Official Draft Public Notice Version **January 22nd, 2026**
The findings, determinations, and assertions contained in this document are not final and subject to change following the public comment period.
State of Utah

Division of Water Quality
Department of Environmental Quality
Salt Lake City, Utah

CLASS III AREA PERMIT

UNDERGROUND INJECTION CONTROL (UIC) PROGRAM

UIC Permit Number: UTU-27-AP-718D759

Major Permit Modification

Millard County, Utah

Issued to:

ACES Delta Solution Mining, LLC
3165 East Millrock Drive, Suite 330
Holladay, Utah 84121

TABLE OF CONTENTS

Contents

PART I. AUTHORIZATION TO CONSTRUCT AND INJECT

Pursuant to the Underground Injection Control (UIC) Program Regulations of the Utah Water Quality Board (UWQB) codified in the Utah Administrative Code (Utah Admin. Code) R317-7,

ACES Delta Solution Mining, LLC
3165 East Millrock Drive, Suite 330
Holladay, Utah 84121

hereafter, referred to as the "Permittee", is hereby authorized, for the sole purpose of constructing storage caverns, to construct and operate Class III solution mining injection wells in a Project Area centered approximately at UTM Northing: 205364015 (NAD 83, UTM Zone 12N, Meters) and UTM Easting: 500135.217 (NAD 83, UTM Zone 12N, Meters), located in Millard County, Utah. A general location map is included as Attachment A.

The intent of the solution mining activity to be conducted under this permit is to construct underground storage caverns in a thick salt body. This permit does not cover the operation and maintenance of the injection wells and caverns for the storage of product after each individual injection well, and cavern system has been released from this Class III UIC permit. In cases where product storage falls under the authority of the Utah Division of Oil, Gas and Mining ("DOGM") and the Utah Board of Oil, Gas and Mining ("BOGM"), a special order issued by BOGM is required before any storage of product may occur and will govern any authorized operation of the well/cavern systems for product storage. In cases where product storage does not fall under the authority of DOGM or BOGM, the Division of Water Quality ("Division") will require a separate UIC Class V permit, which will govern the operational phase for product storage, before any storage of product may occur. Several sections and subsections in Part III of this permit refer to compliance with DOGM rules and BOGM orders. This compliance applies only when DOGM and BOGM have regulatory authority over the point in question.

This permit implements requirements for constructing the wells and caverns, including pre-operation logging and testing of the wells; establishing and maintaining mechanical integrity of the wells and caverns prior to storage of product; pre-operation and monitoring, recording and reporting; and cavern expansion in excess of capacity lost due to salt creep during operations through the use of freshwater displacement. This permit also implements requirements for well and cavern closure and abandonment, and financial assurance to cover closure in the event DOGM does not regulate such closure.

The Division and DOGM shall have concurrent regulatory authority during construction of the wells and during any cavern expansion during operations, through the use of freshwater product displacement to create cavern capacity through solution mining in excess of capacity lost due to salt creep. Freshwater injection to prevent salt precipitation in the tubing strings and to reclaim cavern capacity lost to salt creep are considered solely maintenance activities and, as such, are subject only to the regulatory authority of DOGM, or the Division, if DOGM determines they do not have jurisdiction. To the extent DOGM has obtained regulatory authority over any individual well/cavern system by its release from this permit, the regulations of DOGM and orders of the BOGM shall govern all activities related to operation, maintenance, and testing. Part III.G of this permit details the process for releasing an individual well/cavern system from this permit and for readmitting an individual well/cavern system back into the permit for additional solution mining of the cavern.

The Project Area, defined in the permit application, is located west of the intersection of Highway 174, also known as Brush-Wellman Road, and Jones Road; approximately 3 ½ miles east-northeast of Sugarville, Utah, and 9 miles north of Delta, Utah.

The legal description of the Project Area within which the construction of Class III solution mining wells may occur is included in Attachment B, along with maps showing the facility property boundary, the Project Area, and the Area of Review.

This permit does not convey any mineral rights, nor does it convey any contractual rights that may be necessary to construct the caverns and/or to store product(s) in the caverns subject to this permit.

All references to Utah Admin. Code R315-2-3, Utah Admin. Code R317-7, and Title 40 of the Code of Federal Regulations (40 CFR), are to all regulations that are in effect on the date this permit modification becomes effective. The following are incorporated as enforceable attachments to this permit:

- Attachment A - General Location Map of the ACES Storage Project, Millard County.
- Attachment B - Map of the ACES Storage Project Area of Review including the Class III Solution Mining Injection Wells and the Permit Area
- Attachment C - Corrective Action Plan for Artificial Penetrations into Injection Zone within Area of Review
- Attachment D - Construction and Cavern Development Plan
- Attachment E - Monitoring, Recording, and Reporting Plan
- Attachment F - Web Factor of Safety Geomechanical Model
- Attachment G - Well and Cavern Closure and Abandonment Plan

Attachment H - Financial Responsibility

This modification of the permit is based upon representations made by the Permittee and other information contained in the administrative record. **It is the responsibility of the Permittee to read and understand all provisions of this permit.**

Any person who violates the Utah Water Quality Act (UWQA), or any permit, rule, or order adopted under it, is subject to the provisions of section UCA 19-5-115 of the UWQA governing violations.

This permit shall become effective Month, Day, Year.

This permit and the authorization to inject shall be issued for the life of the project as described in Part III.A – Duration of Permit of this permit, unless terminated.

Signed this Month, Day, Year.

Candice A. Hasenyager, P.E.
Director

DWQ-2025-009639

PART II. GENERAL PERMIT CONDITIONS

A. EFFECT OF PERMIT

The Permittee is allowed to engage in underground injection in accordance with the conditions of this permit. The Permittee, authorized by this permit, shall not construct, operate, maintain, convert, plug, abandon or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water (USDW), if the presence of that contaminant may cause a violation of any primary drinking water standard under the Utah Public Drinking Water Administrative Rules, Utah Admin. Code R309-200 and 40 CFR Part 141, or may otherwise adversely affect the health of persons. Any underground injection activity not explicitly authorized in this permit is prohibited unless otherwise authorized-by-rule or by another UIC permit. Compliance with this permit does not constitute a defense of any action brought under the Utah Water Quality Act (UWQA) Title 19, Chapter 5 Utah Code Annotated 1953, or any other common or statutory law or regulation. Issuance of this permit does not authorize any injury to persons or property, any invasion of other private rights, or any infringement of State or local law or regulations. Nothing in this permit shall be construed to relieve the Permittee of any duties under applicable regulations.

B. SEVERABILITY

The provisions of this permit are severable. If any provision of this permit or the application of any provision of this permit to any circumstance is held to be invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

C. CONFIDENTIALITY

In accordance with Utah Code 19-1-306 (Records of the Department of Environmental Quality), Utah Code 63G-2-309 (Confidentiality Claims), and Utah Code 19-5-113 (the Division Records and Reports Required by Owners/Operators) any information deemed by the Permittee to be entitled to trade secret protection submitted to the UWQB pursuant to this permit may be claimed as confidential by the submitter. Any such claim must be asserted at the time of submission by stamping the words "Confidential Business Information" on each page containing such information. If no claim is made at the time of submission, the UWQB may make the information available to the public without further notice. Claims of confidentiality may be denied by the UWQB according to the procedures detailed in Utah Code 63G-2 and the federal Freedom of Information Act (FOIA). Claims of confidentiality for the following information will be denied as per Utah Admin. Code R317-7-9(9.7):

1. The name and address of the Permittee; and
2. Information that deals with the existence, absence, or level of contaminants in drinking water.

