior to the existence of the surface impoundment. The FIRM map (Map # 400470 0200A) indicates that part of the CCR surface impoundment at HPS may be located within a 100-year floodplain for an unnamed, intermittent tributary of Bird Creek. However, the tributary was altered during construction of the impoundment and no longer exists as shown.

The CCR surface impoundment at the HPS is an existing CCR unit that was receiving wastes prior to April 9, 1994. A base flood elevation for the 100-year flood has been calculated using the interpolation method outlined in FEMA 256 (Managing Floodplain Development in Approximate Zone A Areas – A Guide for Obtaining and Developing Base (100-Year) Flood Elevations, FEMA, April 1995). The calculated base flood elevation for the 100-year flood is 431 feet, MSL immediately upstream and downstream of the area in question. The top of dike elevation is substantially higher (446 feet, MSL). Based on these, the surface impoundment is not such that it would likely restrict the flow of a 100-year flood or significantly reduce the water storage capacity of the floodplain Also, it is not likely that a 100-year flood would result in disturbance and/or carrying away of CCR by water so as to pose a hazard to human health to the environment.

10. Public Water Supply: OAC 252:517-5-10 prohibits the location of a new CCR unit or lateral expansion of a CCR unit within one-mile upgradient of an existing public water supply surface water intake, or one that is permitted for construction when a complete application has been filed with the DEQ; or within a one-year time of travel of a public water supply well. It is not believed that this location restriction applies to the CCR surface impoundment at the HPS since the impoundment is an existing unit (not a new CCR unit) and since WFEC is not seeking to expand an existing permit boundary. However, as indicated from review of the ODEQ data viewer available at the ODEQ website regarding public water supply wells (**Attachment 14-B)** and public surface water intakes (**Attachment 14-C**) and as previously reported to ODEQ (Groundwater Monitoring Program for the Hugo Power Station CCR Units (Burns & McDonnell, March 2016, Revised January 2018)), and included in **Attachment 15** of this application, the permit boundary is not located within one-mile upgradient of a public water supply surface water intake. Also, no public water supply wells were identified within three miles down-gradient of the surface impoundment. Location of public water supply surface water intakes and public water supply wells in relation to the surface impoundment are depicted on Figure 4.

11. Wellhead Protection Area: OAC 252:517-5-11 states that if any new CCR unit or lateral expansion of a CCR unit will be located within two miles of a public water supply well, a wellhead protection area shall be identified, as specified by the State Wellhead Protection Plan, and such information submitted to the DEQ. It is not believed that this location restriction applies to the CCR surface impoundment at the HPS since the impoundment is an existing unit (not a new CCR unit) and since WFEC is not seeking to expand an existing permit boundary. However, as indicated from review of the ODEQ data viewer available at the ODEQ website regarding wellhead protection areas (**Attachment 14-D**) the permitted boundary is not located within two miles of a public water supply well and is not located within a wellhead protection area.

VI SUBSURFACE INVESTIGATION

Subchapter 7 of OAC 252:517 outlines the requirements for a subsurface investigation prior to submitting a permit application for a new CCR unit, or a lateral expansion of an existing CCR unit. It is not believed that the requirements as included under OAC 252:517-7 apply to the CCR surface impoundment at the HPS since the impoundment is an existing unit (not a new CCR unit) and since WFEC is not seeking to expand an existing permit boundary. However, available and pertinent information regarding subsurface conditions at the HPS has been provided to ODEQ and is contained in **Attachment 15** of this application; Groundwater Monitoring Program for the Hugo Power Station CCR Units, (Burns & McDonnell, March 2016, Revised January 2018). Other available subsurface information is contained in this application, including boring logs/well logs for monitoring wells at the HPS (**Attachment 8-C**) and geologic cross sections for the HPS (**Attachment 8-E**).

VII GROUDWATER MONITORING / CORRECTIVE ACTION

Subchapter 9 of OAC 252:517 outlines groundwater monitoring and corrective action requirements at CCR landfills, CCR surface impoundments and lateral expansions of CCR units. Compliance with the applicable requirements of OAC 252:517-9 are discussed below.

1. Groundwater Monitoring System: OAC 252:517-9-2 requires that existing CCR units install a groundwater monitoring system that consists of a sufficient number of wells, installed at appropriate locations and depths to yield groundwater samples from the uppermost aquifer. An approved groundwater monitoring system is in place for the surface impoundment, as outlined in a groundwater monitoring report previously submitted to ODEQ and contained in **Attachment 15** of this application; Groundwater Monitoring Program for the Hugo Power Station CCR Units (Burns & McDonnell, March 2016, Revised January 2018).

2. Groundwater Sampling and Analysis Requirements: OAC 252:517-9-4 requires a developed groundwater sampling and analysis program to include selection of the statistical procedures to be used for evaluating groundwater monitoring. A groundwater sampling and analysis program has been previously submitted to ODEQ and approved. The groundwater sampling and analysis program is described in **Attachment 15** of this application; Groundwater Monitoring Program for the Hugo Power Station CCR Units (Burns & McDonnell, March 2016, Revised January 2018). **Attachment 15**, Appendix A includes a Groundwater Sampling and Analysis Plan. **Attachment 15**, Appendix B includes a Certification of the Groundwater Sampling and Analysis Statistical Method.

3. Detection Monitoring Program: OAC 252:517-9-5 requires that the owner or operator of a CCR unit conduct detection monitoring at all groundwater monitoring wells. A detection monitoring program must include groundwater monitoring for all constituents listed in Appendix A of Chapter 9 of OAC 252:517. Details outlining the detection monitoring program were previously submitted to ODEQ and are contained in **Attachment 15** of this application; Groundwater Sampling and Analysis Plan for the Hugo Power Station CCR Units (Burns & McDonnell, January 2018).

4. Assessment Monitoring Program: If WFEC determines that there is a statistically significant increase over background levels for one or more of the constituents listed in Appendix A of Chapter 9 of OAC 252:517 at any monitoring well at the waste boundary, WFEC will within 90 days of detecting a statistically significant increase over background levels for any constituent, establish an assessment monitoring program meeting the requirements of OAC 252:517-9-6, and have the assessment monitoring program approved by DEQ. WFEC may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. WFEC will complete the written demonstration within 90 days of detecting a statistically significant increase over background levels. If a successful demonstration is completed within the 90-day period, WFEC may continue with a detection monitoring program. If a successful demonstration is not completed within the 90-day period, WFEC will initiate an assessment monitoring program as required under OAC 252:517-9-6 and discussed below.

   If an assessment monitoring program is required, WFEC will prepare a notification stating that an assessment monitoring program has been established. WFEC will place the notification in the facilities operating record as required by OAC 252:517-19-1(h)(5).

   OAC 252:517-9-6 requires that within 90 days of triggering an assessment monitoring program, and annually thereafter, the owner or operator of a CCR unit sample and analyze the groundwater for all constituents listed in Appendix B of OAC 252:517. The owner or operator of a CCR unit may demonstrate the need for an alternative monitoring frequency for repeated sampling and analysis for constituents listed in Appendix B of OAC 252:517 during the active life and post-closure care period based on the availability of groundwater. The need to vary monitoring frequency must be evaluated on a site-specific basis and approved by the DEQ.

   Within 90 days of obtaining the results, and on a least a semiannual basis thereafter, the owner or operator must resample all wells that were installed pursuant to the requirements of OAC 252:517-9-2, conduct analysis for all parameters in Appendix A of OAC 252:517 and for those constituents in Appendix B of OAC 252:517 that are detected, establish

groundwater protection standards for all constituents detected and identify the background concentration and the groundwater protection standards in the annual groundwater monitoring and corrective action report.

If the concentrations of all constituents listed in OAC 252:517 Appendices A and B are shown to be below background values for two consecutive sampling events, the owner or operator may return to detection monitoring, with DEQ approval. If concentrations of any constituents listed in OAC 252:517 Appendices A and B are above background values, but all concentrations are below the established groundwater protection standard, the owner or operator must continue assessment monitoring. If one or more constituents listed in OAC 252:517 Appendices A and B are detected at statistically significant levels above the established groundwater protection standard in any sampling event, the owner or operator must prepare a notification identifying the constituents that have exceeded the groundwater protection standard and submit to DEQ, a proposed plan and schedule for analyzing the environmental release from the facility and for developing appropriate corrective action.

Further details outlining the assessment monitoring program were previously submitted to ODEQ and are contained in **Attachment 15** of this application; Groundwater Sampling and Analysis Plan for the Hugo Power Station CCR Units (Burns & McDonnell, January 2018).

VIII DESIGN CRITERA

Subchapter 11 of OAC 252:517 outlines design criteria for new CCR landfills and any lateral expansion of a CCR landfill, for existing CCR surface impoundments, for new CCR surface impoundments and any lateral expansion of a CCR surface impoundment. In particular, OAC 252:517-11-2 pertains to liner design criteria for existing surface impoundments and OAC 252:517-11-4 pertains to structural integrity criteria for existing CCR surface impoundments. Other portions of Subchapter 11 do not apply to the existing surface impoundment at WFEC HPS.

