Underground Injection Control – Class VI Permit Application for Mockingbird Carbon Storage Project Injection Wells No. 01, No. 02, No. 03, and No. 04

SECTION 3 – AREA OF REVIEW AND CORRECTIVE ACTION PLAN

Mockingbird Carbon Storage Project
Allen Parish, Louisiana
ExxonMobil Low Carbon Solutions Onshore Storage, LLC
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SECTION 3 – AREA OF REVIEW AND CORRECTIVE ACTION PLAN

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Tables

3.1 [redacted]

[redacted] the Louisiana Administrative Code, Title 43 (LAC43): XVII **§3615.B.2**

3.2 [redacted]

[redacted] consistent with the requirements of LAC43: XVII **§3615.B.2.**

- Predict the extent of the CO_2 plume and pressure front, which forms the basis for the AOR using computational modeling, and identify all wells that require corrective action (LAC43: XVII **§3615.B.3**).
- Provide a plan to perform the required corrective action on artificial penetrations in the AOR (LAC43: XVII **§3615.C.1**) that could threaten the underground source of drinking water (USDW).
- Support the development of effective monitoring strategies for the Testing and Monitoring Plan by identifying the locations where groundwater quality or pressure monitoring should be performed.
- Help direct emergency response planning by identifying potential vulnerable areas within or near the AOR that could require consideration when implementing an emergency response.
- Ensure that the Emergency and Remedial Response Plan and financial responsibility demonstration account for the most recently approved AOR (LAC43: XVII **§3615.C.3**).
- Provide a guide for periodic AOR reevaluations to inform site management and monitoring over the life cycle of the Mockingbird Project (LAC43: XVII **§3615.C.2**).
- Retain for 10 years the modeling inputs and data used to support AOR reevaluations (LAC43: XVII **§3615.C.4**).

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[redacted]

Figure 3-1 – Time-Lapse Migration of CO_2 Plume

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[redacted]

Figure 3-2 – Time-Lapse Migration of Critical Pressure Front

[redacted]

Figure 3-3 – Delineated Area of Review

3.3 Stages of Model Development

The stages of development for the CO_2 plume and pressure front model started with pre-operational phase data and industry standards to predict the AOR boundary. The geomodel and reservoir model rely on this data and on industry-standard correlations for the assignments of properties based on site-specific conditions derived from analysis of stratigraphic test well data. Physical rock-property distributions assigned to the model based on geostatistics have been analyzed and are consistent with all available data.

Looking forward to the operational phase of the Mockingbird Project, updates for calibration purposes will be made to the model. The model calibration procedures will likely focus on the parameters that have been identified during the pre-operational modeling effort as the most sensitive parameters during sensitivity analyses. The calibration process is intended to be an iterative one, with updates to the geomodel and input parameters—to achieve an acceptable agreement between model predictions and the collected testing and monitoring data.

3.4 Corrective Action Plan and Schedule

Consistent with LAC43: XVII **§3615.C**, the primary objective of this Corrective Action Plan is to identify the potential risk for loss of CO_2 or brine containment through artificial penetrations of the upper confining zone (UCZ), and to specify corrective actions that would be taken to restore the integrity of the UCZ, if needed. ExxonMobil undertook a thorough investigation of artificial penetrations within and immediately adjacent to the AOR. [redacted]

[redacted] artificial penetrations were found to penetrate the UCZ, based on an analysis of the available data. Following the requirements outlined in LAC43: XVII **§3615.B.3.b**, **§3615.B.3.c**, and **§3615.C.1**, each artificial penetration within the AOR that may penetrate the UCZ was evaluated either for the quality of casing and cementing in the existing wells, or for the quality of plugging and abandonment (P&A) in the abandoned wells. Based on ExxonMobil's review, [redacted] artificial penetrations warrant leak risk modeling or corrective action planning and scheduling based on conservative assumptions regarding the potential for impact by injection.

This section provides for [redacted] a rigorous corrective action process that begins with additional well-assessment activity and ends with establishing incremental barriers to remedy the potential for CO_2 or brine crossflow between the injection zone and the USDW.