D. CONDITIONS APPLICABLE TO ALL UIC PERMITS (40 CFR § 144.51)[1]

The following conditions apply to all Class III permits. Specific requirements for implementing these conditions are included in Part III of this permit, as necessary.

1. Duty to Comply (40 CFR § 144.51(a))

   The Permittee shall comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Safe Drinking Water Act and the UWQA and is grounds for enforcement action, permit termination, revocation and re-issuance, modification; or for denial of a permit renewal application; except that the Permittee need not comply with the provisions of this permit to the extent and for the duration such noncompliance is authorized in an emergency permit issued in accordance with Utah Admin. Code R317-7-8 (40 CFR 144.34). Such noncompliance may also be grounds for enforcement action under the Utah Solid and Hazardous Waste Act (USHWA), Title 19, Chapter 6, Utah Code Annotated 1979.

2. Duty to Reapply (40 CFR 144.51(b))

   If the Permittee wishes to continue an activity regulated by this permit after its expiration date, the Permittee must apply for and obtain a new permit. The Permittee shall submit a complete permit renewal application at least 180 days prior to expiration of this permit. While Class III permits are typically issued for the life of the project, unforeseen circumstances may require the Permittee to reapply for a permit. Class III well permits shall be reviewed by the Director at least once every five years to determine whether they should be modified, revoked and reissued, or terminated.

3. Need to Halt or Reduce Activity Not a Defense (40 CFR § 144.51(c))

   It shall not be a defense for a Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity to maintain compliance with the conditions of this permit.

4. Duty to Mitigate (40 CFR § 144.51(d))

   The Permittee shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with this permit.

5. Proper Operation and Maintenance (40 CFR §144.51(e))

   The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance include effective performance, adequate

[1] Parenthetical references to the Code of Federal Regulations (CFR) and / or the Utah Administrative Code (Utah Admin. Code) for the UIC Program indicate the requirement for inclusion in the permit.

funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to comply with the conditions of this permit.

6. <u>Permit Actions</u>

This permit may be modified, revoked and reissued, or terminated either at the request of any interested person (including the Permittee) or upon the Director's initiative. However, permits may only be modified, revoked and reissued, or terminated for the reasons specified in Part II.D.6.a and Part II.D.6.b. All requests shall be in writing and shall contain facts or reasons supporting the request. The filing of a request for a permit modification, revocation and re-issuance, or termination by the Permittee, does not stay any permit condition. This permit may be transferred in accordance with the procedures outlined in Part II.D.6.d.

a) Modify or Revoke and Re-Issue Permits

When the Director of the Utah Division of Water Quality (hereafter, referred to as 'the Director') receives any information (for example, inspects the facility, receives information submitted by the Permittee as required in the permit, receives a request for modification or revocation and reissuance, or conducts a review of the permit file), the Director may determine whether or not one or more of the causes listed in Part II.D.6.a.1 and Part II.D.6.a.2 for modification or revocation and reissuance or both exist. If cause exists, the Director may modify or revoke and reissue the permit accordingly, subject to the limitations of Part II.D.6.a.3 of this section and may request an updated application if necessary. When a permit is modified, only the conditions subject to modification are reopened. If a permit is revoked and reissued, the entire permit is reopened, subject to revision, and the permit is reissued for a new term. If cause does not exist under Part II.D.6.a or Part II.D.6.c for minor modifications, the Director shall not modify or revoke and reissue the permit. If a permit modification satisfies the criteria for minor modifications in Part II.D.6.c, the permit may be modified without a draft permit or public review. Otherwise, a draft permit must be prepared, and other procedures in 40 CFR 124, incorporated by reference into the Utah UIC Program rules (hereafter, referred to as '40 CFR § 124'), must be followed.

(1) Causes for modification. For Class III wells, the following may be causes for revocation and reissuance, as well as modification.

i. Alterations. There are material and substantial alterations or additions to the permitted facility or activity that occurred after permit issuance, which justify the application of permit conditions that differ from or are absent from the existing permit.

ii. Information. The Director has received information. For UIC area permits, this cause shall include any information indicating that cumulative effects on the environment are unacceptable.

iii. New regulations. The standards or regulations on which the permit was based have been changed by the promulgation of new or amended standards or regulations, or by judicial decision, after the permit was issued.

iv. Compliance schedules. The Director determines that good cause exists for modification of a compliance schedule, such as an act of God, strike, flood, materials shortage, or other events over which the Permittee has little or no control and for which there is no reasonably available remedy. See also Permit Part II.D.6.c.

(2) Causes for modification or revocation and reissuance. The following are causes to modify or, alternatively, revoke and reissue a permit:

i. Cause exists for termination under Permit Part II.D.6.b, and the Director determines that modification or revocation and reissuance is appropriate.

ii. The Director has received notification (as required in the permit, see Permit Part II.D.6.c) of a proposed transfer of the permit. A permit may also be modified to reflect a transfer after the effective date of an automatic transfer (Permit Part II.D.6.d) but will not be revoked and reissued after the effective date of the transfer, except upon the request of the new Permittee.

iii. A determination that the waste being injected is a hazardous waste as defined in 40 CFR 261.3, either because the definition has been revised, or because a previous determination has been changed.

(3) Facility Siting. Suitability of the facility location will not be considered at the time of permit modification or revocation and reissuance unless new information or standards indicate that a threat to human health or the environment exists that was unknown at the time of permit issuance.

b) Termination of Permit

(1) The Director may terminate a permit during its term, or deny a permit renewal application for the following causes:

i. Noncompliance by the Permittee with any condition of the permit;

ii. The Permittee's failure in the application or during the permit issuance process to disclose fully all relevant facts, or the Permittee's misrepresentation of any relevant facts at any time; or

iii. A determination that the permitted activity endangers human health or the environment and can only be regulated to acceptable levels by permit modification or termination;

(2) The Director shall follow the applicable procedures in 40 CFR § 124 for terminating any permit under this section.

c) Minor Modification of Permit

Upon the consent of the Permittee, the Director may modify a permit to make the corrections or allowances for changes in the permitted activity listed in this section, without following the procedures of 40 CFR 124. Any permit modification not processed as a minor modification under this section must be made for cause and with 40 CFR § 124 draft permit and public notice as required in Part II.D.6.a. Minor modifications may only:

(1) Correct typographical errors;

(2) Require more frequent monitoring or reporting by the Permittee;

(3) Change an interim compliance date in a schedule of compliance, provided the new date is not more than 120 days after the date specified in the existing permit and does not interfere with attainment of the final compliance date requirement; or

(4) Allow for a change in ownership or operational control of a facility where the Director determines that no other change in the permit is necessary, provided that a written agreement containing a specific date for transfer of permit responsibility, coverage, and liability between the current and new Permittees has been submitted to the Director.

(5) Change quantities or types of fluids injected that are within the capacity of the facility as permitted and, in the judgment of the Director, would not interfere with the operation of the facility or its ability to meet conditions described in the permit and would not change its classification.

(6) Change construction requirements approved by the Director pursuant to 40 CFR § 144.52.a.1. (establishing UIC permit conditions), provided that any such alteration shall comply with the requirements of 40 CFR § 144 and 40 CFR § 146.