1. Liner Design: OAC 252:517-11-2 requires that an existing surface impoundment have a liner consisting of a minimum of two feet of compacted soil with a hydraulic conductivity of no more than 1 X 10^{-7} cm/sec. Documentation that the liner for the impoundment meets the thickness and permeability requirements is included in **Attachment 16** of this Application.

2. Structural Integrity

a. Permanent marker: OAC 252:517-11-4(a)(1) requires that an existing surface impoundment have a permanent marker that identifies the CCR units permit number, name, and owner or operator. Two markers currently exist at the CCR surface impoundment; one for the north cell (CCR 2) and one for the south cell (CCR 3). Once the surface impoundment is permitted, these markers will be updated with required information.

b. Periodic hazard potential classification assessments: OAC 252:517-11-4(a)(2) requires that the owner or operator of an existing surface impoundment conduct initial and periodic hazard potential classification assessments. An initial hazard potential was performed for the CCR surface impoundment at the HPS. The surface impoundment was found to be a "low hazard potential CCR surface impoundment." Findings are included in **Attachment 13-A** of this application; Combined Initial Hazard Potential Classification, Structural Stability, and Safety Factor Assessment (Guernsey, October 17, 2017).

c. Emergency Action Plan (EAP): OAC 252:517-11-4(a)(3) requires the development of an EAP for CCR surface impoundments that have a high or significant hazard classification. As mentioned above, the hazard classification of the CCR surface impoundment at the HPS was found to be a "low hazard classification". Therefore, an EAP is not required.

d. Slope Protection: OAC 252:517-11-4(a)(4) requires that the CCR unit and surrounding areas be designed, constructed, operated and maintained with vegetated slopes of dikes. WFEC will comply with this requirement.

e. History of Construction: As per OAC 252:517-11-4(c), the owner or operator of the CCR unit must compile a history of construction. The history of construction shall be submitted to ODEQ. A history of construction was compiled for the surface impoundment and submitted to ODEQ. The report is contained in **Attachment 17** of this application; Hugo CCR Surface Impoundment History of Construction (Burns & McDonnell, October 14, 2016).

f. Periodic Structural Stability Assessments: As per OAC 252:517-11-4(d), the owner or operator of the CCR unit must conduct initial and periodic structural stability assessments and document whether the design, construction, operation and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. As per OAC 252:517-11-4(f), periodic assessments must be conducted every five years. A structural stability report for the surface impoundment is contained in **Attachment 13-A** of this application; Combined Initial Hazard Potential Classification, Structural Stability, and Safety Factor Assessment Report (Guernsey, October 17, 2016). Reports pertaining to corrections made to the eastern embankment of the surface impoundment are contained in **Attachment 13-B**; Geotechnical Engineering Report (Terracon, November 14, 2016) and in **Attachment**

13-C of this application; CCR Impoundment Safety Factor Assessment (Terracon, November 28, 2017). Periodic structural stability assessments will continue as per the rule.

g. Periodic Safety Factor Assessments: As per OAC 252:517-11-4(e), the owner or operator must conduct an initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each CCR unit achieve the minimum safety factors (as prescribed in the rule) for the critical cross section of the embankment. As per OAC 252:517-11-4(f), periodic assessments must be conducted every five years. A safety factor assessment for the surface impoundment is contained in **Attachment 13-A** of this application; Combined Initial Hazard Potential Classification, Structural Stability, and Safety Factor Assessment Report (Guernsey, October 17, 2016). Periodic safety factor assessments will continue as per the rule.

IX OPERATIONAL REQUIREMENTS

Subchapter 13 of OAC 252:517 outlines operational requirements for CCR landfills and CCR surface impoundments. Compliance with applicable requirements under this Subchapter are discussed below. In particular, OAC 252:517-13-1 pertains to minimizing airborne CCR, OAC 252:517-13-3 pertains to hydrologic and hydraulic capacity requirements for CCR surface impoundments, OAC 252:517-13-4 pertains to inspection requirements for CCR surface impoundments and OAC 252:517-13-6 pertains to discharges. Other portions of Subchapter 13 do not apply to the existing surface impoundment at WFEC HPS.

1. Air Criteria and Fugitive Dust Control: OAC 252:517-13-1(a) requires that the owner or operator of a CCR landfill, CCR surface impoundment, or any lateral expansion of a CCR unit adopt measures that will effectively minimize CCR from becoming airborne at the facility, including CCR fugitive dust originating from CCR units, roads, and other CCR management and material handling activities. A CCR fugitive dust control plan is included as **Attachment 18** of this application; CCR Fugitive Dust Control Plan (Burns & McDonnell, October 2016).

   OAC 252:517-13-1(c) requires an Annual CCR fugitive dust control report that includes a description of the actions taken by the owner or operator to control CCR fugitive dust, a record of all citizen complaints, and a summary of corrective measures taken. As an example of annual reports, the annual report for 2016 is included in **Attachment 19-A** of this application; Annual Fugitive Dust Report for the Hugo Plant (Burns & McDonnell, December 2016). The annual report for 2017 is included in **Attachment 19-B** of this application; Annual Fugitive Dust Report for the Hugo Plant (Western Farmers Electric Cooperative, December 2017). WFEC will continue to submit fugitive dust reports on an annual basis as per the rule.

2. Hydrologic/Hydraulic Capacity Requirements for CCR Surface Impoundments: OAC 252:517-13-3(a) requires that the owner or operator of an existing or new CCR surface impoundment or lateral expansion of a CCR surface impoundment design, construct, operate, maintain an inflow design flood control system as specified in OAC 252:517-13-3(a)(1)-(2) which state that the inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood and that the inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood.

   The inflow design flood control system was selected according to a CCR surface impoundment's hazard potential classification. The CCR surface impoundment at the HPS was classified as a "low hazard potential CCR surface impoundment" as set forth in **Attachment 10**; Combined Initial Hazard Potential Classification, Structural Stability, and Safety Factor Assessment (Guernsey, October 2017). OAC 252:517-13-3(a)(3)(C) states that a CCR surface impoundment with a "low hazard potential" must be designed to manage the 100-year flood. A demonstration that the CCR surface impoundment is designed to manage the 100-year flood is contained in **Attachment 7** of this application; Hugo CCR Surface Impoundment Inflow Design Flood Control (Burns & McDonnell, October 14, 2016).

3. Inspection Requirements for CCR Surface Impoundments: OAC 252:517-13-4(a) requires CCR surface impoundments and any lateral expansion of a CCR surface impoundment to be examined by a qualified person as follows:

   (A) At intervals not exceeding seven days, inspect for any appearances of actual or potential structural weakness and other conditions which are disrupting or have the potential to disrupt the operation or safety of the CCR unit;
   (B) At intervals not exceeding seven days, inspect the discharge of all outlets of hydraulic structures which pass underneath the base of the surface impoundment or through the dike of the CCR unit for abnormal discoloration, flow or discharge of debris or sediment; and
   (C) At intervals not exceeding 30 days, monitor all CCR unit instrumentation.
   (D) The results of the inspection by a qualified person must be recorded in the facility's operating record as required by OAC 252:517-19-1(g)(5)

   Inspections of the CCR surface impoundment at the HPS are conducted by a qualified person in accordance OAC 252:517-13-4(a) and are recorded in the facilities operating record. Examples of inspection reports for December 1, 2016 and October 12, 2017 are included as **Attachment 20** of this application. **Attachment 20-A** contains an Inspection Report for December 1, 2016. **Attachment 20-B** contains an Inspection Report from October 12, 2017. The requirements of 30-day inspections are met in the regular seven-day inspections of the CCR surface impoundment.

OAC 252:517-13-4(b) requires that existing or new CCR surface impoundments or any lateral expansion of the CCR surface impoundment is subject to the periodic structural stability assessment requirements under OAC 252:517-11-(d) or OAC 252:517-11-5(d). The CCR unit must additionally be inspected on a periodic basis by a qualified professional engineer to ensure that the design, construction, operation and maintenance of the unit is consistent with recognized and accepted good engineering standards. An inspection was conducted that included a review of available information regarding the status and condition of the CCR unit, a visual inspection of the CCR unit to identify signs of distress or malfunction of the CCR unit and appurtenant structures, and a visual inspection of any hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit for structural integrity and continued safe and reliable operation. Examples of inspection reports are contained in **Attachment 21** of this application. The most recent inspection report is included in **Attachment 21-A**; Combined Coal Combustion Residual Surface Impoundments and Landfill Annual Inspection Report Hugo Plant (Cardinal Engineering, October 2017). Previous annual inspection reports are included in **Attachment 21-B**; Combined Coal Combustion Residual Surface Impoundment & Landfill 2016 Annual Inspection Report Hugo Plant (Guernsey, January 2017) and **Attachment 21-C**; Combined Coal Combustion Residual Surface Impoundments & Landfill Annual Inspection Report Hugo Plant (Guernsey, January 2016).

