Denbury Carbon Solutions, LLC

Testing and Monitoring Plan

Leo Storage Facility, Simpson and Copiah Counties, Mississippi

Denbury

TABLE OF CONTENTS

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[redacted]

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
ACZ	Above Confining Zone
AoR	Area of Review
ASTM	American Society for Testing and Materials
CAST	Circumferential Acoustic Scanning Tool
CO2	Carbon Dioxide
CFR	Code of Federal Regulations
CM	Corrective Maintenance
CRDS	Cavity Ring-Down Spectroscopy
ERRP	Emergency and Remedial Response Plan
IRMS	Isotope Ratio Mass Spectrometry
kh	Transmissibility
mg/L	Milligram per Liter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
OA	Oxygen Activation
P/T	Pressure and temperature
PM	Preventive Maintenance
PNL	Pulsed Neutron Log
QASP	Quality Assurance and Surveillance Plan
QC	Quality Control
UIC	Underground Injection Control
USDW	Underground Source of Drinking Water
USEPA	United States Environmental Protection Agency
USIT	Ultrasonic Imager Tool
WFL	Water Flow Log

1.0 FACILITY INFORMATION

Facility Name: Leo Storage Facility

Facility Location: [redacted]

Mailing Address: 5851 Legacy Circle, Suite 1200

Plano, Texas 75024

Well Location(s): Simpson County, Mississippi

Well Coordinates: [redacted]

This Testing and Monitoring Plan describes how Denbury Carbon Solutions, LLC (Denbury) will monitor the Leo Storage Facility site pursuant to 40 CFR 146.90. In addition to demonstrating that the well is operating as planned, the carbon dioxide (CO_2) plume and pressure front are moving as predicted, and that there is no endangerment to any underground source of drinking water (USDW), the monitoring data will be used to validate and adjust the geological models used to predict the distribution of the carbon dioxide within the storage zone to support Area of Review (AoR) reevaluations and a non-endangerment demonstration.

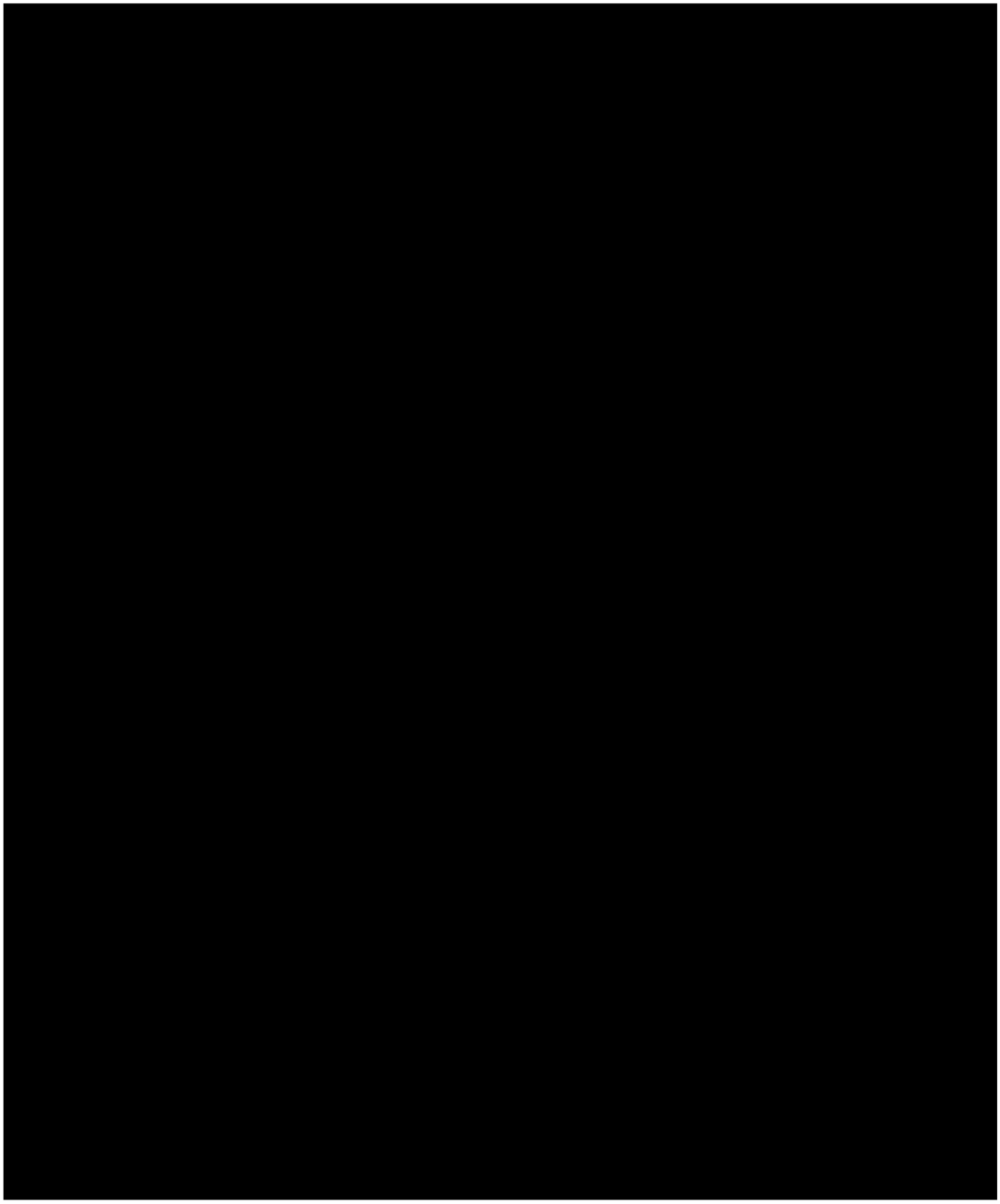
[redacted]

2.0 OVERALL STRATEGY AND APPROACH FOR TESTING AND MONITORING

This Testing and Monitoring plan for the Leo Storage Facility includes an analysis of the injected CO_2, continuous and periodic testing of the injection wells, a corrosion-monitoring plan for the injection wells, a leak detection and monitoring plan for surface components of the CO_2 injection system, and a subsurface leak detection plan to monitor for potential movement of the CO_2 outside of the storage reservoir. As such, this plan simultaneously meets the permit requirements for three required monitoring activities:

1) Corrosion monitoring and prevention;
2) Surface leak detection and monitoring; and
3) Subsurface leak detection and monitoring.

All of the above monitoring efforts will be used to verify that the geologic storage project is operating as permitted and is protecting USDWs. [redacted]



2.1 QUALITY ASSURANCE AND SURVEILLANCE PROCEDURES

A quality assurance and surveillance plan (QASP), pursuant to 40 CFR 146.90(k), for testing and monitoring activities described in this Testing and Monitoring Plan is provided in Appendix A. [redacted]

2.2 REPORTING PROCEDURES

Denbury will report the results of all testing and monitoring activities to the USEPA in compliance with the requirements under 40 CFR 146.91, as follows:

(a) Semi-annual reports containing:

(1) Any changes to the physical, chemical, and other relevant characteristics of the carbon dioxide stream from the proposed operating data;

(2) Monthly average, maximum, and minimum values for injection pressure, flow rate and volume, and annular pressure;

(3) A description of any event that exceeds operating parameters for annulus pressure or injection pressure specified in the permit;

(4) A description of any event which triggers a shut-off device required pursuant to § 146.88(e) and the response taken;

(5) The monthly volume and/or mass of the carbon dioxide stream injected over the reporting period and the volume injected cumulatively over the life of the project;

(6) Monthly annulus fluid volume added; and

(7) The results of monitoring prescribed under § 146.90.