(7) Amend a plugging and abandonment plan that has been updated.

d) Transfer of Permit

(1) Transfers by Modification. Except as provided in Permit Part II.D.6.a, a permit may be transferred by the Permittee to a new owner or operator only if the permit has been modified or revoked and reissued (Permit Part II.D.6.a), or a minor modification made (Permit Part II.D.6.c) to identify the new Permittee and incorporate such other requirements as may be necessary under the Safe Drinking Water Act.

(2) Automatic Transfers. As an alternative to transfers under Permit Part II.D.6.a, any UIC permit for a well not injecting hazardous waste or injecting carbon dioxide for geologic sequestration may be automatically transferred to a new Permittee if:

i. The current Permittee notifies the Director at least 30 days in advance of the proposed transfer date referred to in Permit Part II.D.6.b of this section;

ii. The notice includes a written agreement between the existing and new Permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them, and the notice demonstrates that the following financial responsibility requirements of 40 CFR § 144.52.a.7 will be met by the new Permittee:

The Permittee, including the transferor of a permit, is required to demonstrate and maintain financial responsibility and resources to close, plug, and abandon the underground injection operation in a manner prescribed by the Director until:

(A) The well has been plugged and abandoned in accordance with an approved plugging and abandonment plan and submitted a plugging and abandonment report; or

(B) The well has been converted, or

(C) The transferor of a permit has received notice from the Director that the owner or operator receiving transfer of the permit, the new Permittee, has demonstrated financial responsibility for the well.

The Permittee shall provide evidence of such financial responsibility to the Director by submitting a surety bond or other adequate assurance, such as a financial statement or other materials acceptable to the Director.

iii. The Director does not notify the existing Permittee and the proposed new Permittee of the intent to modify or revoke and reissue the permit. A modification under this paragraph may also be a minor modification under Permit Part II.D.6.c. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in Permit Part II.D.6.d.2.ii.

7. <u>Property Rights (40 CFR § 144.51(g))</u>

This permit does not convey any property rights of any sort or any exclusive privilege.

8. <u>Duty to Provide Information (40 CFR § 144.51(h))</u>

The Permittee shall furnish to the Director within the time specified any information the Director may request to determine whether cause exists for modifying, revoking and re-issuing, or terminating this permit, or determining compliance with this permit. The Permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

9. <u>Inspection and Entry (40 CFR § 144.51(i))</u>

The Permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

a) Enter upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b) Have access to and copy, at reasonable times, any records that are kept under the conditions of this permit;

c) Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

d) Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the SDWA and / or UWQA, any substances or parameters at any location.

10. <u>Monitoring and Records (40 CFR § 144.51(j))</u>

a) Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

b) The Permittee shall retain records of all monitoring information, including the following:

(1) Calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by request of the Director at any time; and

(2) The nature and composition of all injected fluids until three years after the completion of any plugging and abandonment, as appropriate. The Director may require the owner or operator to deliver the records to the Director at the conclusion of the retention period.

c) Records of monitoring information shall include:

(1) The date, exact place, and time of sampling or measurements;

(2) The individual(s) who performed the sampling or measurements;

(3) The date(s) analyses were performed;

(4) The names of individual(s) who performed the analyses;

(5) The analytical techniques or methods used; and

(6) The results of such analyses.

11. <u>Signatory Requirements (40 CFR § 144.51(k))</u>

All reports or other information submitted as required by this permit or requested by the Director shall be signed and certified as follows:

a) Applications. All permit applications shall be signed as follows:

(1) For a corporation: by a responsible corporate officer[2]. For the purpose of this section, a responsible corporate officer means;

i. A president, secretary, treasurer, or vice president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or

ii. The manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

(3) For a municipality, State, Federal, or another public agency: by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes: (i) the chief executive officer of the agency, or (ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).

b) Reports. All reports required by permits and other information requested by the Director shall be signed by a person described in Part II.D.11.a, or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described in Part II.D.11.a of this section;

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, or a position of equivalent responsibility. (A duly authorized representative may thus be either a named individual or any individual occupying a named position); and

(3) The written authorization is submitted to the Director.

c) Changes to authorization. If an authorization under Part II.D.11.b is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements

[2] DEQ does not require specific assignments or delegations of authority to responsible corporate officers identified in 40 CFR 144.32(a)(1)(i). DEQ will presume that these responsible corporate officers have the requisite authority to sign permit applications unless the corporation has notified the Director to the contrary. Corporate procedures governing authority to sign permit applications may provide for assignment or delegation to applicable corporate positions under 40 CFR 144.32(a)(1)(ii) rather than to specific individuals.

of Part II.D.11.b must be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative.

d) Certification. Any person signing a document under Part II.D.11.a or Part II.D.11.b shall make the following certification:

"I CERTIFY UNDER PENALTY OF LAW THAT THIS DOCUMENT AND ALL ATTACHMENTS WERE PREPARED UNDER MY DIRECTION OR SUPERVISION IN ACCORDANCE WITH A SYSTEM DESIGNED TO ASSURE THAT QUALIFIED PERSONNEL PROPERLY GATHER AND EVALUATE THE INFORMATION SUBMITTED BASED ON MY INQUIRY OF THE PERSON OR PERSONS WHO MANAGE THE SYSTEM, OF THOSE PERSONS DIRECTLY RESPONSIBLE FOR GATHERING THE INFORMATION, THE INFORMATION SUBMITTED IS, TO THE BEST OF MY KNOWLEDGE AND BELIEF, TRUE, ACCURATE, AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE INFORMATION, INCLUDING THE POSSIBILITY OF FINE AND IMPRISONMENT FOR KNOWING VIOLATIONS."

12. Reporting Requirements (40 CFR § 144.51(l))

Specific requirements for reporting the following items are included in Part III of the permit.

a) Planned Changes
The Permittee shall give written notice to the Director, as soon as possible, of any planned physical alterations or additions to the UIC-permitted facility. Notification of planned changes by the Permittee does not stay any permit condition.

b) Anticipated Noncompliance
The Permittee shall give advance notice to the Director of any planned changes to the permitted facility or activity that may result in noncompliance with permit requirements. Notification of anticipated noncompliance on the part of the Permittee does not stay any permit condition.

c) Permit Transfers
This permit is not transferable to any person except in accordance with Part II.D.6.d. The Director may require modification, or revocation and re-issuance of the permit to change the name of the Permittee and incorporate such other requirements as may be necessary under the Safe Drinking Water Act and / or the UWQA.

d) Monitoring
Monitoring results shall be reported at the intervals specified in Part III of this permit.

e) Compliance Schedule Reports
Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule specified

in Part III.B of this permit shall be submitted no later than 30 days following each schedule date.

f) Noncompliance
The Permittee shall report to the Director any noncompliance that may endanger health or the environment, as follows:

(1) Twenty-four Hour Reporting
Noncompliance information shall be provided orally within 24 hours from the time the Permittee becomes aware of the circumstances. Such reports shall include, but not be limited to, the following information:

i. Any monitoring or other information that indicates any contaminant may cause an endangerment to a USDW, or

ii. Any noncompliance with a permit condition or malfunction of the injection system that may cause fluid migration into or between USDWs.