4. Discharges: OAC 252:517-13-6(a) states that all CCR units shall be operated to:

(1) Prevent the discharge of contaminated storm water unless the proper permit is obtained from the DEQ's Water Quality Division;
(2) Prevent the discharge of pollutants that violates any requirements of federal Clean Water Act, including, but not limited to, the Oklahoma Pollutant Discharge Elimination System (OPDES) requirements;
(3) Prevent the discharge of a non-point source of pollution that violates any requirements of an area-wide or State-wide water quality management plan that has been approved in accordance with the federal Clean Water Act; and
(4) Comply with all requirements of their OPDES permit, if applicable. A copy of the OPDES permit shall be maintained in the operating record.

The surface impoundment is operated to prevent discharge of contaminated storm water. Excess water from the surface impoundment drains by way of an ash water recycle structure to a process waste pond located directly east of the surface impoundment. The process waste pond is not used to store CCR wastes and CCR cannot enter this pond based on configuration of the surface impoundment and the bottom ash water recycle structure. WFEC has an OPDES permit (OK0035327) from ODEQ Water Quality Division to discharge water from the process waste pond.

X CLOSURE AND POST-CLOSURE CARE

Subchapter 15 of OAC 252:517 outlines closure and post-closure care requirements. Compliance with applicable requirements under this Subchapter are discussed in the plans listed below.

1. Closure Plan: The HPS has an approved closure plan for the CCR surface impoundment. The closure plan is contained in **Attachment 9** of this application; Hugo CCR Surface Impoundment CCR Unit Closure Plan (Burns & McDonnell, September 2016). Written notification will be provided to ODEQ prior beginning final closure.

2. Post-Closure Plan: The HPS has an approved post closure plan for the CCR surface impoundment. The post closure plan is included in **Attachment 22** of this application; Hugo CCR Surface Impoundment CCR Unit Post Closure Plan (Burns & McDonnell, October 14, 2016).

XI FINANCIAL ASSURANCE

Subchapter 17 of OAC 252:517 outlines cost estimate and financial assurance requirements. Compliance with applicable requirements under this Subchapter are discussed below.

1. Duty to Maintain Financial Assurance: WFEC is required to maintain financial assurance for closure and post-closure care activates, and corrective action, if required until compliance with associated requirements is demonstrated. Financial assurance shall be provided by a corporate guarantee as described in OAC 252:517-17-82 in the amount of the approved cost estimate.

2. Economic Life of Site: Economic life of site for the CCR surface impoundment at the HPS is calculated based on the historical fill rate. The impoundment has received an estimated 231,000 cubic yards of ash over an operating life of approximately 37 years. This equates to 6,243 cubic yards per year. The estimated remaining capacity of the impoundment is 833,000 cubic yards. The estimated remaining site life is thus approximately 133 years (833,000/6243).

3. Closure and Post-Closure Cost Estimate: OAC 252:517-17-31(a) and OAC 252:517-17-32(a) require cost estimates for the execution of the closure and post-closure plans to be submitted to the DEQ for approval. The estimates should be a detailed written estimate, in current dollars, of the cost of hiring a third party to conduct closure and post-closure activates. HPS has approved cost estimates for the CCR surface impoundment that satisfy the requirements of OAC 252:517-17-31(a) and OAC 252:517-17-32(a). The closure and post-closure cost estimates are included as **Attachment 23** of this application.

4. Corrective Action: If corrective action is required, WFEC will submit cost estimates to ODEQ for approval.

5. Annual Adjustments: Cost estimates for closure, post-closure, and corrective action will be adjusted and submitted for ODEQ approval annually.

6. Financial Assurances of Closure and Post-Closure: WFEC will establish and maintain financial assurance that satisfies OAC 252:517-17-71. Financial assurance shall be provided by a corporate guarantee as described in OAC 252:517-17-82 in the amount of the approved cost estimate.

PREPARED BY THE
OKLAHOMA DEPARTMENT OF TRANSPORTATION
STRATEGIC ASSET AND PERFORMANCE
MANAGEMENT DIVISION

IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

HUGO LAKE

Cedar Creek

Rock Creek

Oil Well Branch

Gates Branch

Bird Creek

HWY. 70

HWY. 47

HWY. 209

HWY. 109

5304

11768

18522

18651

3905

26100

25536

30613

28015

28013

20623

27636

SAWYER
POP. 321

WEST FORT TOWSON

OLD FORT TOWSON

FORT TOWSON

27902

10427

4877

10600

31074

27703

10425

FORT TOWSON
POP. 519

PROPOSED PERMIT BOUNDARY

BOUNDARY OF WASTE DISPOSAL AREA

WFEC BOUNDARY

RAYMOND GARY LAKE

21152

5310

5455

5989

19983

5991

9196

22199

12315

Legend

- Interstate Highway
- US Highway
- State Highway
- Divided Highway, 4 or more lanes
- Paved Road
- Gravel Road
- Grade & Drain Road
- Unimproved Road
- Railroad
- State Line
- County Line
- Section Line
- Corporate Limit
- Wildlife Management Area
- Wildlife Refuge
- River or Stream
- Lake or Reservoir
- Bridges
- Low Water Crossing
- Natural Elevation Point
- Natural Elevation Point

N

2000' 0' 2000' 4000'

SCALE 1" = 2000' FEET

Y:\Projects\WesternFarmers\WFEE160000_Hugo\04_CAD\FIG-1.dwg Sep 20, 2018 - 8:36am

SIGNATURE/SEAL:

PROJECT
HUGO CCR IMPOUNDMENT

LOCATION
FORT TOWSON, OK

PREPARED FOR
WESTERN FARMERS
ELECTRIC COOPERATIVE

DRAWING TITLE
GENERAL LOCATIOIN MAP

Project No.	20170331
Drawn By	RKF
Checked By	CSS
Date	9/20/18
Scale	AS NOTED
Issued For	----
Drawing No.	

FIG. 1

CARDINAL ENGINEERING
An ENVIROCLEAN Company
525 Central Park Drive, Suite 402
Oklahoma City, OK 73105
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Fax 405.843.4687

3700 West Robinson St., Suite 200
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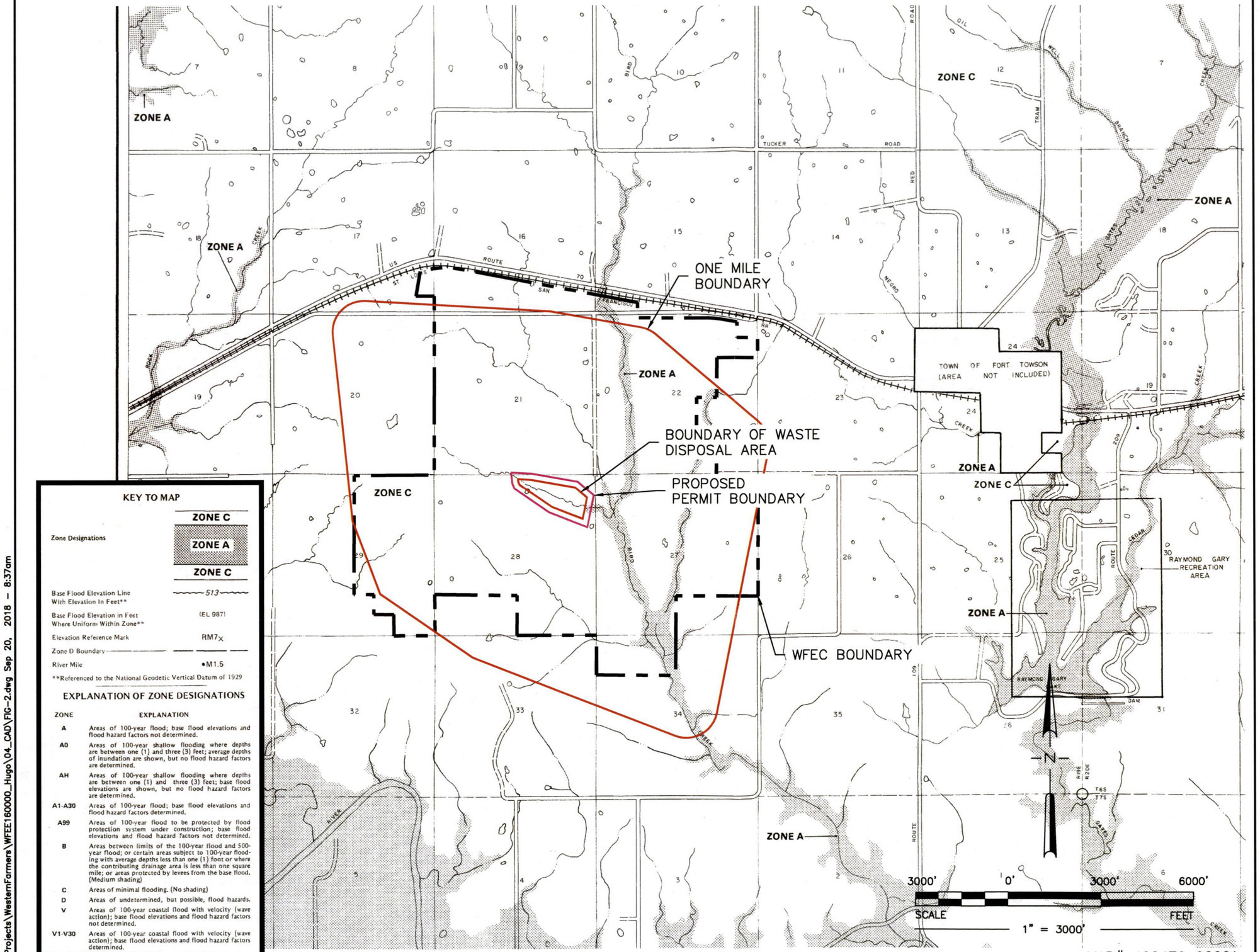
Phone 405.579.0655
Fax 405.701.5208
http://www.cardinalengineers.com
CA# 7110, expiration date 06.20.2020