(b) Report, within 30 days, the results of:

(1) Periodic tests of mechanical integrity;

(2) Any well workover; and,

(3) Any other test of the injection well conducted by the permittee if required by the Director.

(c) Report, within 24 hours:

(1) Any evidence that the injected carbon dioxide stream or associated pressure front may cause an endangerment to a USDW;

(2) Any noncompliance with a permit condition, or malfunction of the injection system, which may cause fluid migration into or between USDWs;

(3) Any triggering of a shut-off system (*i.e.,* down-hole or at the surface);

(4) Any failure to maintain mechanical integrity; or.

(5) Pursuant to compliance with the requirement at § 146.90(h) for surface air/soil gas monitoring or other monitoring technologies, if required by the Director, any release of carbon dioxide to the atmosphere or biosphere.

(d) Owners or operators must notify the Director in writing 30 days in advance of:

(1) Any planned well workover;

(2) Any planned stimulation activities, other than stimulation for formation testing conducted under § 146.82; and

(3) Any other planned test of the injection well conducted by the permittee.

3.0 ANALYSIS OF INJECTED CO_2 AND INJECTION WELL TESTING

3.1 CO_2 ANALYSIS

Prior to injection, Denbury will determine the chemical and physical characteristics of the CO_2 stream using appropriate analytical methods as described in the attached QASP document.

3.1.1 Analysis Parameters

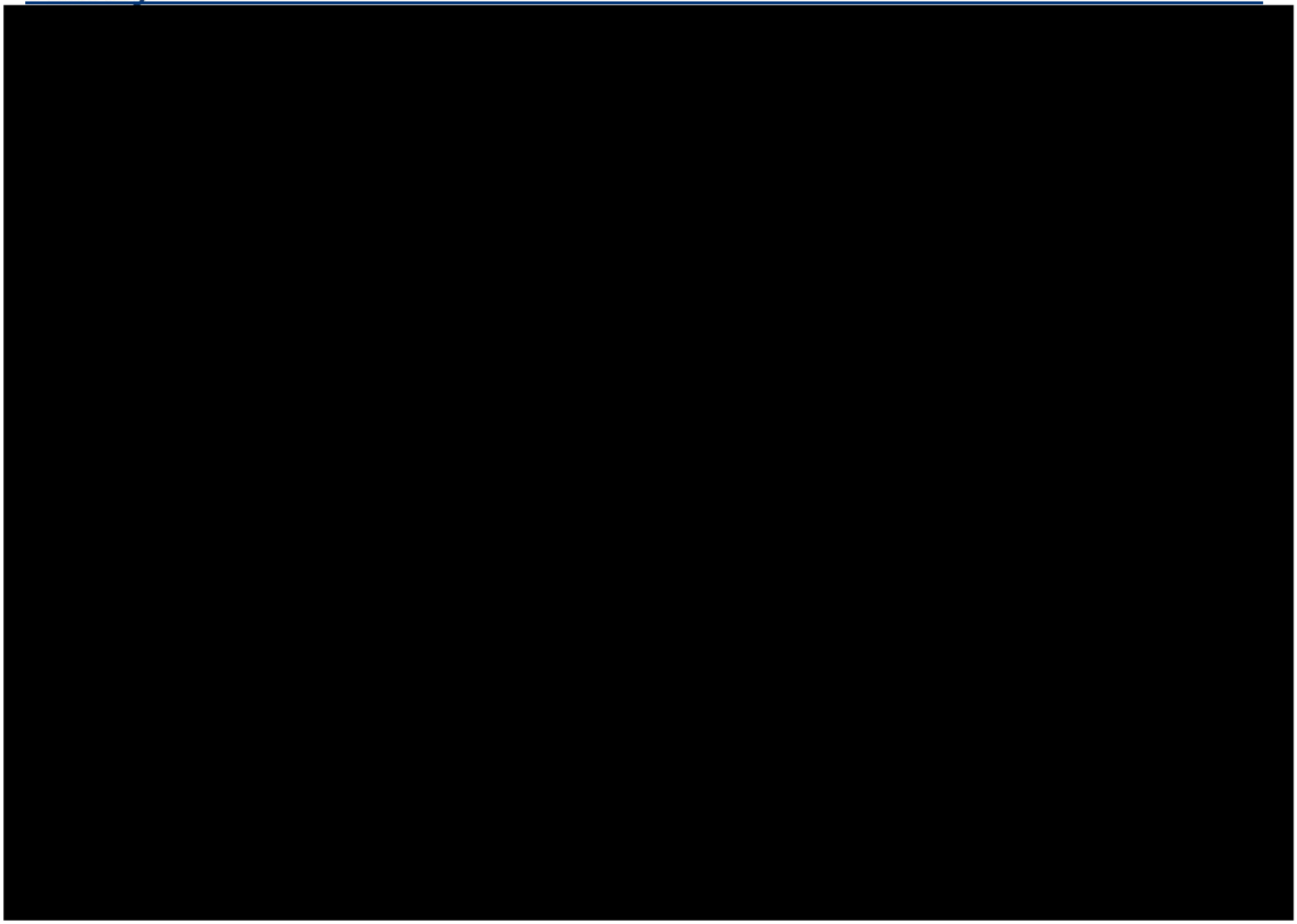
According to the requirements of 40 CFR 146.90. an analysis of the CO_2 stream is required with sufficient frequency to provide data representative of its chemical and physical characteristics. [redacted]