(2) Five-day Reporting
A written submission shall be provided within five days of the time the Permittee becomes aware of the circumstances of the endangering noncompliance. The written submission shall contain a description of the noncompliance and its cause, the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

g) Other Noncompliance
The Permittee shall report all instances of noncompliance not reported under Part II.D.12.f, Part II.D.12.e, and Part II.D.12.f in the next Monitoring Report. The reports shall contain a description of the noncompliance and its cause, the period of noncompliance, including exact dates and times, and, if the noncompliance has not been corrected, the anticipated time it is expected to continue, and the steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

h) Other Information
When the Permittee becomes aware of a failure to submit any relevant facts in the permit application or of having submitted incorrect information in a permit application or in any report to the Director, the Permittee shall submit such facts or information within 10 days after becoming aware of the failure to submit relevant facts.

13. <u>Requirements Prior to Commencing Injection (40 CFR § 144.51(m))</u>

a) For a new injection well authorized by an individual permit, a new injection well may not commence injection until construction is complete, and

(1) The Permittee has submitted notice of completion of construction to the Director; and

(2) Either of the following:

i. The Director has inspected or otherwise reviewed the new injection well and finds it complies with the conditions of the permit; or

ii. The Permittee has not received notice from the Director of their intent to inspect or otherwise review the new injection well within 13 days of the date of the notice in Part II.D.12.a, in which case prior inspection or review is waived, and the Permittee may commence injection. The Director shall include in his notice a reasonable time period in which he shall inspect the well.

b) For new injection wells authorized by an area permit under Utah Admin. Code R317-7-7 (40 CFR § 144.33), requirements prior to commencing injection shall be specified in Part III of the permit.

14. Notification Prior to Conversion or Abandonment. (40 CFR § 144.51(n))

The Permittee shall notify the Director at such times as the permit requires, before conversion or abandonment of the well, or, in the case of area permits before closure of the projects.

15. Plugging and Abandonment Requirements. (40 CFR § 144.51(o))

A Class III permit shall include conditions for developing a plugging and abandonment plan that meets the applicable requirements of Utah Admin. Code R317-7 to ensure that plugging and abandonment of the well will not allow the movement of fluids into or between USDWs. If the plan meets the plugging and abandonment requirements of Utah Admin. Code R317-7, the Director shall incorporate it into the permit as a permit condition. Where the review of the plan submitted with the permit application indicates that the plan is inadequate, the Director may require the applicant to revise the plan, prescribe conditions meeting the requirements of this paragraph, or deny the permit. For purposes of this paragraph, temporary or intermittent cessation of injection operations is not considered abandonment. Requirements for implementing the approved plugging and abandonment plan are specified in Part III of this permit.

16. Plugging and Abandonment Report. (40 CFR § 144.51(p))

Requirements for submitting a plugging and abandonment report are specified in Part III of this permit.

17. Duty to Establish and Maintain Mechanical Integrity. (40 CFR § 144.51(q))

a) The owner or operator of a Class III well shall establish prior to commencing injection or on a schedule determined by the Director, and thereafter maintain mechanical integrity as defined in 40 CFR 146.8.

b) When the Director determines that a Class III well lacks mechanical integrity pursuant to 40 CFR 146.8, written notice of this determination shall be given to the owner or operator. Unless the Director requires immediate cessation, the owner or operator shall cease injection into the well within 48 hours of receipt of the Director's determination. The Director may allow plugging of the well pursuant to the requirements of Utah Admin. Code R317-7 or require the Permittee to perform such additional construction, operation, monitoring, reporting, and corrective action as is necessary to prevent the movement of fluid into or between USDWs caused by the lack of mechanical integrity. The owner or operator may resume injection upon written notification from the Director that the owner or operator has demonstrated mechanical integrity pursuant to 40 CFR 146.8.

c) The Director may allow the owner/operator of a well that lacks internal mechanical integrity pursuant to 40 CFR 146.8(a)(1) to continue or resume injection, if the owner or operator has made a satisfactory demonstration that there is no movement of fluid into or between USDWs.

PART III. SPECIFIC PERMIT CONDITIONS

A. DURATION OF PERMIT (Utah Admin. Code R317-7-9(9.5) and 40 CFR § 144.36)

This UIC Class III Solution Mining permit shall be issued for a period to include that time required to:

1. complete solution mining of each underground storage cavern, and
2. demonstrate mechanical integrity of the well/cavern system, and
3. either to:
    a) affect the transfer of control from the Utah Division of Water Quality (The Division) to the Utah Division of Oil, Gas and Mining (DOGM) for regulatory oversight of the operation and maintenance of those well/cavern systems that will be used for storing products for which DOGM has regulatory authority, as detailed in Part III.G, or
    b) obtain a UIC Class V permit from the Division for authority to store products outside of DOGM's regulatory authority.

Once regulatory authority over an individual well/cavern system has been transferred to either DOGM or the Division under a Class V permit, that particular well/cavern system shall be released from this permit.

The Director of the Division of Water Quality (hereafter 'the Director') shall review this permit once every five (5) years to determine whether it should be modified, revoked and re-issued, terminated, or undergo minor modification according to the conditions of Part II.D.6 of this permit.

B. COMPLIANCE SCHEDULE (40 CFR § 144.53)

The Permittee must address each of the following conditions within the time period indicated for each item. Failure to do so may result in the termination of the permit according to Part II.D.6.b) of this permit.

1. <u>Construction and Cavern Development Plan</u>

   Attachment D of the permit includes a conceptual Construction and Cavern Development Plan (CCDP) that outlines the steps to be taken in developing CCDPs specific to one of the following cavern categories anticipated to be developed at the facility: liquid hydrocarbon storage with brine displacement, liquid hydrocarbon storage with overlying vapor space, gas storage, or compressed air energy storage. CCDPs shall ensure that caverns are constructed in such a way as to allow mechanical integrity testing appropriate for the category of cavern. All CCDPs shall be submitted to and approved by the Director prior to receiving authorization to drill from the Division and DOGM. All CCDPs must meet the permit conditions contained herein.

2. Monitoring, Recording, and Reporting Plan

Attachment E of the permit includes a conceptual Monitoring, Recording, and Reporting Plan (MRRP) that outlines the steps to be taken in developing MRRPs specific to one of the following cavern categories anticipated to be developed at the facility: liquid hydrocarbon storage with brine displacement, liquid hydrocarbon storage with overlying vapor space, gas storage, or compressed air energy storage. All MRRPs shall be submitted to and approved by the Director prior to receiving authorization to drill by the Division and DOGM. All MRRPs must meet the permit conditions contained herein.

3. Financial Responsibility

Prior to drilling any cavern wells for storage of product for which DOGM has or will assume regulatory oversight, ACES shall submit proof of adequate financial assurance naming the Division as a beneficiary. The Permittee may either add the Division as a party required to approve release of financial responsibility under the existing financial assurance instrument approved by DOGM, or may secure additional, separate financial assurance acceptable to the Director to implement the approved closure and abandonment plan required by this permit.

Prior to drilling any cavern wells for storage of products for which DOGM will not assume regulatory oversight during the operational phase, the Permittee shall submit financial assurance acceptable to the Director to implement the approved closure and abandonment plan required by this permit.

C. CORRECTIVE ACTION (40 CFR § 144.52(2). 40 CFR § 144.55, 40 CFR § 146.7)

As of the effective date of this permit modification, no wells have been identified, within the area of review for the Permittee's Storage Project, that require corrective action.

D. CONSTRUCTION AND CAVERN DEVELOPMENT REQUIREMENTS (Utah Admin. Code R317-7-10(10.1.B) and 40 CFR § 146.32)

1. Well Construction and Cavern Development Standards

Each well shall be constructed and each cavern developed according to the requirements for Class III injection wells as outlined in R317-7-10(10.1.B) and 40 CFR § 146.32.