KEY TO MAP

Zone Designations: ZONE C / ZONE A / ZONE C

Base Flood Elevation Line With Elevation In Feet**	513
Base Flood Elevation in Feet Where Uniform Within Zone**	(EL 987)
Elevation Reference Mark	RM7x
Zone D Boundary	
River Mile	•M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

SIGNATURE/SEAL:

PROJECT
HUGO CCR IMPOUNDMENT

LOCATION
FORT TOWSON, OK

PREPARED FOR
WESTERN FARMERS ELECTRIC COOPERATIVE

DRAWING TITLE
FLOOD PLAIN MAP

Project No.	20170331
Drawn By	RKF
Checked By	CSS
Date	9/20/18
Scale	AS NOTED
Issued For	----

Drawing No.
FIG 2

CARDINAL ENGINEERING
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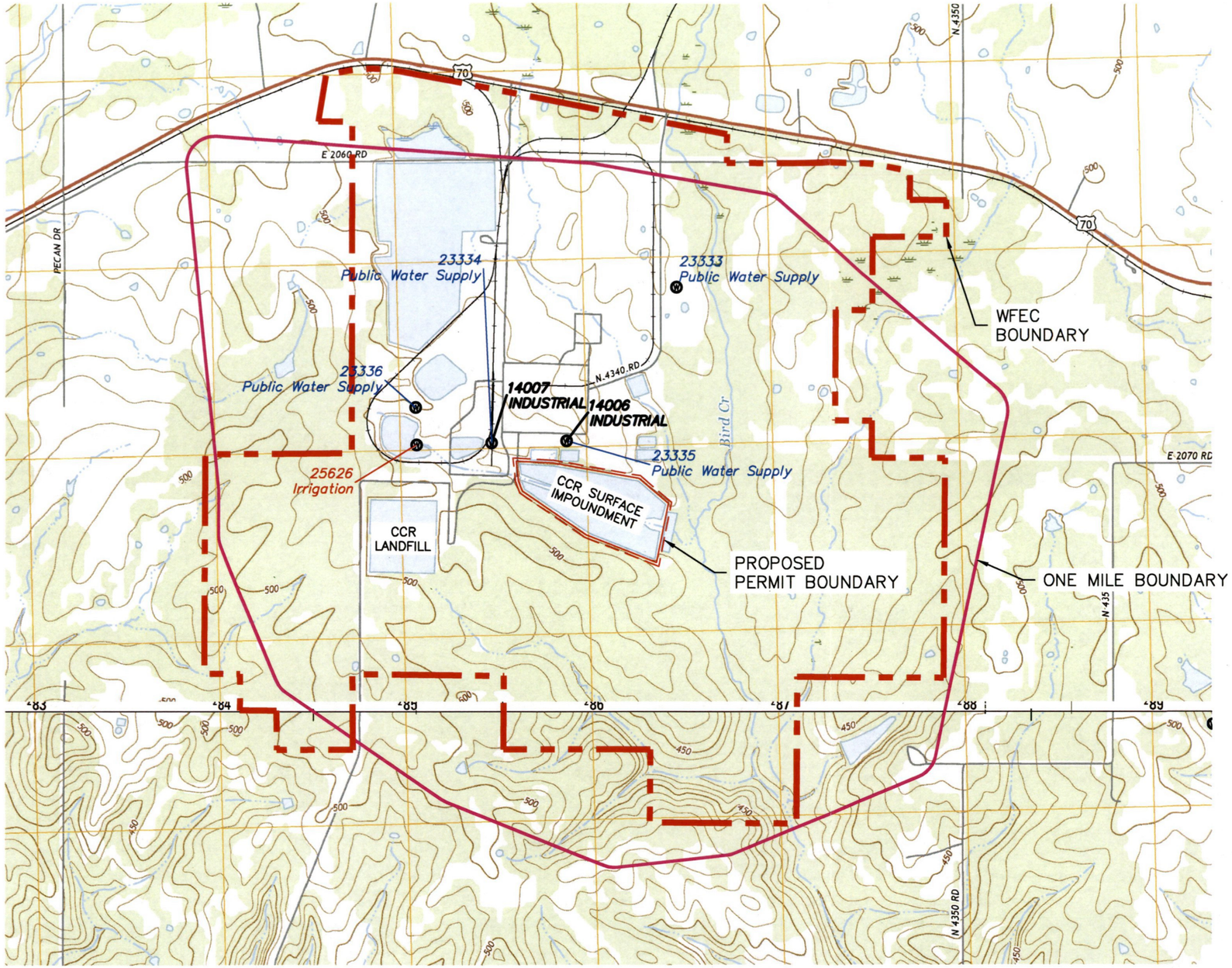
Y:\Projects\WesternFarmers\WFEE160000_Hugo\04_CAD\FIG-2.dwg Sep 20, 2018 - 8:37am

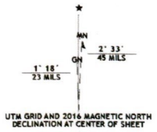


Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 15S
10 000-foot ticks: Oklahoma Coordinate System of 1983 (south zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, August 2013
Roads.....U.S. Census Bureau, 2014 - 2015
Names.....GNIS, 2015
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2007
Boundaries.....Multiple sources; see metadata file 1972 - 2015

Wetlands.....FWS National Wetlands Inventory 1977 - 2014



UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
TT
Grid Zone Designation
15S

QUADRANGLE LOCATION

1	2	3
4		5
6	7	8

1 Rattan
2 Spencerville
3 Sobol
4 Hugo Dam
5 Swink
6 Shoals
7 Frogville
8 Klomatia

ADJOINING QUADRANGLES

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

Ⓦ = EXISTING WELL

—N—

2000' 0' 2000' 4000'
SCALE FEET
1" = 2000'

FORT TOWSON, OK
2016

SIGNATURE/SEAL:

PROJECT
HUGO CCR IMPOUNDMENT

LOCATION
FORT TOWSON

PREPARED FOR
WESTERN FARMERS ELECTRIC COOPERATIVE

DRAWING TITLE
QUADRANGLE TOPOGRAPHIC MAP
(FORT TOWSON, 2016)

Project No.	20170331
Drawn By	RKF
Checked By	CSS
Date	9/20/18
Scale	AS NOTED
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Drawing No.
FIG 3

CARDINAL ENGINEERING
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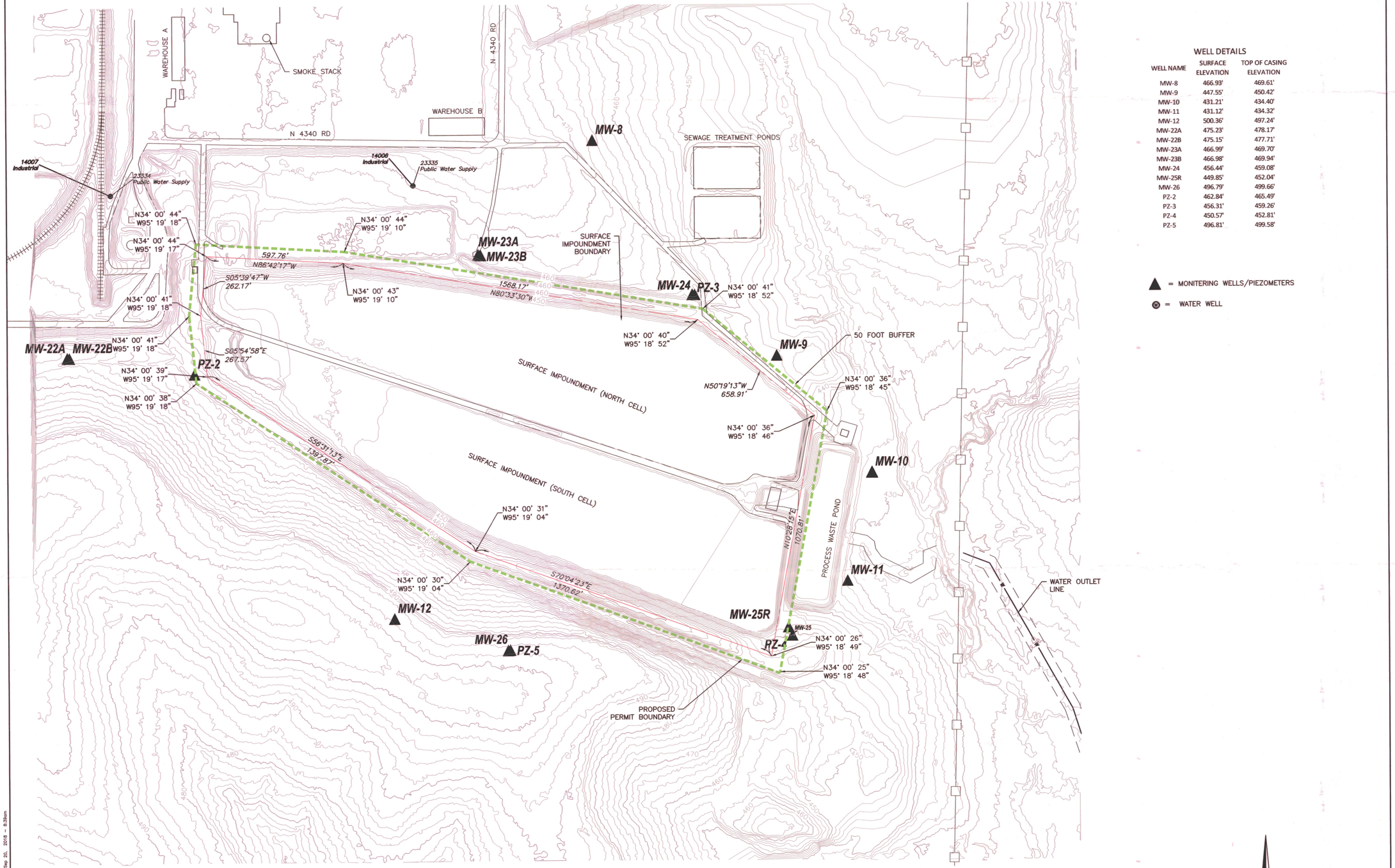