3.4.1 Data Acquisition and Evaluation of Artificial Penetration Information

In accordance with LAC43: XVII **§3607.C.1, §3607.C.2.d**, and **§3615.B.3.b**, a search was conducted to identify and assess the occurrence of artificial penetrations within the AOR. A comprehensive search of publicly available data sets was also performed to search for state- or EPA-approved subsurface cleanup sites, including Superfund/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites, hazardous waste/Resource Conservation and Recovery Act (RCRA) sites, brownfields, and leaking underground storage tanks—as well as springs, mines, and quarries within the AOR.

The following data searches were conducted for the Mockingbird Project to make a determination. Based on a data search utilizing the EPA EnviroAtlas, the Mockingbird Project is free of any Superfund/CERCLA sites, hazardous waste sites, and brownfields. [redacted] are shown in *Appendix C5*. The Mockingbird Project is free of any mines or quarries according to the Office of Surface Mining Reclamation and Enforcement and the National Mine Map Repository.

The following data sources were reviewed to identify potential artificial penetrations within the AOR:

- The Louisiana Department of Energy and Natural Resources (LDENR) Strategic Online Natural Resources Information System (SONRIS) GIS Database
- Third-party oil-and-gas record databases including Enverus Drilling Info, IHS Energy Portal, Tobin Data, EMSDB, HART, and Enerdeq

A tabulation of identified artificial penetrations within the AOR was created using a combination of the above data and is summarized in Table 3-1. Available records for the identified artificial penetrations are included in *Appendix C*.

Based on the artificial penetrations identified in the above databases, the following additional analysis was or will be conducted to assess the accuracy of well presence, location, and condition:

- A physical record request was made to the LDENR, and the available documents were reviewed.
- An aeromagnetic survey of the AOR will be conducted.
- In-person reconnaissance surveys will be conducted once surface access is secured.

Table 3-1 – Summary of Artificial Penetrations Within the AOR

[redacted]

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[1] Readily available well identification numbers provided from public data sources up to October 8, 2024.

Area of Review: Freshwater Wells List

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Figure 3-4 – Freshwater Wells Within the AOR

3.4.1.1 Physical Records Review

The records of artificial penetrations with the AOR were reviewed through digital copies on the LDENR online databases, Enverus Drilling Info, and IHS Energy Portal. These records are included in *Appendix C*.

3.4.1.2 Aeromagnetic Survey

Due to the age of well development in the area, additional data collection is required to improve the accuracy of well locations and details. Magnetic survey methods—planned to be conducted in 2025—will be used to scan portions of the AOR for magnetic anomalies caused by subsurface features, which could include abandoned wellbores with iron or steel casing.

This section and its associated tabulation of artificial penetrations will be updated with aeromagnetic survey results once the surveys are executed. Legacy well locations will be updated and any additional artificial penetrations of the UCZ added, and corrective actions required to remediate the UCZ will be planned.

3.4.1.3 Review of Abandoned Well Plugging Records

ExxonMobil conducted an evaluation of the information available for the artificial penetrations listed in Table 3-1. The list of topics reviewed included the following:

- Well depth and completion
- Well drilling date
- Well abandonment date
- Openhole or cased-hole identification
- Location of reported plugs
- Casing and cementing records
- Well deviations

[redacted] were identified as penetrating the UCZ and subject to an assessment of plugging records—and, potentially, to corrective action for deficiencies.

3.4.1.4 Summary of Artificial Penetrations Tabulation

Wells and boreholes that did not penetrate the UCZ were determined to pose no hypothetical risk to function as a vertical conduit from the injection zone. For those artificial penetrations that were completed below the UCZ, multiple sources of information were reviewed, and the relevant information was analyzed in detail (LAC43: XVII **§3615.B.3.b**). Table 3-1 presented a summary of the artificial penetrations of interest for developing the Corrective Action Plan. Schematics detailing UCZ-penetrating wells and their proposed corrective actions are presented in *Appendix C*.