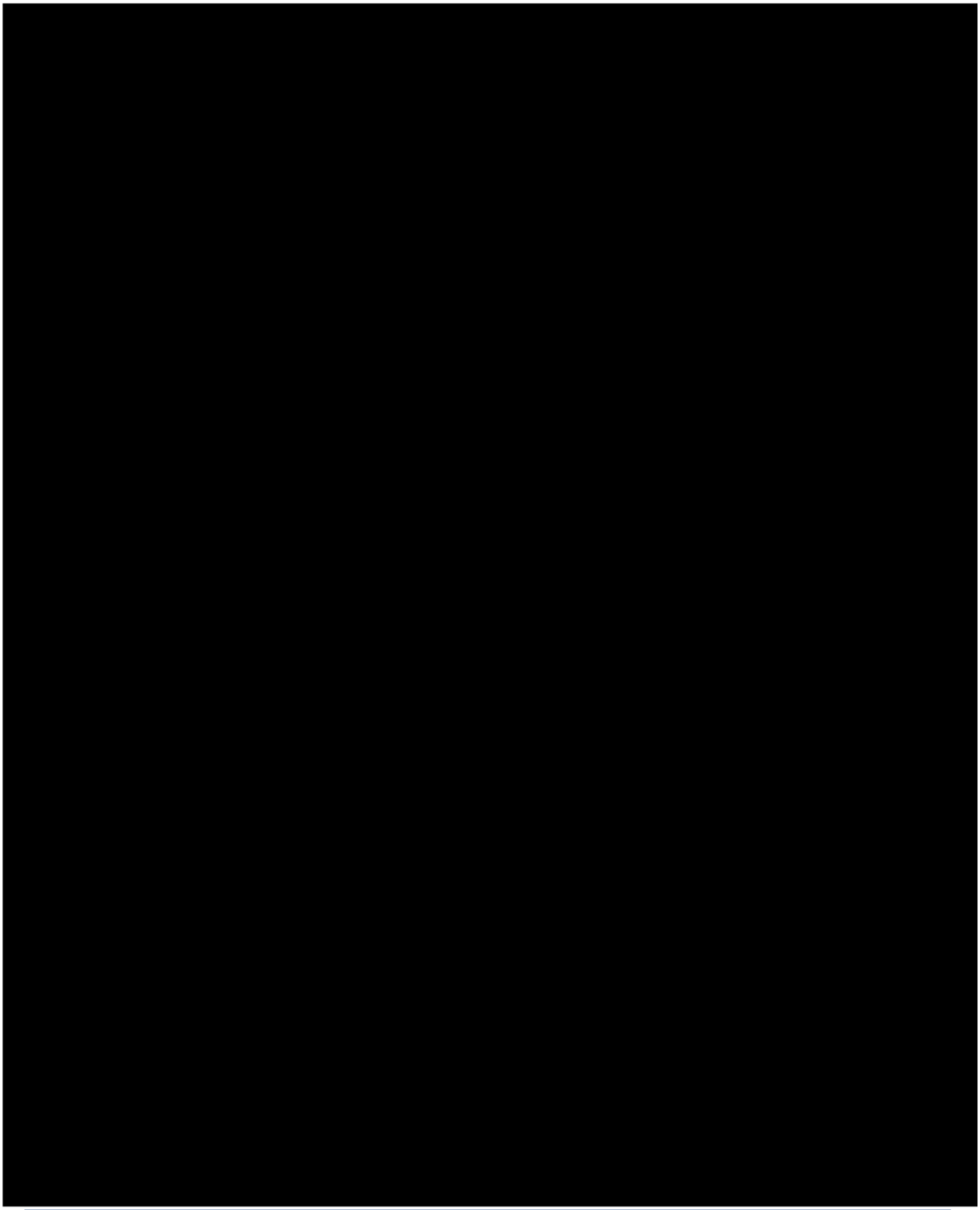
3.2 INJECTION WELL INTEGRITY TESTS

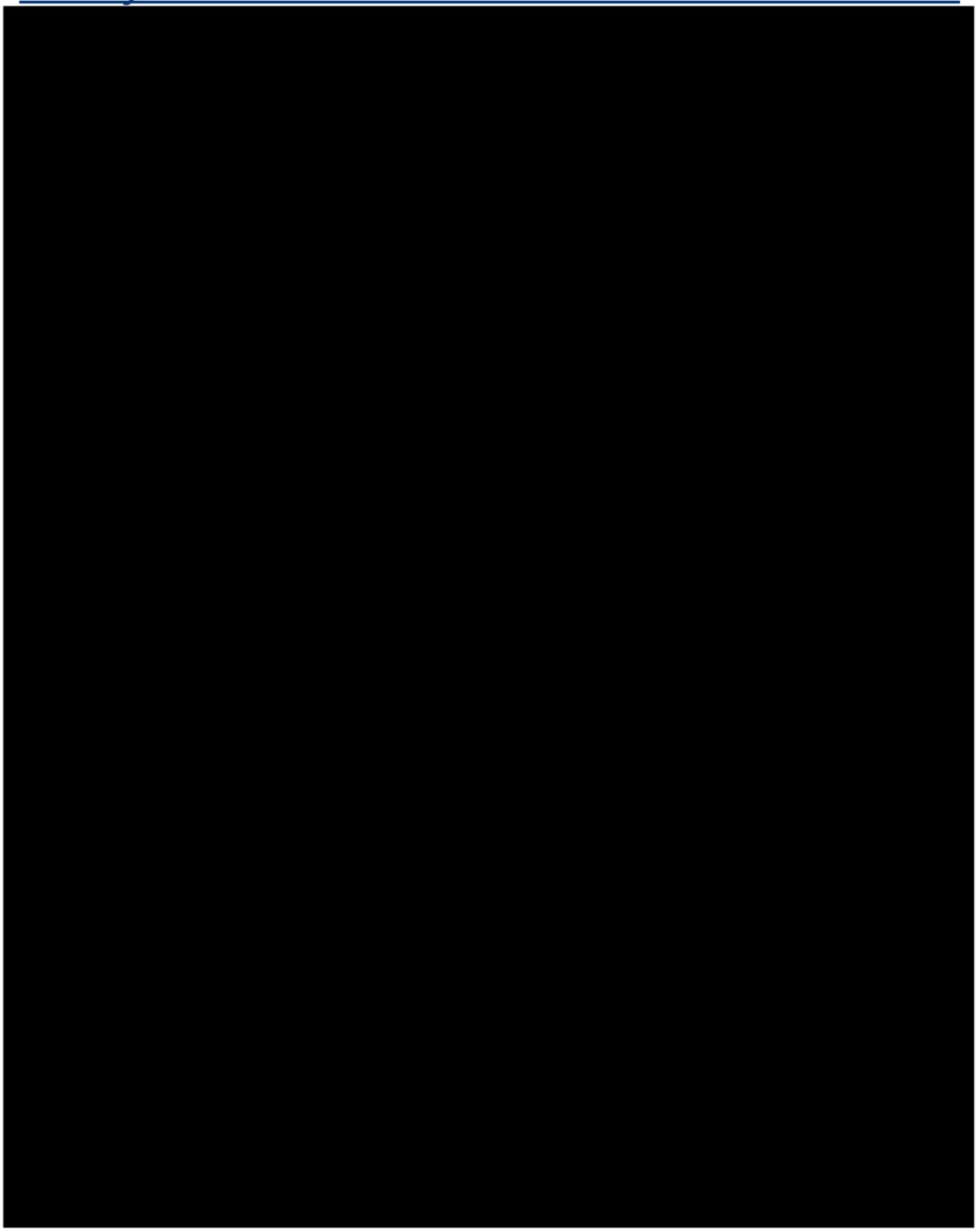
Until the CO_2 injection well is plugged, Denbury will be able to monitor both its internal and external mechanical integrity. [redacted]