WELL DETAILS

WELL NAME	SURFACE ELEVATION	TOP OF CASING ELEVATION
MW-8	466.93'	469.61'
MW-9	447.55'	450.42'
MW-10	431.21'	434.40'
MW-11	431.12'	434.32'
MW-12	500.36'	497.24'
MW-22A	475.23'	478.17'
MW-22B	475.15'	477.71'
MW-23A	466.99'	469.70'
MW-23B	466.98'	469.94'
MW-24	456.44'	459.08'
MW-25R	449.85'	452.04'
MW-26	496.79'	499.66'
PZ-2	462.84'	465.49'
PZ-3	456.31'	459.26'
PZ-4	450.57'	452.81'
PZ-5	496.81'	499.58'

▲ = MONITERING WELLS/PIEZOMETERS

Ⓦ = WATER WELL

N

200' 0' 200' 400'

SCALE 1" = 200' FEET

REVISIONS

No.	Description	Date

KEY PLAN

SIGNATURE/SEAL

PROJECT
HUGO CCR IMPOUNDMENT

LOCATION
FORT TOWSON

PREPARED FOR
WESTERN FARMERS ELECTRIC COOPERATIVE

DRAWING TITLE
EXISTING CONTOUR MAP-SITE MAP

Project No.	20170331
Drawn By	RKF
Checked By	CSS
Date	9/20/18
Scale	AS NOTED
Issued For	----
Drawing No.	

FIG 4

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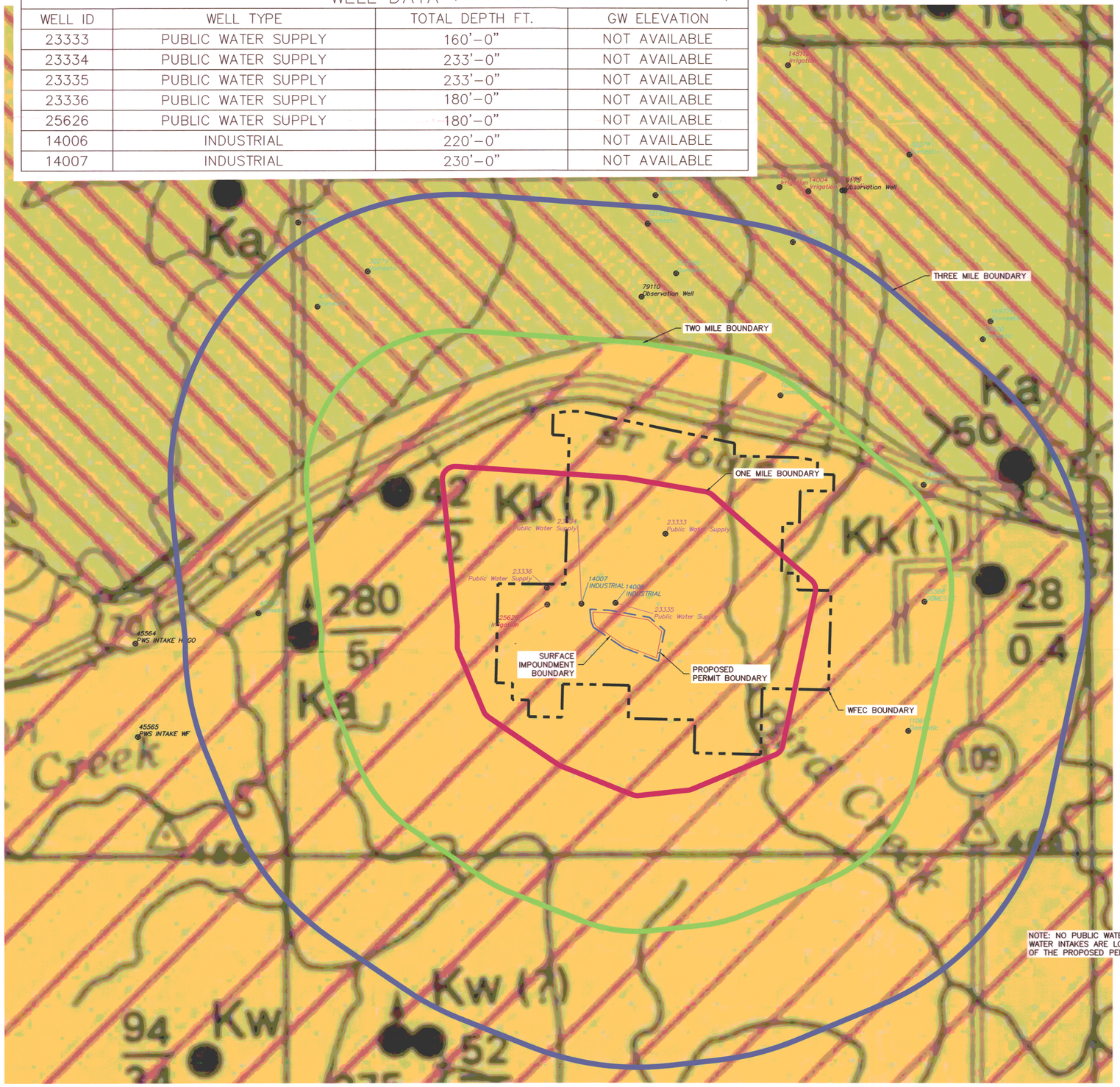
Fax 405.701.5208

http://www.cardinalengineers.com
CA# 7110, expiration date 06.20.2020

WELL DATA (WELLS IDENTIFIED WITHIN 1 MILE OF PROPOSED PERMIT BOUNDARY)

WELL ID	WELL TYPE	TOTAL DEPTH FT.	GW ELEVATION
23333	PUBLIC WATER SUPPLY	160'–0"	NOT AVAILABLE
23334	PUBLIC WATER SUPPLY	233'–0"	NOT AVAILABLE
23335	PUBLIC WATER SUPPLY	233'–0"	NOT AVAILABLE
23336	PUBLIC WATER SUPPLY	180'–0"	NOT AVAILABLE
25626	PUBLIC WATER SUPPLY	180'–0"	NOT AVAILABLE
14006	INDUSTRIAL	220'–0"	NOT AVAILABLE
14007	INDUSTRIAL	230'–0"	NOT AVAILABLE



MAP REFERENCE: RECONNAISSANCE OF THE WATER RESOURCES OF THE MCALESTER AND TEXARKANA QUADRANGLES, SOUTHEASTERN OKLAHOMA

NOTE: NO PUBLIC WATER SUPPLY SURFACE WATER INTAKES ARE LOCATED WITHIN 2 MILES OF THE PROPOSED PERMIT BOUNDARY.

N

2000' 0' 2000' 4000'
SCALE FEET
1" = 2000'

EXPLANATION

AQUIFERS

Ka — ANTLERS SANDSTONE
Sandstone and sand, white to reddish-yellow to orange-brown to gray, fine- to coarse-grained, quartzose, crossbedded, moderately to weakly indurated, interbedded with varicolored clays and conglomerates; contains fossil wood and dinosaurs; rests unconformably upon Ouachita rocks but conformably on DeQueen Limestone; thickness, 0 to 320 feet, thickening southeastward to 900 feet in subsurface.