The following references apply to the underground storage of hydrocarbons in solution-mined caverns, in general. These references were used to inform the development of the permit conditions contained herein, where they apply to the construction and development of brine-compensated and pressurized gas caverns, particularly in regard to cavern integrity and stability.

- *Common Practices – Gas Cavern Site Characterization, Design, Construction, Maintenance, and Operation, SMRI Research Report RR2012-03*
- *Design and Operation of Solution-Mined Salt Caverns Used for Liquid Hydrocarbon Storage – API Recommended Practice 1115 (2nd Edition),* API, November 2018
- *Design and Operation of Solution-mined Salt Caverns Used for Natural Gas Storage – API Recommended Practice 1170*, API, July 2015
- *Canadian Standard Association, CWA Z341 Series 14 – Storage of hydrocarbons in underground formations,* April 2014

Additionally, the requirements in the approved Application for a Permit to Drill (APD) issued by DOGM for underground hydrocarbon storage caverns must be met, if applicable, as explained in Part I of this permit. If DOGM does not issue an APD, State well construction standards, outlined in R649-3, must be followed in addition to the requirements for Class III injection wells.

2. Construction and Cavern Development Plan

The conceptual Construction and Cavern Development Plan (CCDP) is included as Attachment D of this permit. Prior to receiving authorization to commence drilling, ACES shall submit a CCDP for each cavern category for review and approval by the Director. Each approved CCDP shall become an enforceable amendment to Attachment D of the permit.

Each CCDP shall include:

a. a maximum design capacity (Open Cavern Volume) for the specific cavern category;
b. the Required Pillar Width based on geomechanical analysis.

If the design criteria for the CCDPs differ significantly from the design assumptions used in preparing the original geomechanical analysis dated September 2010, a new geomechanical analysis must be performed that reflects the intended design. A new geomechanical analysis must be performed for caverns developed to store any product other than the product for which the original geomechanical analysis was performed, unless a statement is provided from an expert knowledgeable in the evaluation of geomechanical analyses of caverns and cavern fields stating that the original geomechanical analysis performed for the storage of natural gas applies to the newly proposed product. The geomechanical analysis must support each CCDP.

Each CCDP must include a detailed plan for cavern enlargement if product storage commences before completion of cavern development to its permitted volume. The plan must address all modes of cavern enlargement.

3. Changes to the Construction and Cavern Development Plan

Changes to the approved CCDPs must be approved by the Director as minor modifications of the permit according to Part II.D.6.c.6 of this permit. No such changes may be physically incorporated into the construction of the well or the development of the cavern prior to approval of the modification by the Director. All changes must comply with Utah Admin. Code R317-7 and those sections of 40 CFR § 144 and 40 CFR § 146 incorporated by reference in the state rule. To facilitate the minor modification of the permit to incorporate changes to the CCDP, the Permittee will ensure that the Division receives courtesy copies of all sundry notices sent to DOGM and notice of all related filings before the BOGM.

4. Casing and Cement

All new Class III wells shall be cased and cemented to prevent the migration of fluids into or between underground sources of drinking water. The Director may waive the cementing requirement for new wells in existing projects or portions of existing projects where there is substantial evidence that no contamination of underground sources of drinking water would result. It is the Permittee's responsibility to provide such evidence to the Director. The casing and cement used in the construction of each newly drilled well shall be designed for the life expectancy of the well. The Permittee shall consider the following factors in designing a casing and cementing program for the well:

(1) Depth to the injection zone;

(2) Injection pressure, external pressure, internal pressure, axial loading, etc.;

(3) Hole size;

(4) Size and grade of all casing strings (wall thickness, diameter, nominal weight, length, joint specification, and construction material);

(5) Corrosiveness of injected fluids and formation fluids;

(6) Lithology of injection and confining zones; and

(7) Type and grade of cement.

The following requirements concerning the cement and casing shall apply:

a) Only new casing shall be installed.

b) Surface and intermediate casing strings shall be used to protect USDWs above the salt structure.

c) All casings shall be cemented to the surface.

d) A minimum of one cemented casing shall be set across all non-salt formations.

e) A minimum of two cemented casing strings shall be set in the salt body.

f) Appropriate cement shall be used for cementing across salt formations.

g) Centralizers shall be used on all cemented casing strings and shall be placed to optimize the placement of cement in the casing/borehole annulus.

h) Boreholes shall be conditioned prior to running cement.

i) Joints of the last cemented casing shall be gas-tight to prevent leakage of gaseous product and/or gaseous blanket material.

5. Logging and Testing

Appropriate logs and other tests shall be conducted during the drilling and construction of new Class III wells. A descriptive report interpreting the results of such logs and tests shall be prepared by a knowledgeable log analyst and submitted to the Director. The logs and tests appropriate to each type of Class III well shall be determined based on the intended function, depth, construction, and other characteristics of the well, availability of similar data in the area of the drilling site, and the need for additional information that may arise from time to time as the construction of the well progresses. Deviation checks shall be conducted on all holes where pilot holes and reaming are used, unless the hole will be cased and cemented by circulating cement to the surface. Where deviation checks are necessary, they shall be conducted at sufficiently frequent intervals to ensure that vertical avenues for fluid migration in the form of diverging holes are not created during drilling.

The following geophysical logs and tests must be performed during the construction of each well/cavern system:

a) Cement Evaluation Log shall be run according to Part III.H of this permit.

b) Casing Inspection Log (ultrasonic or electromagnetic flux) shall be run on the last cemented casing, from casing seat to surface, before installing leaching strings.

c) Hydrostatic pressure and nitrogen/brine interface tests according to the methods and schedule in Part III.H of this permit.

d) Inclination and directional surveys starting at 500’, taken 500’ thereafter. Deviation control shall be implemented to maintain the verticality of the well to a maximum of 1.5 degrees average inclination from the vertical at the top of the salt, with no more than 2 degrees or less at any depth.

6. Injection Zone Characterization

a) Where the injection zone is a formation that is naturally water-bearing, the following information concerning the injection zone shall be determined or calculated for new Class III wells or projects:

(1) Fluid pressure;

(2) Fracture pressure (determined on MH-1); and

(3) Physical and chemical characteristics of the formation fluids.

b) Where the injection formation is not a water-bearing formation, only the fracture pressure must be submitted.

c) The Permittee shall include in each CCDP a description of the method for determining the top of the salt body.

d) The Permittee shall submit for Director's approval a Formation Testing Program to determine the fracture pressure of the salt at the last cemented casing seat. The approved and enforceable Formation Testing Program is included in the CCDP in Attachment D of this permit.

e) The Permittee shall include in the Formation Testing Program of the CCDP in Attachment D a detailed description of the methodologies to be employed to characterize anomalous zones during the drilling of new cavern wells. The location of these anomalous zones may be interpolated/extrapolated from corresponding anomalous zones in adjacent cavern wells.

7. Well Stimulation Program

If the operator intends to stimulate the well to clean the well bore, enlarge channels, and increase pore space in the interval to be injected, thereby enhancing the injectivity of the well, a Well Stimulation Program must be prepared for the Director's approval and included in the CCDP in Attachment D of this permit.

8. Monitoring Wells

No monitoring wells are required by this permit. However, ground water monitoring will be addressed in an approved Operating Plan enforceable under the product specific BOGM Order.