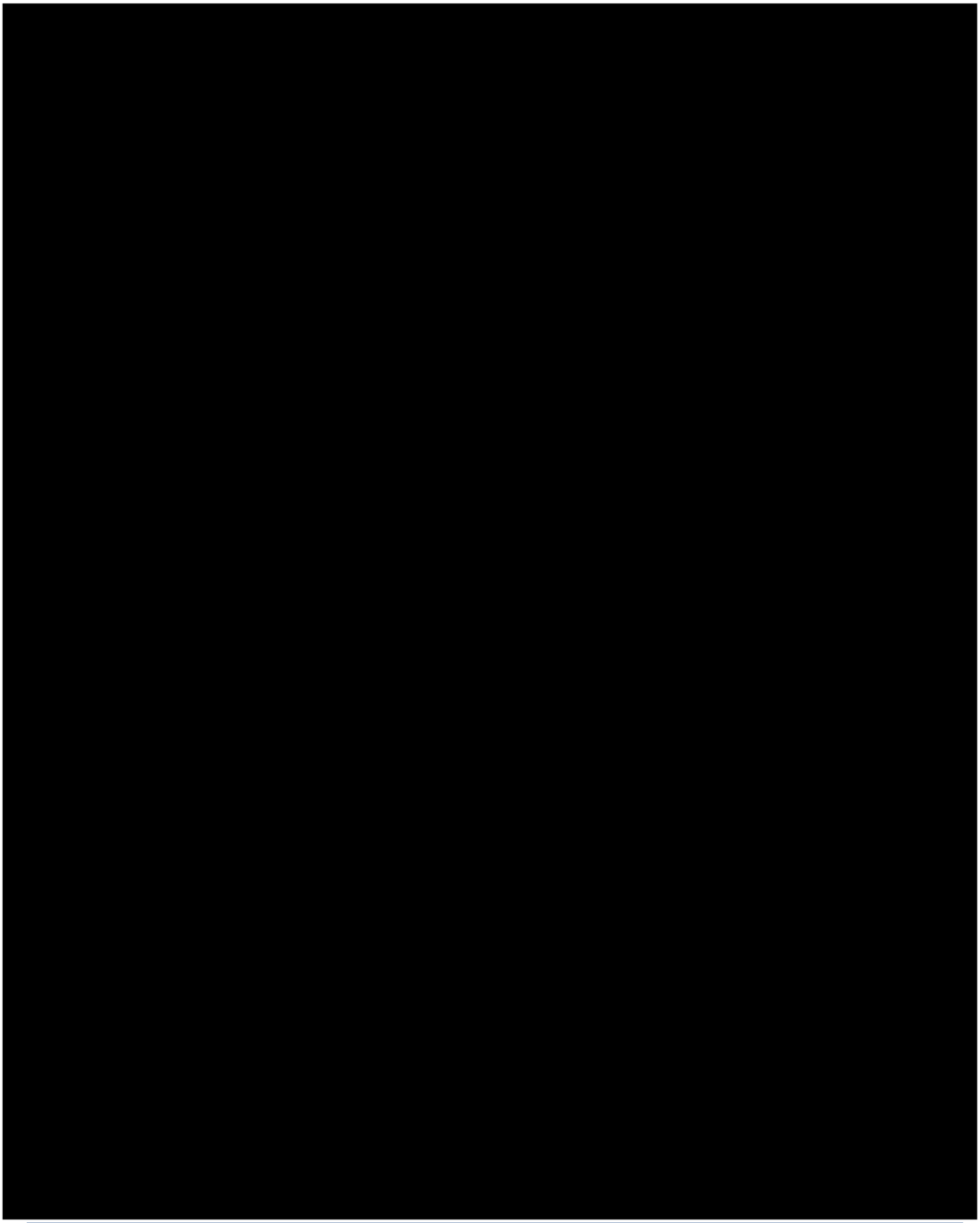
4.0 CONTINUOUS RECORDING OF OPERATIONAL PARAMETERS

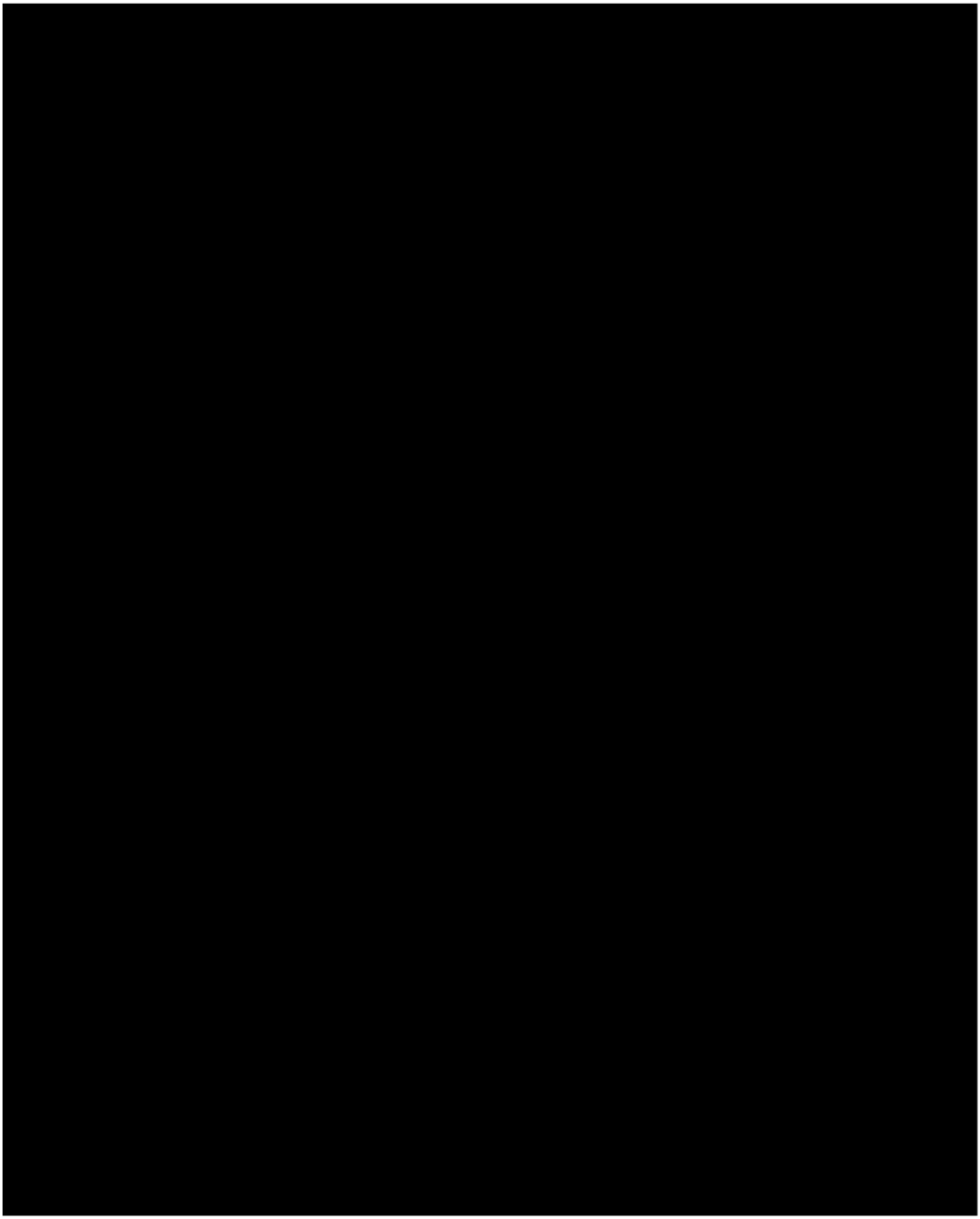
Denbury will ensure operation of continuous recording devices and alarms and automatic shut-off systems as required by 40 CFR 146.88(e)