Kw — WOODBINE FORMATION
Sand, dark-green, yellowish-red, white, gray, fine- to coarse-grained, tuffaceous in lower part; crossbedded, quartzose, and brownish-red noncalcareous clay; some gravel lentils with little to no quartz and some lignites and fossil plants; rests unconformably upon successively older Cretaceous units eastward; thickness, 325 to 455 feet, increasing eastward.

Kk — KIAMICHI FORMATION
Shale, dark-gray to black, with some brown fossiliferous limestones, with *Texigryphaea navia*; thickness, 28 to 36 feet, and up to 80 feet in subsurface of southern McCurtain County.

W = XXXX PUBLIC WATER SUPPLE WELL
W = XXXX IRRIGATION WELL
W = XXXX DOMESTIC WELL
W = XXXX PWS PUBLIC WATER INTAKE OR OBSERVATION WELL
W = XXXX INDUSTRIAL WELL

ALLUVIUM
Alluvium along the Red River has a maximum thickness of about 110 feet and consists of clay and silt at the surface, grading downward into coarse sand and fine gravel at the base.

A B — ANTLERS FORMATION
In area A, water in the Antlers Formation is under water-table conditions. The formation is mainly fine- to medium-grained sand containing local beds of sandstone and extensive layers and lenses of clay. The formation ranges in thickness from about 300 feet at the northern edge of area B to a maximum of 680 feet in southeastern McCurtain County. The depth to the top of the formation ranges from about 100 feet along the northern edge of area B to about 1,400 feet in southeastern McCurtain County. In southeastern McCurtain County water in the Antlers Formation is too highly mineralized for most uses (see sheet 3).

WELL YIELDS
(gallons per minute)
100 to 500
50 to 100

Locally, individual wells in any of the areas shown on the map may yield more than is indicated for that area.

Approximate area boundary; dashed where two areas overlap

Upper number is depth of well in feet; middle number is depth to water in feet below land surface in 1970 and 1971; lower number is yield of well in gallons per minute; where only two numbers are shown they are well depth and depth to water. Letter symbol indicates geologic source of water; symbols are the same as those on the geologic map; query (?) indicates geologic source is not definitely known.

Flowing well

Upper number is depth of well in feet; lower number is rate of flow in gallons per minute.

Well field

Upper number is number of wells in field; middle number is average depth of wells in feet; lower number is average well yield in gallons per minute.

Spring

Number beside spring symbol is yield in gallons per minute.

x = unknown
r = reported value
e = estimated
< = less than value shown
> = greater than value shown

AVAILABILITY OF GROUND WATER

The availability of ground water in any given part of the McAlester-Texarkana Quadrangle depends on the storage capacity and permeability of the underlying rocks. Of the various formations in the quadrangle, alluvium along the Red River, which consists of unconsolidated sand and some gravel, is one of the most favorable sources for large amounts of ground water (fig. 4). Except for a few domestic and stock wells, however, this aquifer is little used. As alluvium along other streams in the area is generally thin and contains a high proportion of silt and clay, it yields only small amounts of water, except possibly in a few local areas.

Terrace deposits are widespread along the Red River, but they provide only small supplies of water because of their high silt content and thinness, both of which greatly reduce the storage capacity. Terrace deposits in Pittsburg County consist of fairly clean, well-sorted sand, but these deposits are thin and go dry during periods of low rainfall.

The Antlers Formation is an important aquifer and has considerable potential for future development. According to Davis (1966, p. 29) the Antlers Formation (Pliney Sand of Davis) in southern McCurtain County consists of about 35 percent sand with a few gravel lenses, 40 percent sandy shale and shale, and 5 percent limestone. The sand occurs more consistently in the lower part of the formation, and that part of the section should be the most favorable for large well yields. North of the outcrop of the Goodland Limestone, which is shown on the geologic map (sheet 1), the Antlers Formation crops out at the surface, and water in the formation is under water-table conditions. Few large-yield wells are known in this area, partly because wells do not penetrate deeply enough and partly because of inadequate well construction.

South of its outcrop area, the Antlers is overlain by the nearly impermeable Goodland Limestone, and therefore the water is confined and is under artesian pressure. Under such conditions, water in wells penetrating the Antlers rises above the top of the Goodland Formation and some wells in topographically low areas may flow at the surface. Well yields in the artesian belt of the Antlers range from a few gallons per minute to 500 gpm. Large yields probably could be obtained throughout most of this belt if wells penetrated all or most of the formation and if better well-construction methods were used.

With the exception of the Antlers and Holly Creek Formations, rocks of Cretaceous age are generally fine grained and contain much silt and clay; consequently, they are unproductive of water in quantities greater than what is needed for household use.

North of the Choctaw Fault, the rocks are mainly shales which also generally yield only enough water for household use. Interbedded with the shales, however, are layers of sandstone, such as the Bloxjacket and Bartholomew, as well as many sandstone units not shown on the map, which yield moderate amounts of water locally. In the vicinity of Hoxwner, for example, artesian wells in sandstone aquifers yield as much as 50 gpm. Static water levels in these wells are near the surface, and a few wells flow.

The Biglork Chert and the Arkansas Novaculite in central McCurtain County and in the Potato Hills area are highly broken and fractured and probably are capable of storing and yielding moderate to large amounts of water. However, because of their remoteness few wells have been drilled into these formations, and their potential can only be inferred. Furthermore, these formations have been greatly folded and faulted, and selecting a well site would require careful study.

With the exception of the Biglork Chert and the Arkansas Novaculite, bedrock in the area between the Choctaw Fault and the Cretaceous rocks consists mainly of shale, siliceous shale, and sandstone. These rocks have been subjected to low-grade dynamic metamorphism which has increased their brittleness so that they have been broken by folding and faulting. These factors all combine to increase permeability, particularly in the sandstone and siliceous shale.

Geologically, the most advantageous sites to drill wells into these rocks, in general order of favorability, are (1) on anticlinal noses, (2) on flanks of anticlines, (3) near the ends of synclinal troughs, and (4) on flanks of synclines. Fault zones in sandstones may be favorable, but similar zones in siliceous shales apparently are not significantly greater in productivity. Flat-lying or gently dipping rocks, particularly shale, are least productive. In general, the water-yielding capabilities of the rocks between the Choctaw Fault and the Cretaceous rocks differ markedly from place to place. Well yields range from a few gallons per minute to as much as 50 gpm, but in local areas yields are not sufficient even for household use.

Because of the low level of ground-water usage from the major aquifers, as compared with the amount available, problems of overdevelopment have not occurred, except possibly in some very local areas. Large-yielding wells too close together may cause excessive drawdown, decreasing well yields and increasing pumping costs. This problem can be prevented or alleviated by proper well spacing. Although withdrawals from the alluvial aquifer along the Red River are insignificant at present, the aquifer may be used in the future to provide supplemental irrigation. Pumpage from wells in the alluvium may lower the water level, thereby inducing water to flow from the river into the alluvium. Although stream flow is reduced by the amount of induced recharge, water in the aquifer is continually replenished as long as streamflow is available. The most significant problem that might result from inducing recharge is degradation of water quality in the aquifer if the river water is more highly mineralized than that in the aquifer or if it contains pollutants.

REVISIONS

No.	Description	Date

KEY PLAN

SIGNATURE/SEAL

PROJECT
HUGO CCR IMPOUNDMENT

LOCATION
FORT TOWSON

PREPARED FOR
WESTERN FARMERS ELECTRIC COOPERATIVE

DRAWING TITLE
GROUND WATER RESOURCE & USAGE MAP

Project No.	20170331
Drawn By	RKF
Checked By	CSS
Date	9/20/18
Scale	AS NOTED
Issued For	----
Drawing No.	FIG 5