The Division will issue a UIC Class V permit for regulatory oversight of the operation and maintenance of those well/cavern systems used for storing products for which DOGM does not have regulatory authority. Requirements for monitoring wells, if any, will be addressed in the UIC Class V permit.

9. Leaching String

a) The Permittee shall select an appropriate blanket/brine interface tool and appropriate leaching string pair such that the depth of the blanket/brine interface can be confirmed periodically during solution mining of the cavern and such that a sonar survey can be obtained through both leaching strings to monitor the development of the cavern. If the Permittee is unable to obtain sonar surveys through both leaching strings, the inner leaching string shall be removed so that a sonar survey can be obtained to ensure a clear image of the full roof.

b) The joints of the outer hanging leaching string shall be gas-tight to prevent the loss of the gaseous blanket material or gaseous product.

10. Cavern Configuration, Spacing, and Standoff Requirements

Each cavern shall be developed and spaced with sufficient salt back (salt above the roof of the cavern), standoff (set back from the boundary of the salt body), and set back from the permit area boundary to maintain mechanical integrity of the caverns, the salt web (the in-situ mass separating adjacent underground caverns and caverns and the edge of the salt body), and the overburden during all modes of cavern development, operation and abandonment for the lifetime of the facility.

The Cavern Configuration, including Salt Back, Standoff, and Required Pillar Width to achieve a Maximum Web Factor of Safety Value of 2.00 or greater for each storage cavern, shall be defined by a geomechanical analysis required by Part III.D.2, above. The geomechanical model used for the analysis is available in Attachment F.

The maximum design capacities, or volumes, for each cavern will be included in each CCDP as submitted and approved.

If the Permittee proposes to construct caverns near the flanks of the salt body, each CCDP shall be amended to include a plan for assessing and defining the edge of salt and determining an adequate standoff to maintain the mechanical integrity of the cavern and surrounding salt.

11. Requirements Prior to Solution Mining

In accordance with Part II.D.13 of this permit, the following requirements must be met prior to commencing injection (solution mining):

a) Well Completion Data / Report

The operator shall submit to DOGM, if applicable, as explained in Part I of this permit, and for the Director's review, an injection well completion report consisting of:

(1) All available logging and testing data on the well;

(2) Primary cement calculations and evidence of cement returns to surface;

(3) Results of satisfactory demonstration of mechanical integrity;

(4) Actual maximum injection pressure and injection flow rate;

(5) Results of the formation testing program, if applicable;

(6) Actual solution mining procedures;

(7) Status of all wells requiring corrective action within the area of review, if applicable;

(8) Detailed 'As-Built' Well Schematic including:

i. Casing details including size, weight, grade, and setting depths,

ii. Cement details including type, special formulations, calculated volumes, actual pumped volumes, and yield (cubic feet/sack),

iii. Formation horizons,

iv. Ground water horizons,

v. Pilot hole.

b) Director's Approval to Commence Solution Mining

Within 7 days after receipt of the well completion report, the Director shall provide written notice denying or granting approval to commence injection.

c) Compliance with DOGM Requirements and BOGM Orders

The Permittee shall comply with all DOGM administrative requirements and BOGM orders, if applicable, as explained in Part I of this permit.

12. Cavern Development

The CCDPs (Attachment D) shall address all modes of cavern development that the Permittee intends to implement. This includes cavern development before initial product storage and various scenarios of re-leaching of existing caverns. Maintaining the geo-mechanical stability of the cavern network must be the first priority in developing and implementing an operating plan for cavern development. Cavern shape shall be controlled by maintaining the blanket material, controlling the water injection rate, controlling the locations of the water injection and brine removal, and controlling the salinity of injected water. Control of cavern development shall be facilitated by the use of computer simulations appropriate to the mode of cavern development.

The following conditions shall apply:

a) Pressurized caverns, if any, are generally expected to be completed within 5 years after the commencement of cavern solution mining. All caverns specific to natural gas, if any, shall be completely solution mined before product storage commences, and

b) Hanging strings shall be removed after each solution mining phase, and

c) Sonar surveys of the cavern, cavern floor, and cavern roof shall be conducted after each solution mining phase and before commencement / re-commencement of product storage, and'

d) Nitrogen/brine interface MIT shall be conducted according to Part III.H after each solution mining phase and before commencement / re-commencement of product storage, and

e) Submittal of well/cavern completion report required by Part III.G.1 after each solution mining phase and before commencement / re-commencement of product storage, and

f) Written approval from the Director to commence / re-commence product storage shall be required.

g) Approval from the Director of DOGM to commence / re-commence product storage shall be required, if applicable, as explained in Part I of this permit.

h) If no APD has been issued by DOGM, the Division may issue a Notice to Proceed once a bond has been issued, and the construction reporting requirements listed in the CCDP have been received.

13. Maximum Allowable Operating Pressure Gradient (MaxAOPG)

Except during well stimulation, the maximum allowable operating pressure gradient (MaxAOPG) shall be calculated to ensure that pressure in the injection zone during injection does not initiate new fractures or propagate existing fractures in the injection zone. In no case shall the injection pressure initiate fractures in the confining zone or cause the migration of injection or formation fluids into an USDW.

Based on the geomechanical analysis of the salt formation in the MH-1 exploratory well, the upper limit of operating pressures is 0.92 psi/ft of depth to the last cemented casing seat. However, the Permittee shall provide additional protection by operating at pressure gradients below 0.92 psi/ft of depth as follows:

a) The typical operating pressure gradient of a cavern will be 0.55 psi/ft of depth to the last cemented casing seat.

b) The maximum allowable operating pressure gradient (MaxAOPG) will not exceed 0.80 psi/ft of depth to the last cemented casing seat, unless the Permittee submits a geomechanical analysis for approval that justifies a higher MaxAOPG while providing a safety factor. A higher MaxAOPG shall not be implemented without the Director's written authorization. At no time will the caverns be subjected to pressures above the approved MaxAOPG, including pressure pulsations, and during abnormal operating conditions.

c) The maximum allowable test pressure gradient will not exceed 0.80 psi/ft of depth to the last cemented casing seat.

14. Minimum Allowable Operating Pressure Gradient (MinAOPG)

The Permittee shall maintain a minimum operating pressure gradient during the creation and operation of each cavern that protects the integrity of the wells, caverns, salt web, and overburden. ACES shall maintain a MinAOPG of 0.30 psi/ft of depth based on the geomechanical analysis of the salt formation.

15. Borehole – Casing Annulus Injection Prohibited

Injection between the outermost casing protecting USDW's and the well bore is prohibited.

E. MONITORING AND RECORDING REQUIREMENTS (Utah Admin. Code R317-7-10.3(B), 40 CFR § 144.54, and 40 CFR § 146.34)

1. Well and Cavern Monitoring and Recording Standards

Monitoring and recording requirements for the drilling and solution mining of each well/cavern are outlined in R317-7-10(10.3.BB) and 40 CFR § 144.54.

The following references apply to the underground storage of hydrocarbons in solution-mined caverns, in general. They were used to inform the development of the permit conditions contained herein, where they apply to the monitoring of brine-compensated and pressurized gas caverns, particularly in regards to cavern integrity and stability.