3.4.2 Corrective Action Plans for Artificial Penetrations

ExxonMobil developed a corrective action plan for each artificial penetration that was identified to have the potential to act as a vertical conduit, because it was either not plugged or not plugged in a manner that, as required by LAC43: XVII **§3615.B.3** and **§3615.C.1**, mitigates the movement of CO_2 or other fluids that could potentially endanger USDWs. For the wells identified with plugging deficiencies, the basis for the corrective action strategy is to reenter and install cement barriers to mitigate migration potential.

3.4.2.1 Corrective Action Phasing

[redacted]

As described in *Section 5 – Testing and Monitoring Plan*, direct and indirect monitoring technologies will be used to track the CO_2 plume and pressure front. A planned reevaluation of the AOR will occur after 5 years of injection and at least at 5-year intervals throughout the life cycle of the Mockingbird Project. If, at any evaluation, the rate of the CO_2 plume or pressure front expansion is predicted to impact additional artificial penetrations that may be found, the Corrective Action Plan will be amended to include the necessary corrective actions to address the potential for USDW endangerment, in accordance with LAC43: XVII **§3615.B.2.b.i–iv**.

3.4.2.2 Analysis of Wells Identified for Corrective Action

Table 3-3 summarizes the available information concerning the borehole or well completion features and the P&A activities, as appropriate. ExxonMobil reviewed this information and determined the specific defects that require mitigation under LAC43: XVII **§3615.B.3** and **§3615.C.1**.

Table 3-2 – List of Artificial Penetrations and Schedule for Corrective Action

[redacted]

Table 3-3 – Summary of P&A Deficiency for Wells Penetrating the UCZ

[redacted]

3.4.3 [redacted]

The planned actions are based on proposed plug deficiencies potentially present in the legacy wells, based on the available records (displayed in Table 3-3). Each artificial penetration in the CO_2 plume will be reentered, and if sufficient barriers are not present, each well will have the appropriate barriers installed during the corrective action P&A field operations. The barriers will be established at the UCZ, the surface casing shoe (where applicable), the base of the lowermost USDW, and the wellhead surface. The barrier at the UCZ will be constructed of CO_2-compatible material consistent with LAC43: XVII **§3615.C.1**.

A general approach for well reentry and corrective actions is summarized in the sections below.

A detailed summary of the corrective action sequence for each well is presented in Table 3-4—and in *Appendix C*, as specific well schematics for each well identified in the AOR.

3.4.3.1 Preparing the Surface Location

Prior to mobilizing at a well location, ExxonMobil will conduct an initial site visit to identify current site access and wellhead conditions. A subsurface survey may be completed utilizing ground-penetrating radar to identify the well location. If legacy equipment remains on the site, the equipment will be removed prior to mobilization. Surface piping and electrical components will be assessed and removed from the site locations. Additionally, access roads to the area surrounding the pad and wellhead-access improvements may be needed to facilitate safe entrance and egress along with rig operations.

If a sign or marker is present, the first step will be to confirm that the API number on the plat corresponds to the well where mobilization is taking place, to complete corrective action operations. After the P&A marker or exposed metal plate is removed, the necessary equipment will be rigged up on the well. The cement surface plug of the well will be drilled out and the hole reentered for corrective action.

ExxonMobil will follow required notification requirements prior to commencing remedial field activities that may take the form of workover or drilling operations. Prior to commencement of well plugging operations, ExxonMobil will acquire a work permit from the LDENR outlining the proposed procedure for plugging the wells. ExxonMobil will also provide the completion paperwork after the plugging operations are complete.

3.4.3.2 [redacted]

[redacted]

[redacted]

[redacted]

3.4.3.3 Setting a Plug for the UCZ

Each legacy well requiring corrective action will have a 100’ CO_2-compatible cement plug set at the UCZ. The cement will be designed to withstand the long-term exposure of temperature, pressure, and chemical environment. The barrier will be tested for estimated hardness and integrity after placement.