CARDINAL ENGINEERING
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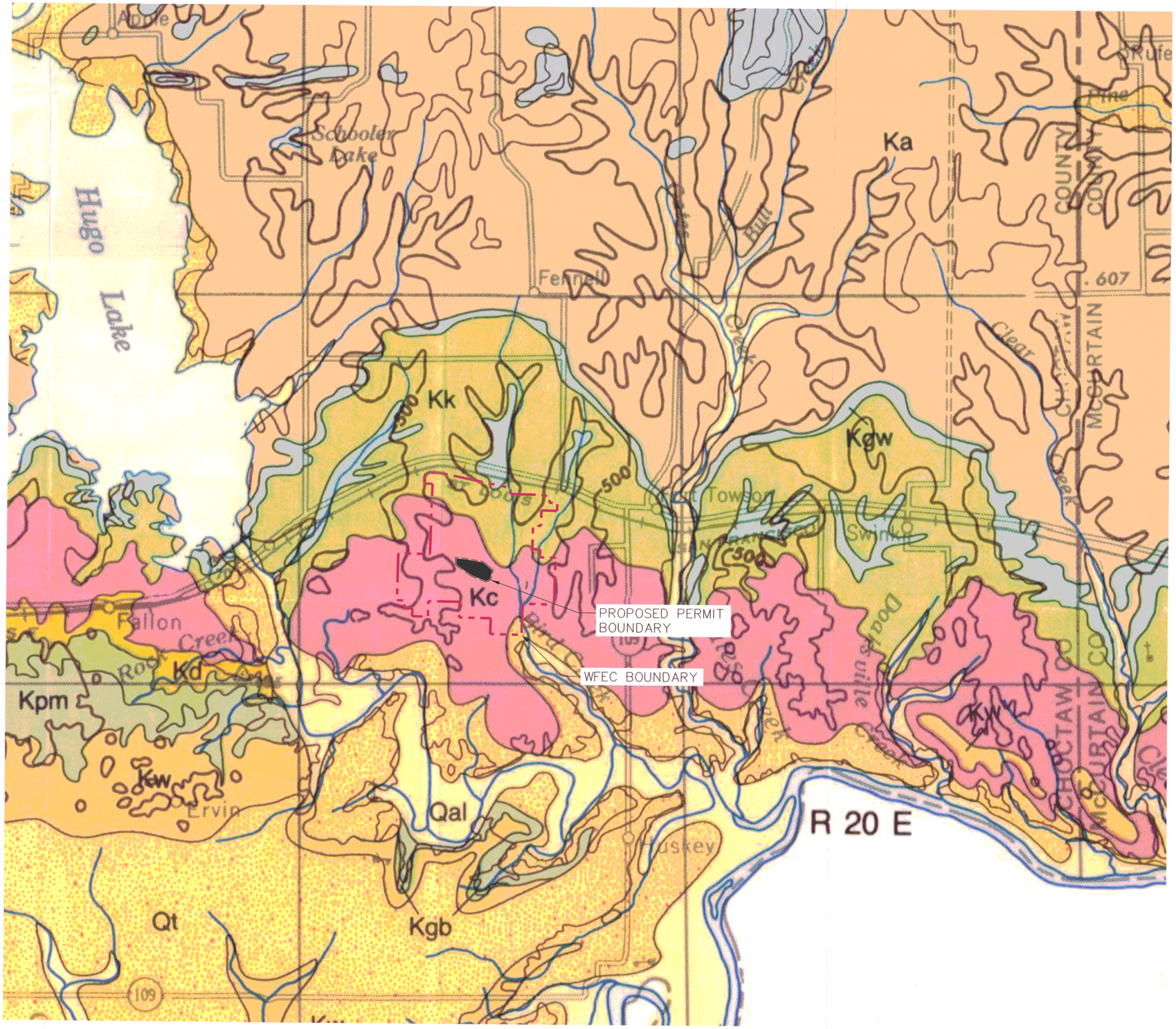

Kpm

PAWPAW SANDSTONE AND McNUTT LIMESTONE
Pawpaw Sandstone, yellowish- to reddish-gray, fine-grained, with gray to reddish-purple sandy clay; thickness, 35 feet. *McNutt Limestone* at base, grayish-brown, arenaceous, with *Rastellum quadriplicatum*; thickness, 2 to 3 feet.

Kgb

GRAYSON MARL AND BENNINGTON LIMESTONE
Grayson Marl, olive-gray, weakly indurated, with *Texigryphaea reesensi*; thickness, about 25 feet. *Bennington Limestone* at base, gray to gray-brown, sandy, fossiliferous, overlapped eastward by Woodbine; thickness, 0 to 18 feet.

Kgw

GOODLAND LIMESTONE AND WALNUT CLAY
Limestone, white, finely crystalline, massive-bedded, with *Texigryphaea mucronata*; some argillaceous buff beds in lower few feet may be Walnut Clay equivalents; erodes into a mappable escarpment; thickness, 26 to 55 feet.

Kw

WOODBINE FORMATION
Sand, dark-green, yellowish-red, white, gray, fine- to coarse-grained, tuffaceous in lower part; crossbedded, quartzose, and brownish-red noncalcareous clay; some gravel lentils with little to no quartz and some lignites and fossil plants; rests unconformably upon successively older Cretaceous units eastward; thickness, 325 to 455 feet, increasing eastward.

Kd

DENTON CLAY
Clay and shale, blue- to brownish-gray, and marly, fossiliferous limestone with *Texigryphaea washitaensis*; thickness, 45 to 65 feet.

Ka

ANTLERS SANDSTONE
Sandstone and sand, white to reddish-yellow to orange-brown to gray, fine- to coarse-grained, quartzose, crossbedded, moderately to weakly indurated, interbedded with variicolored clays and conglomerates; contains fossil wood and dinosaurs; rests unconformably upon Ouachita rocks but conformably on DeQueen Limestone; thickness, 0 to 320 feet, thickening southeastward to 900 feet in subsurface.

Kk

KIAMICHI FORMATION
Shale, dark-gray to black, with some brown fossiliferous limestones, with *Texigryphaea navia*; thickness, 28 to 36 feet, and up to 80 feet in subsurface of southern McCurtain County.

Kc

CADDO FORMATION
Limestones, white to cream, silty, alternating with gray shales, with *Texigryphaea washitaensis*; 7-foot bed at top (Fort Worth equivalent) and blue-gray silty shales and limestones below with *Texigryphaea navia* (Duck Creek equivalent); thickness, 150 feet.

Qt

TERRACE DEPOSITS
Gravel, sand, silt, clay and volcanic ash; several levels 20 to 160 feet or more above present flood plains, with each level containing deposits that average 20 to 30 feet in thickness, some windblown sand on top; may include colluvial wash down sides of hills.

Qal

ALLUVIUM
Gravel, sand, silt, and clay, including low terraces about 30 feet above channels; thickness, about 50 feet along Little River and 110 feet along Red River.

MAP REFERENCE:
RECONNAISSANCE OF THE WATER RESOURCES OF THE MCALESTER AND TEXARKANA QUADRANGLES, SOUTHEASTERN OKLAHOMA

N

4000' 0' 4000' 8000'
SCALE FEET
1" = 4000'

REVISIONS

No.	Description	Date

KEY PLAN

SIGNATURE/SEAL

PROJECT
HUGO CCR IMPOUNDMENT

LOCATION
FORT TOWSON

PREPARED FOR
WESTERN FARMERS ELECTRIC COOPERATIVE

DRAWING TITLE
SURFACE GEOLOGIC MAP

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Drawn By	RKF
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Scale	AS NOTED
Issued For	----
Drawing No.	

FIG 6

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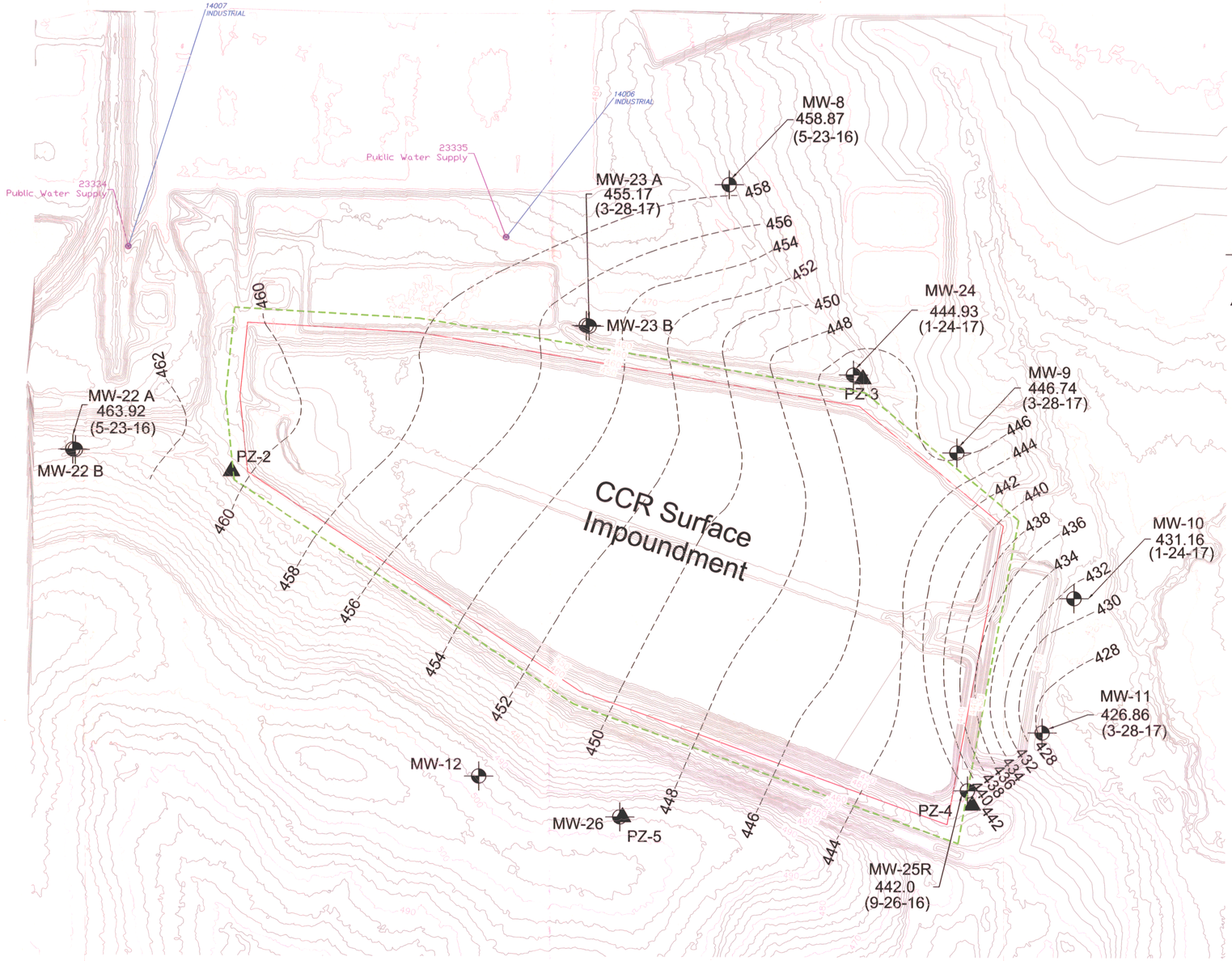