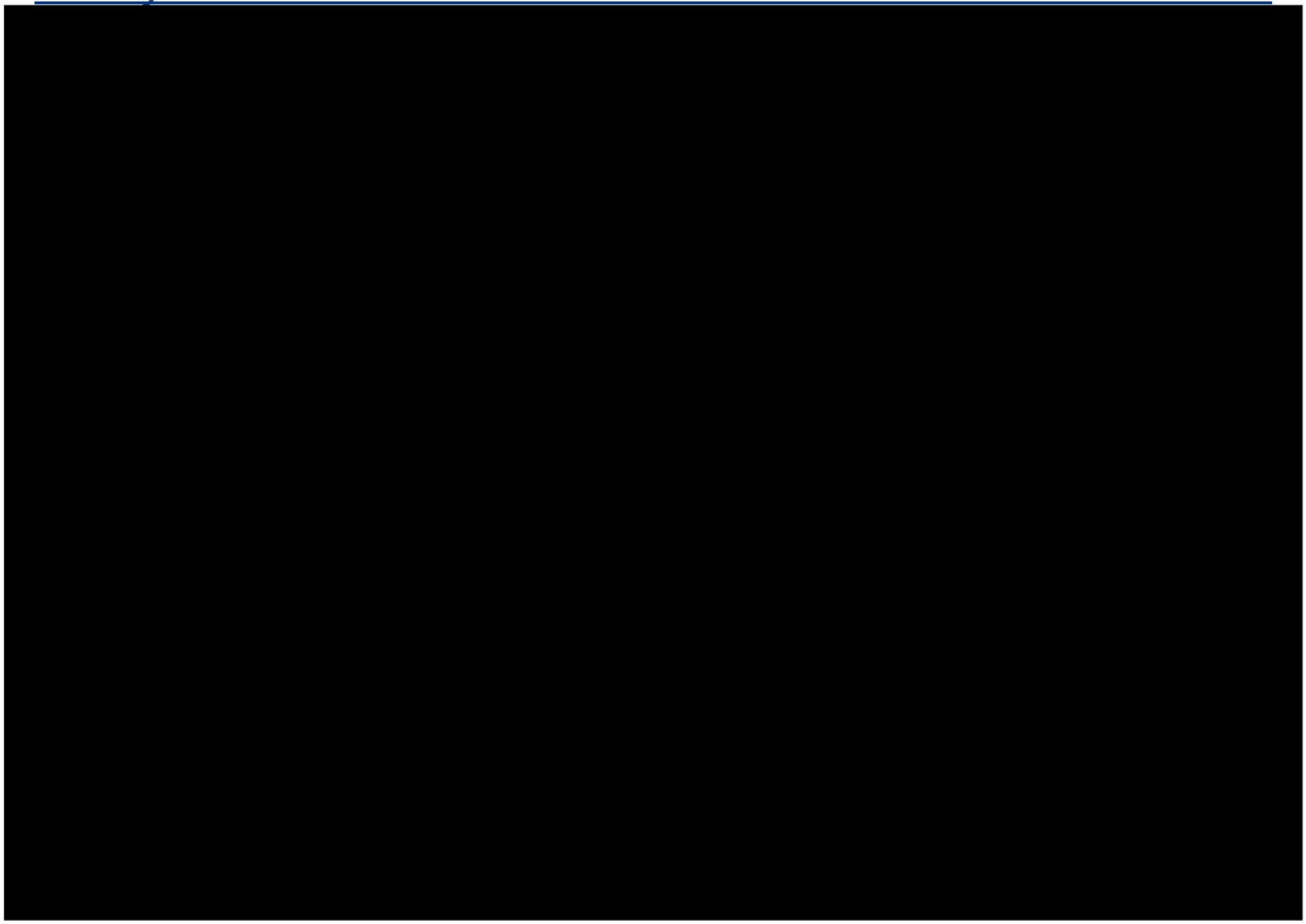


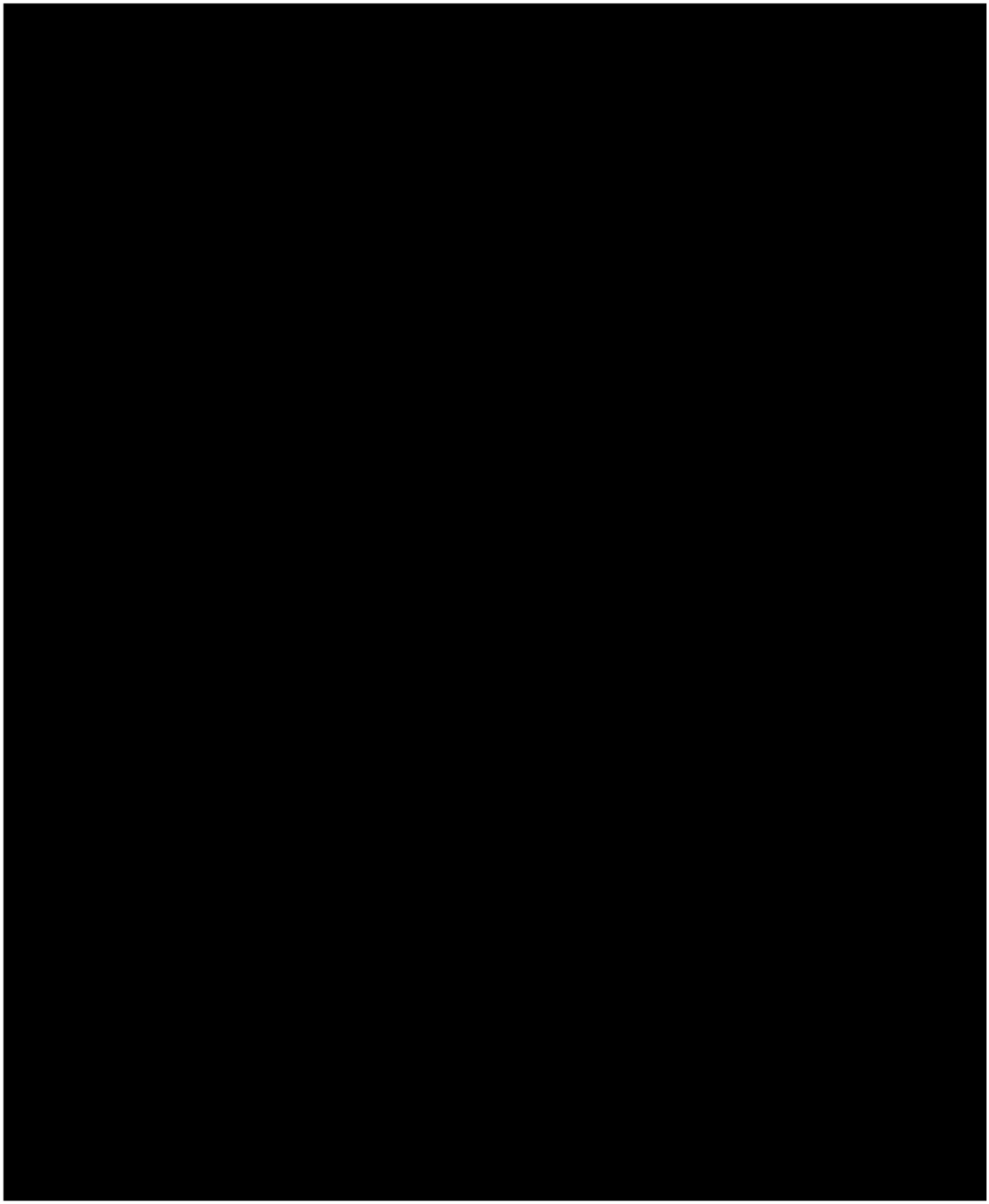


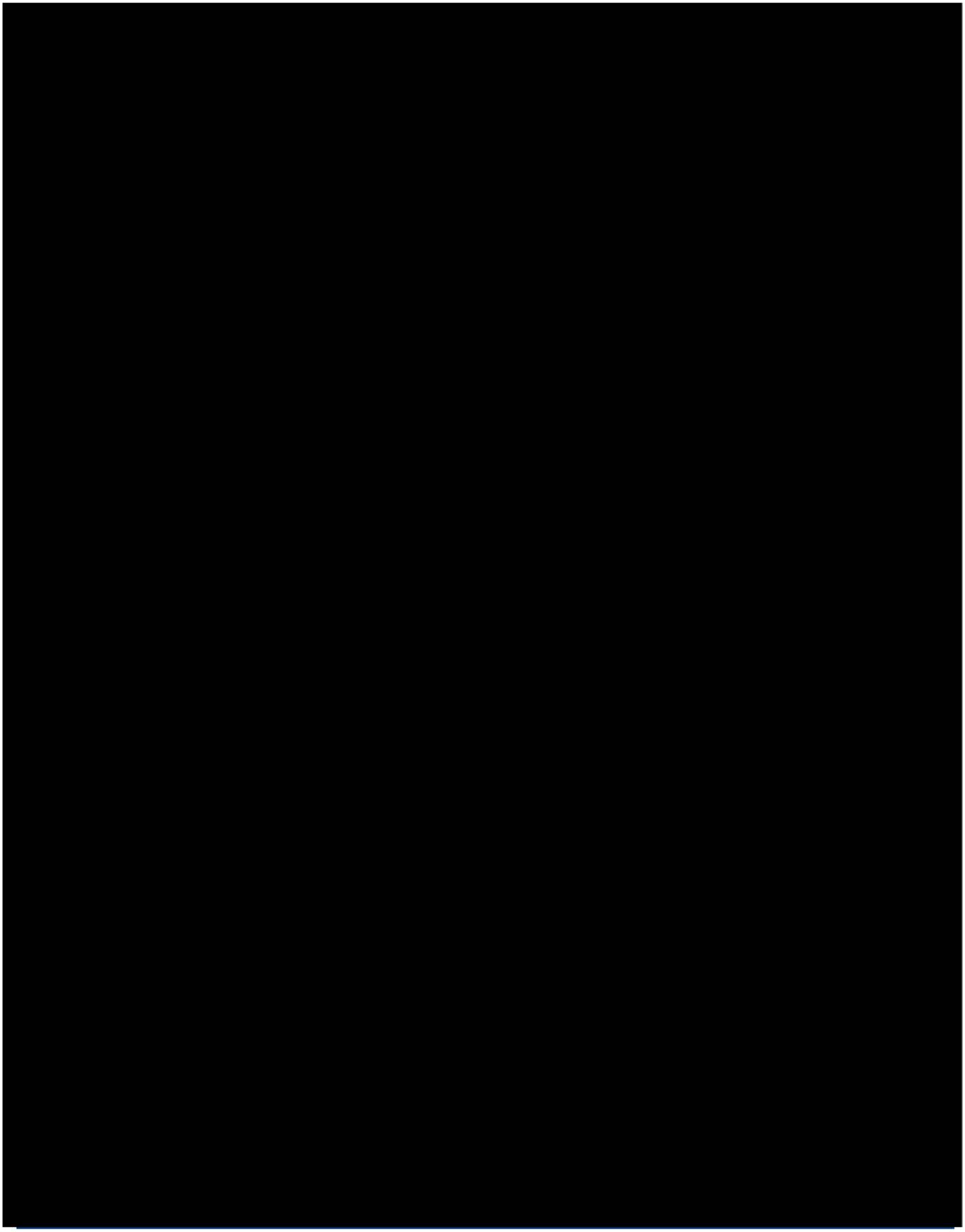


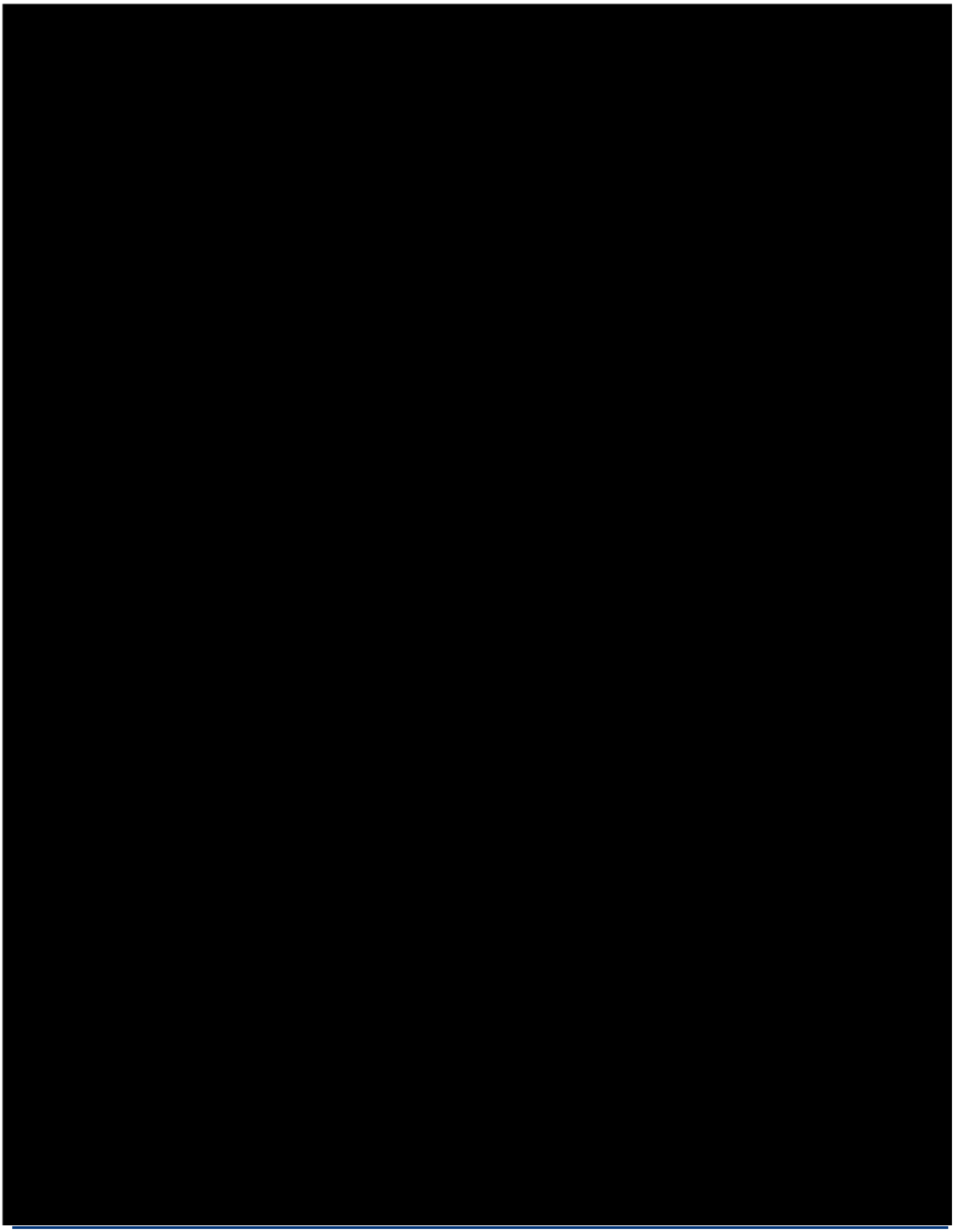


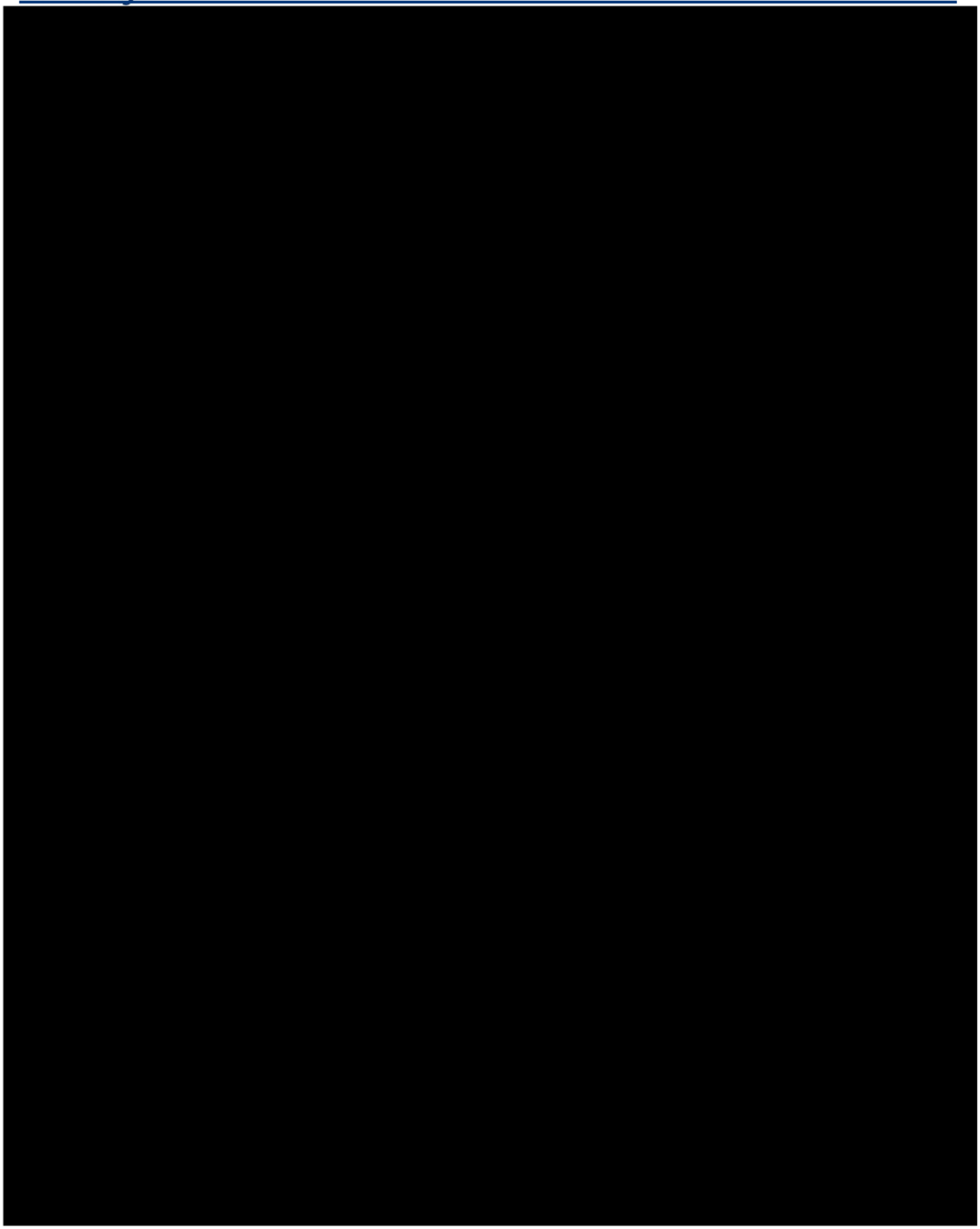


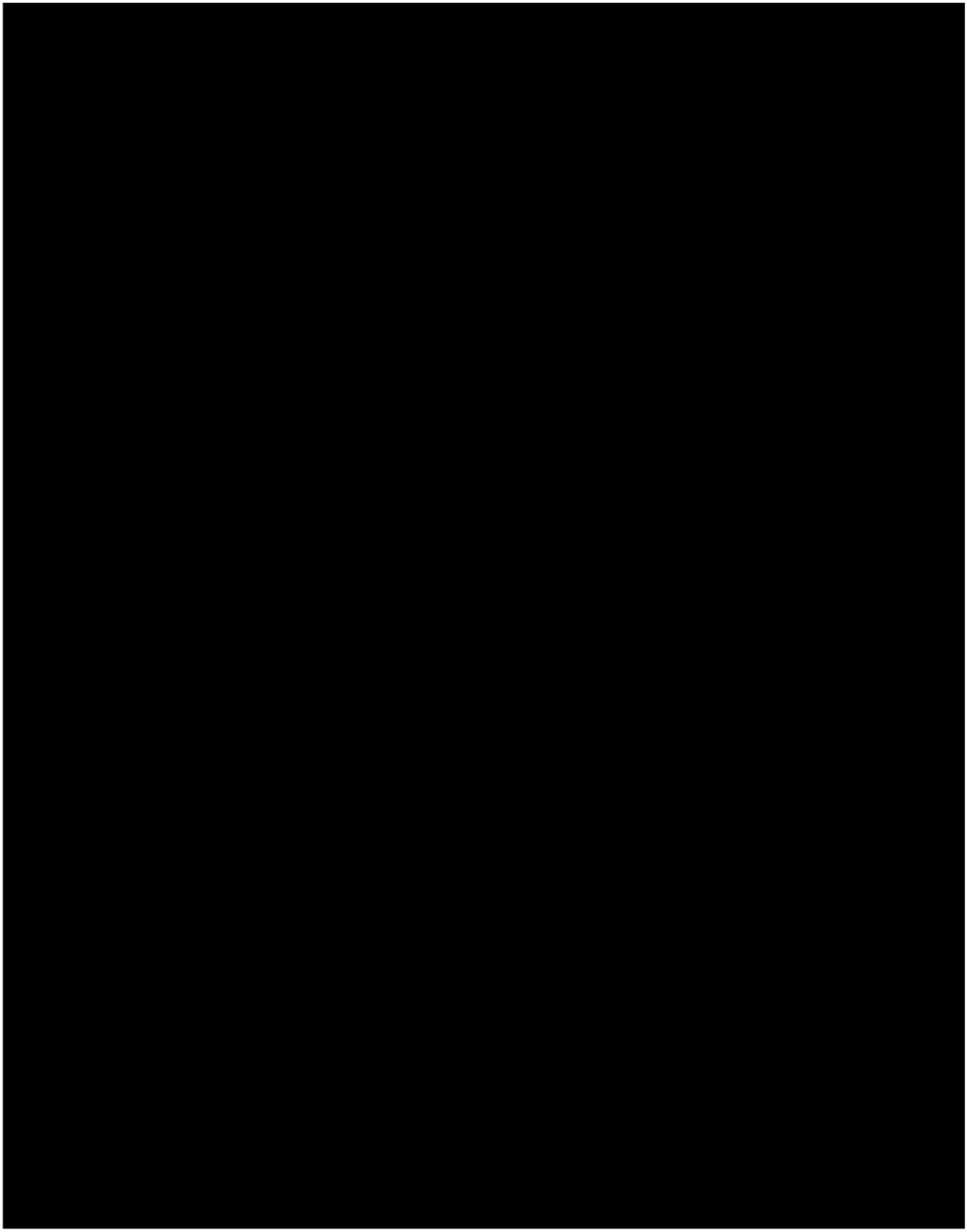












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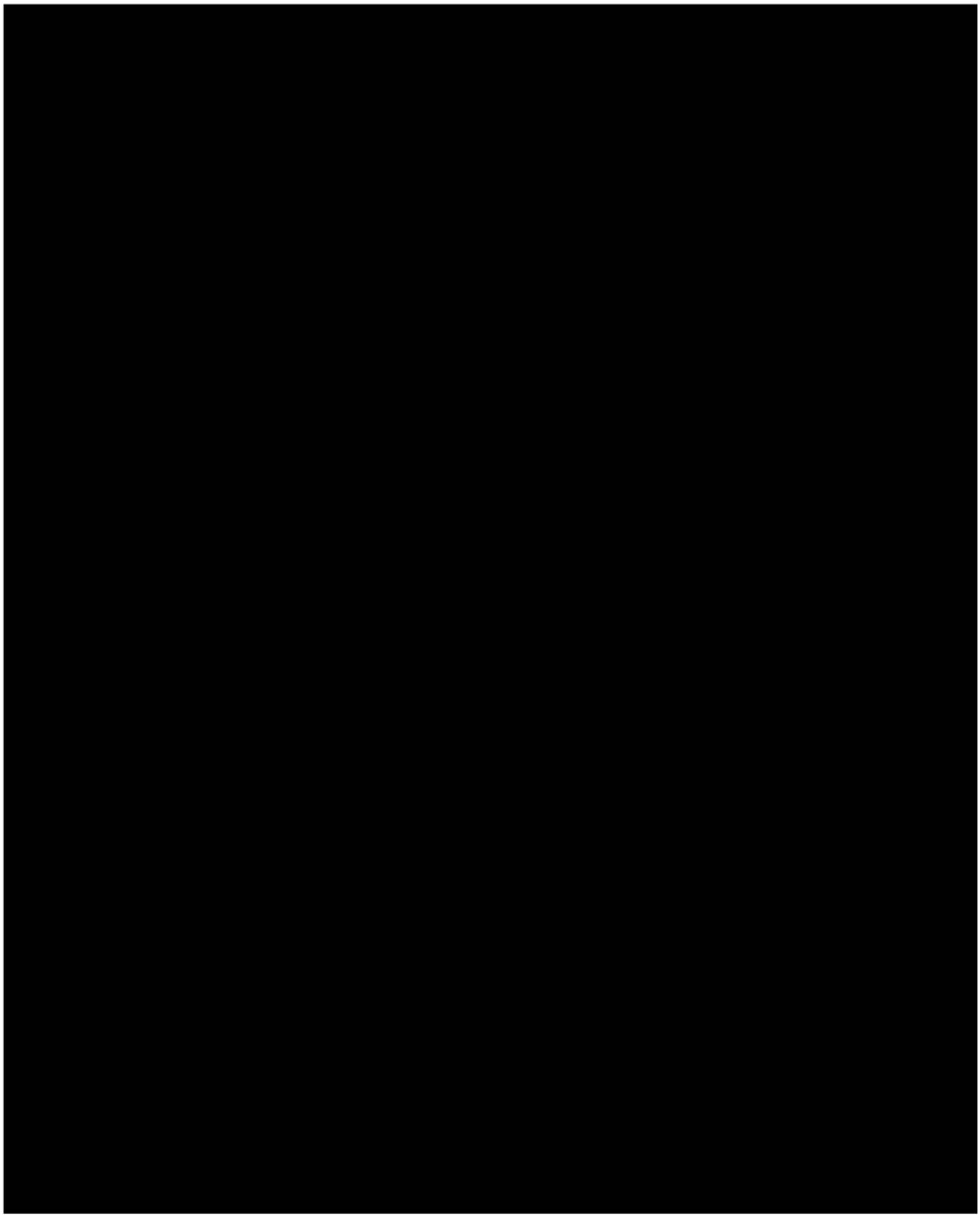