- *Common Practices – Gas Cavern Site Characterization, Design, Construction, Maintenance, and Operation, SMRI Research Report RR2012-03*
- *Design and Operation of Solution-Mined Salt Caverns Used for Liquid Hydrocarbon Storage – API Recommended Practice 1115 (2nd Edition),* API, November 2018
- *Design and Operation of Solution-mined Salt Caverns Used for Natural Gas Storage – API Recommended Practice 1170,* API, July 2015
- *Canadian Standard Association, CWA Z341 Series 14 – Storage of hydrocarbons in underground formations,* April 2014

Additionally, the monitoring and recording requirements for the drilling of each well in the approved Application for a Permit to Drill (APD) issued by DOGM must be met, if applicable, as explained in Part I of this permit. Monitoring and recording requirements for hydrocarbon storage shall be established by DOGM once the well/cavern system has been released from the Class III UIC permit, according to Part III.G of this permit.

2. Monitoring, Recording, and Reporting Plan

The conceptual MRRP required by Part III.B.2 of this permit is included as Attachment E of this permit. Prior to receiving authorization to commence drilling, ACES shall submit an MRRP for each cavern category for review and approval by the Director. Each approved MRRP shall become an enforceable amendment to Attachment E of the permit.

3. Monitoring Equipment and Methods

All monitoring equipment shall be properly selected, installed, used, and maintained according to the manufacturer's specifications to yield data that are representative of the monitored activity. All monitoring methods shall be properly selected and implemented at appropriate intervals and frequency to yield data that are representative of the monitored activity. Documentation verifying, if applicable, the proper selection, installation, use, and maintenance of monitoring equipment and the proper implementation of monitoring methods shall be made available to the Director upon request.

4. Injectate Characterization

The Permittee shall monitor the nature of injected fluids with sufficient frequency to yield representative data on their characteristics. The Permittee shall provide qualitative analyses and ranges in concentrations of all constituents of injected fluids. Whenever the injection fluid is modified to the extent that this analysis is incorrect or incomplete, a new analysis shall be provided to the Director. The applicant may request confidentiality in accordance with Part II.C of this permit. If the information is proprietary, an applicant may, in lieu of the ranges in concentrations, choose to submit maximum concentrations, which shall not be exceeded. In such a case, the applicant shall retain records of the undisclosed concentrations and provide them upon request to the Director as part of any enforcement investigation.

The Permittee shall submit a complete chemical analysis of the solution mining media (injectate) every two years. The sample shall be taken during a period of active solution mining.

5. Mechanical Integrity Testing (MIT)

Mechanical integrity testing shall be conducted according to the methods and schedule in Part III.H of this permit.

6. Cavern Development Monitoring

The following must be monitored during cavern development:

a) The Permittee shall monitor the shape of the cavern using sonar surveys during development to ensure a stable shape and configuration is achieved and to ensure the Required Pillar Width is maintained.

b) The Permittee shall maintain the location of the blanket/brine interface. It is not sufficient to estimate the depth of the interface from the volume of blanket material injected. The Permittee shall perform periodic wireline surveys to confirm the location of the blanket/brine interface with increased frequency when the solution mining mode is switched from direct to reverse. If wireline surveys cannot confirm the interface, solution mining must stop immediately until the interface can be re-established and confirmed.

c) The Permittee shall conduct daily monitoring of the flow rate of injected water, saturation level of injected water, pressure of injected water, temperature of injected water, flow rate of produced brine, saturation level of produced brine, pressure of produced brine, temperature of produced brine, pressure of blanket, volume of blanket, temperature of blanket.

7. Weekly Brine Analysis

The Permittee shall conduct weekly or more frequent analyses, as needed, of the produced brine for at least magnesium (Mg) and potassium (K) to identify zones of highly soluble salts. If highly soluble zones are identified, adjustment of the solution mining process may be necessary.

F. REPORTING REQUIREMENTS (Utah Admin. Code R317-7-10(10.4.B) and 40 CFR § 144.54)

1. Quarterly Monitoring Reports

a) Schedule for Submitting Quarterly Monitoring Report

Quarter		Report Due On:
1st Quarter	Jan 1 – Mar 31	April 30
2nd Quarter	Apr 1 – Jun 30	July 31
3rd Quarter	Jul 1 – Sep 30	October 31
4th Quarter	Oct 1 – Dec 31	January 31

b) Content of Quarterly Monitoring Reports

Monitoring data for the following shall be included in the quarterly monitoring reports:

(1) Periodic Injectate Characterization

(2) Daily cavern development monitoring data

(3) Weekly Brine Analysis

(4) Wireline logs for all blanket/brine interface confirmations

(5) Sonar surveys for all cavern shape and configuration verification

(6) Noncompliance Not Previously Reported – Such reports shall contain a description of the noncompliance and its cause, the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

(7) 4th Quarterly Monitoring Report shall include a tabulation of the pillar thickness (P) between adjacent caverns and between caverns and the permit area boundaries at 200' depth intervals beginning at the depth of the last cemented casing. The data for this tabulation is available from the most recent sonar surveys of each cavern and its adjacent caverns.

(8) Other Required Monitoring

2. Drilling Reporting

If DOGM does not issue an APD/Permit to Drill, the Permittee shall report drilling requirements to the Division for review. These requirements are found in the

CCDP, and in R649-3-4 and R649-3-6. In addition to the Well Completion Report, the Permittee will provide the following reports during the drilling of Individual cavern wells:

(1) 24-hour Spud Notice via email;
(2) Entity Action Form reported on DOGM Form 6 within 5 days of sending the spud notice;
(3) Encounters with fresh water sand reported on DOGM Form 7;
(4) Report of Water Encountered During Drilling reported on DOGM Form 8;
(5) Monthly status report reported on DOGM Form 9 submitted by the 5^{th} day of the following calendar month:
(6) Changes to the approved Drilling Program reported on DOGM Sundry Notice Form;
(7) Formation testing reports for individual caverns within 30 days of completion

3. <u>Notices</u>

The Permittee will submit the following 24-hour advanced notices to the Division to provide the ability to witness logging and testing activities on-site during the drilling of individual cavern wells:

(1) Casing Cementing;
(2) Casing Pressure testing;
(3) Cement bond logging; and
(4) Mechanical Integrity Testing

4. <u>Noncompliance Reporting</u>

The Permittee shall report to the Director any noncompliance that may endanger health or the environment, as follows:

a) Twenty-four Hour Reporting
Noncompliance information shall be provided orally within 24 hours from the time the Permittee becomes aware of the circumstances. Such reports shall include, but not be limited to, the following information:

(1) Any monitoring or other information that indicates any contaminant may cause an endangerment to a USDW, or
(2) Any noncompliance with a permit condition or malfunction of the injection system that may cause fluid migration into or between USDWs.

b) Five-day Reporting
A written submission shall be provided within five days of the time the Permittee becomes aware of the circumstances of the endangering noncompliance. The written submission shall contain a description of the noncompliance and its cause, the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

5. Planned Changes

The Permittee shall give written notice to the Director, as soon as possible, of any planned physical alterations or additions to the UIC-permitted facility. Notification of planned changes by the Permittee does not stay any permit condition.

6. Anticipated Noncompliance

The Permittee shall give advance notice to the Director of any planned changes to the permitted facility or activity that may result in noncompliance with permit requirements. Notification of anticipated noncompliance by the Permittee does not stay any permit condition.

7. Permit Transfers

This permit is not transferable to any person except in accordance with Part II.D.6.d of this permit. The current Permittee shall notify the Director at least 30 days in advance of the proposed transfer date. Notification shall comply with the requirements in Part II.D.6.d of this permit.

8. Compliance Schedule Reporting

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule specified in Part III.B of this permit shall be submitted no later than 30 days following each schedule date.