HIGHEST GROUNDWATER AT NETWORK WELLS (MW-8, MW-9, MW-10, MW-11, MW-22A, MW-23A, MW-24, NW-25/25R) FROM 8 BACKGROUND MONITORING EVENTS BETWEEN 5-23-16 & 8-23-17.

* HIGHEST GROUNDWATER ELEVATION MEASURED IN MW-25. MW-25 WAS PLUGGED AND REPLACED BY MW-25R.

WELL DETAILS

WELL NAME	SURFACE ELEVATION	TOP OF CASING ELEVATION
MW-8	466.93'	469.61'
MW-9	447.55'	450.42'
MW-10	431.21'	434.40'
MW-11	431.12'	434.32'
MW-12	497.24'	500.36'
MW-22A	475.23'	478.17'
MW-22B	475.15'	477.71'
MW-23A	466.99'	469.70'
MW-23B	466.98'	469.94'
MW-24	456.44'	459.09'
MW-25R	449.85'	452.04'
MW-26	496.79'	499.66'
PZ-2	462.84'	465.49'
PZ-3	456.31'	459.26'
PZ-4	450.57'	452.82'
PZ-5	496.81'	499.59'

MONITORING WELL
XXX.XX HIGHEST MEASURED GROUNDWATER ELEVATION
(X-XX-XX) DATE OF HIGHEST MEASURED GROUNDWATER ELEVATION

PIEZOMETER

Ⓦ = XXXX PUBLIC WATER SUPPLY WELL

Ⓦ = XXXX INDUSTRIAL WELL

-N-

200' 0' 200' 400'
SCALE FEET
1" = 200'

REVISIONS

No.	Description	Date

KEY PLAN

SIGNATURE/SEAL

PROJECT
HUGO CCR IMPOUNDMENT

LOCATION
FORT TOWSON

PREPARED FOR
WESTERN FARMERS ELECTRIC COOPERATIVE

DRAWING TITLE
HIGHEST GROUNDWATER CONTOUR MAP

Project No.	20170331
Drawn By	RKF
Checked By	CSS
Date	9/20/18
Scale	AS NOTED
Issued For	----

Drawing No.

FIG 7

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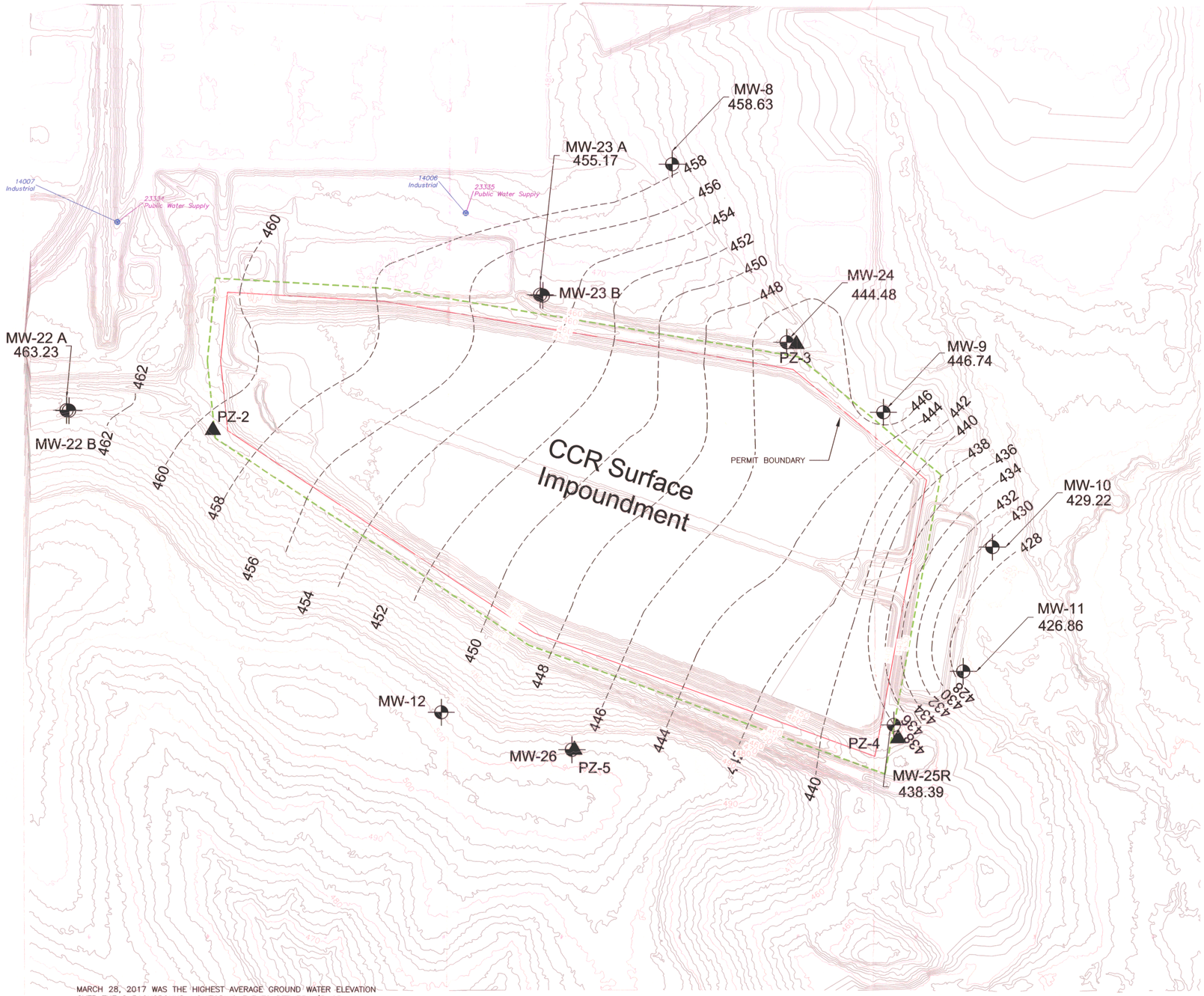

MARCH 28, 2017 WAS THE HIGHEST AVERAGE GROUND WATER ELEVATION OVER THE 8 BACKGROUND MONITORING EVENTS BETWEEN (5-23-19 – 8-27-17) USING MEASUREMENTS FROM THE NETWORK WELLS (MW-8, MW-9, MW-10, MW-11, MW-224A, MW-234A, MW-24 & MW-25/25R).

WELL DETAILS

WELL NAME	SURFACE ELEVATION	TOP OF CASING ELEVATION
MW-8	466.93'	469.61'
MW-9	447.55'	450.42'
MW-10	431.21'	434.40'
MW-11	431.12'	434.32'
MW-12	497.24'	500.36'
MW-22A	475.23'	478.17'
MW-22B	475.15'	477.71'
MW-23A	466.99'	469.70'
MW-23B	466.99'	469.94'
MW-24	456.45'	459.09'
MW-25R	449.85'	452.04'
MW-26	496.79'	499.66'
PZ-2	462.84'	465.49'
PZ-3	456.32'	459.26'
PZ-4	450.57'	452.82'
PZ-5	496.81'	499.59'

MONITORING WELL

PIEZOMETER

Ⓦ = XXXX PUBLIC WATER SUPPLY WELL

Ⓦ = XXXX INDUSTRIAL WELL

N

200' 0' 200' 400'

SCALE 1" = 200' FEET

REVISIONS

No.	Description	Date

KEY PLAN

SIGNATURE/SEAL

PROJECT

HUGO CCR IMPOUNDMENT

LOCATION
FORT TOWSON

PREPARED FOR
WESTERN FARMERS ELECTRIC COOPERATIVE

DRAWING TITLE
POTENTIOMETRC SURFACE MAP

(3-28-17)

Project No.	20170331
Drawn By	RKF
Checked By	CSS
Date	9/20/18
Scale	AS NOTED
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Drawing No.

FIG 8

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