9.0 BASELINE MONITORING PLAN

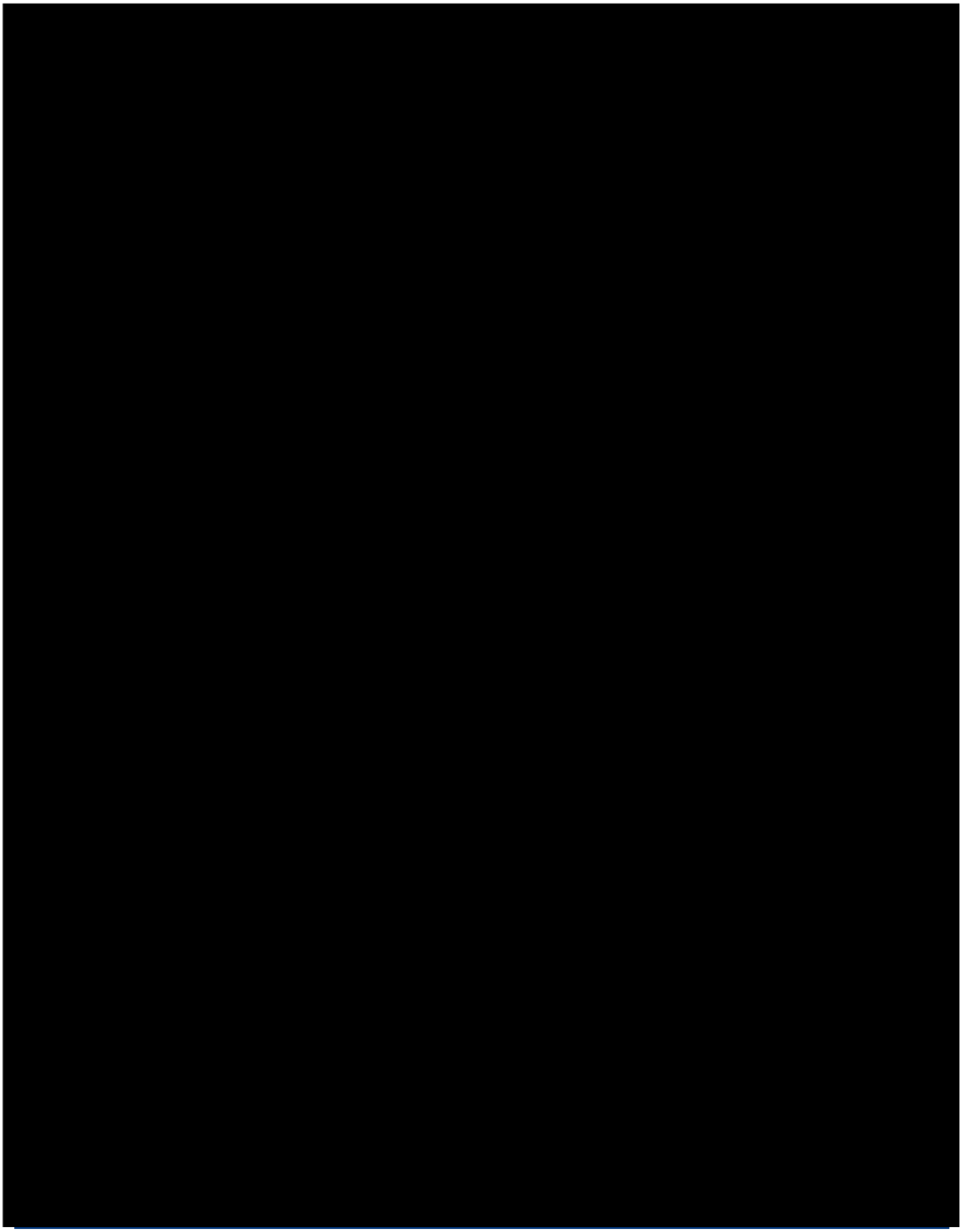
The Baseline Monitoring Plan establishes pre-operational site conditions (e.g., soil-gas composition, surface water properties, groundwater geochemical properties, and seismicity) before CO_2 injection. [redacted]



9.2 SOIL GAS BASELINE MONITORING

9.2.1 Soil Gas Baseline Analysis

A process-based approach will be employed by measuring N_2, O_2, CO_2 in each soil gas sampling location to determine whether they reflect the natural atmosphere composition (78% N_2, 21% O_2, 0.04% CO_2).



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11.0 DEEP SUBSURFACE MONITORING OF FREE-PHASE CO_2 PLUME AND PRESSURE FRONT

Denbury will implement direct and indirect methods to monitor the location, thickness, and distribution of the free-phase CO_2 plume (plume) and associated pressure (pressure) relative to the permitted storage reservoir.

[redacted]