3.4.3.4 Setting Plugs at the Casing Shoe, Lowermost USDW, and Surface

A cement plug will be set at the USDW and casing shoe (when present). The lowermost USDW will be plugged with a minimum 100-foot cement plug in a cased hole and a minimum 250-foot plug in an open hole that will be set at the base of the lowermost USDW depth—starting from 50–100 feet beneath that depth and extending 50–150 feet above the target depth. The casing shoe will be plugged with a minimum 100-foot cement plug set at the base of the surface casing shoe, starting 50 feet beneath that depth and extending 50 feet above the target depth. The cement will be lab-tested prior to pumping, and pressure-tested or tagged at each relevant marker. A final 30-foot cement plug will be set at the surface before cutting the casings 2 feet beneath the plow depth.

3.4.3.5 [redacted]

3.4.3.6 Surface Restoration

The wellhead will be cut off at 5 feet below ground level. A metal plate with the API number will be welded to the top of the casing. The area around the well will be backfilled above the casing stub to the surface. The site will then be restored to its previous conditions.

3.4.3.7 Reporting Completion of Corrective Action

After completing the corrective actions and re-plugging a well, a Form UIC-P&A plugging report will be submitted to the LDENR within 30 days of plugging. Records of the corrective actions will be submitted to the Commissioner of Conservation (Commissioner).

3.4.4 Site-Specific Review of Corrective Actions

Table 3-4 provides the corrective action sequences for the [redacted] wells, [redacted] of which ExxonMobil is not proposing corrective action for. For each legacy well that will be reentered for evaluation and re-plugging, *Appendix C* provides the well schematics that have been developed based on both the historical information and the completion of the associated proposed corrective actions.

Table 3-4 – Summary of Corrective Actions for Wells Penetrating the UCZ

[redacted]

[redacted]

[redacted]

[redacted]

3.4.5 Plan for Site Access

In accordance with LAC43: XVII **§3615.B.2.b.iv** and **§3615.C.1**, ExxonMobil is in the process of negotiating land access for each of the artificial penetrations identified for corrective action. Research to identify the well owners via regulatory databases has been completed. The process of securing necessary access rights (Table 3-5) will be completed in advance of the final submittal of this permit application to the Commissioner.

Discussions are underway with the owner and operators of record to enter into an access agreement to perform corrective actions. If appropriate and necessary, ExxonMobil will seek plugging orders from the LDENR to obtain access for corrective actions.

If the AOR reevaluation conducted at the minimum schedule of once every 5 years identifies the potential for corrective action requirements at additional wells, ExxonMobil will promptly begin review of the additional wells in accordance with the process described in this Corrective Action Plan. If site access issues are identified for wells identified for corrective action, ExxonMobil will notify the Commissioner.

Table 3-5 – Summary of Access Milestones for Corrective Action

[redacted]

3.5 [redacted]

3.5.1 [redacted]

[redacted]

[redacted]

3.5.2 [redacted]

[redacted]

- [redacted]
- [redacted]
- [redacted]

3.5.3 [redacted]

[redacted]

[redacted]

[redacted]

Table 3-6 – Triggers for AOR Reevaluation

[redacted]

[redacted]

Quatre Minerals LLC #001 Corrective Action Schematic
Rice Land & Lumber Co. #001 Corrective Action Schematic
Quatre Parish #001 Corrective Action Schematic
Quatre Parish #001 Corrective Action Schematic
Quatre Parish Company #001 Corrective Action Schematic
Quatre Parish Company #001 Corrective Action Schematic
Powell Lumber Company #001 Corrective Action Schematic
Hillyur Deutsch Edwards #001 Corrective Action Schematic
Riceland Lumber Company #001 Corrective Action Schematic
FEAGIN & TUBB #001 Corrective Action Schematic
VUA; MYRICK U #001 Corrective Action Schematic
Quatre Parish Co #001 Corrective Action Schematic
Rice Land & Lumber Co #001 Corrective Action Schematic
Quatre Parish Co #001 Corrective Action Schematic
VUC; P Broussard U1 #1 Corrective Action Schematic

Appendix C – Area of Review and Corrective Actions