9. Mechanical Integrity Reporting

a) Mechanical Integrity Demonstration – Except where it is required to commence or re-commence product storage, the Permittee shall submit the results of any MI demonstration within 60 days after completion of the test. The Permittee shall include in the report a detailed description of the tests and the methods used to demonstrate MI. In the event of MI failure, the Permittee shall also describe in detail what steps were taken and they were taken to reestablish MI.

b) Loss of Mechanical Integrity –

(1) In the event of a mechanical integrity failure that may potentially endanger an USDW, report to the Director verbally within 24 hours, followed by submission of a written report within 5 days.

(2) Within 14 days after loss of MI, submit to the Director a schedule indicating what will be done to restore MI to the well, or if it will be plugged.

10. Closure and Abandonment ("As-Plugged") Report

If a well/cavern system is required to be closed and abandoned prior to being released from the UIC Class III permit for regulatory oversight by DOGM, the Division will assume regulatory oversight of the closure, and the following requirements shall apply:

Within 60 days after permanently or temporarily plugging and abandoning a well, the Permittee shall submit a Closure and Abandonment Report to the Director. The report shall be certified as accurate by the person who performed the closure and abandonment operation, and shall consist of either:

a) A statement that the well was plugged in accordance with the Well and Cavern Closure and Abandonment Plan (Attachment G), required by Part III.I of this permit, previously submitted to, and all conditions of approval provided by, the Director; or

b) If the actual closure and abandonment differed from the approved plan(s), a statement and diagrams defining the actual closure and abandonment, and why the Director should approve such deviation, should be provided. Any deviation from the previously approved individual plans required by this permit that may endanger waters of the State of Utah, including USDWs, is cause for the Director to require the operator to re-plug the well.

11. <u>Permit Review Report</u>

Within 30 days after receipt of this permit, the Permittee shall report to the Director that the person(s) responsible for implementing this permit have read and are personally familiar with all terms and conditions of this permit.

12. <u>Electronic Reporting</u>

In addition to submitting the hard copy data, the Permittee shall submit the required monitoring data in the electronic format specified by the Director.

G. PROCEDURES FOR RELEASING AND READMITTING WELL/CAVERN SYSTEMS

1. <u>Release Individual Well/Cavern System from Permit</u>

Requirements for requesting and obtaining a release of an individual well/cavern system from this permit for sole regulatory oversight by DOGM and BOGM are as follows:

a) Request for Release

Thirty (30) days prior to commencing product storage, the Permittee shall submit a letter to the Division requesting its release from the permit.

b) Well/Cavern Completion Report

The Permittee shall submit to DOGM, if applicable, as explained in Part I of this permit, and to the Division Director, for review, a well/cavern completion report at the end of each solution mining phase consisting of:

(1) All available logging and testing data on the well/cavern system not previously submitted with the well completion report;

(2) Results of mechanical integrity testing for the well/cavern system;

(3) Detailed 'As-Built' well/cavern schematic, including any changes made to the original well 'As-Built' schematic;

(4) Sonar survey of the cavern, including floor and roof surveys;

c) Director's Approval to Release Well / Cavern System from Permit

Within 7 days after receiving all components of the Well/Cavern Completion Report required by b) above, the Director shall provide written notice denying or granting approval to release the individual well/cavern system from the permit.

d) Compliance with DOGM Requirements and BOGM Orders

The Permittee shall comply with all DOGM administrative requirements and BOGM orders prior to the commencement of product storage, if applicable, as explained in Part I of this permit.

2. <u>Readmit Individual Well/Cavern System to Permit for Solution Mining</u>

Requirements for requesting and obtaining re-admittance of an individual well/cavern system back into this permit to actively solution mine the cavern under the sole regulatory authority of the Division for conventional solution mining without product displacement or under concurrent regulatory authority for freshwater displacement of product as described in the Concurrent Division and DOGM/BOGM Regulatory Authority section below are as follows:

a) Sixty (60) days prior to re-commencing solution mining, the Permittee shall submit a letter, with attachments, to the Division requesting that an individual well/cavern system be readmitted to this permit. The letter shall include the following attachments:

(1) A history of the product recovery method used for brine-compensated caverns during the time the cavern was released from this permit. The type of displacement media, fresh water or brine, and the length of time each media was used for product recovery should be included.

(2) A chronology of all geophysical surveys/tests conducted during the time the cavern was released from this permit, including a summary of the results.

(3) Reports of any nitrogen brine interface mechanical integrity tests and sonar surveys that were conducted during the time the cavern was released from this permit.

(4) An updated, current tabulation of the information required in Part III.F.1.b.7 of this permit

(5) A request for a variance from the other requirements in this section.

b) The Permittee shall conduct and submit a report of a sonar survey of the entire individual well/cavern system from the last cemented casing to the cavern floor.

c) The Division shall review all information required in this section including any requests for variance. The Director shall provide written notice denying or granting approval to readmit the individual well/cavern system back into this permit within the 60-day period indicated above.

3. Concurrent Division and DOGM/BOGM Regulatory Authority

Instances in which the Division and DOGM/BOGM share regulatory authority are described in detail in Part I of this permit.

If freshwater injection during product storage operation is performed to create additional cavern capacity over and above that which is necessary to reclaim capacity lost due to salt creep, a maintenance activity, the Division and DOGM/BOGM shall have concurrent jurisdiction over the cavern, with the Division regulating the growth of the cavern and DOGM/BOGM regulating the product storage operations of the cavern, such that the regulatory requirements of both the Division, as detailed in this permit, and DOGM/BOGM shall apply.

H. MECHANICAL INTEGRITY
(R317-7-10.3(B) and 40 CFR § 146.8)

1. Class III Injection Well Mechanical Integrity Standards

Mechanical integrity testing requirements for each Class III well are outlined in R317-7-10(10.3.B) and 40 CFR § 146.8. Additionally, the mechanical integrity requirements for each well in the approved Application for a Permit to Drill (APD) issued by DOGM must be met, if applicable, as explained in Part I of this permit.

All injection wells shall have and maintain mechanical integrity (MI) consistent with the requirements of 40 CFR § 146.8. An injection well has MI if there is:

a) No significant leak in casing, tubing, or packer (internal MI), and
b) No significant fluid movement into an USDW through vertical channels adjacent to the injection well bore (external MI).

2. Mechanical Integrity Testing (MIT) Methods

Unless and until an individual well/cavern system has been released from the UIC Class III permit for regulatory oversight by DOGM, the following testing methods shall be employed to demonstrate MI of the well/cavern system:

a) Internal MI

(1) Hydrostatic Pressure Test

The hydrostatic pressure test shall be conducted according to R649-3-7(7.4) – Well Control, Pressure Tests as follows:

i. Last two cemented casings in salt at the time of construction
ii. Casing seat of last cemented casing after drilling 20’ into salt

(2) Nitrogen/Brine Interface Test

The nitrogen/brine interface test shall be conducted according to UIC Guidances UIC-3-14, 15, 16, and 17 as follows:

i. Last cemented casing string before commissioning the cavern

ii. Last cemented casing string after workover involving last cemented casing

iii. Last cemented casing string every 5 years after initial test

b) External MI

(1) Nitrogen/Brine Interface Test

i. Well/pilot hole before solution mining of the cavern commences

ii. Well/cavern before commissioning the cavern

iii. Well/cavern every 5 years after initial test

(2) Cement Records

Primary cement records for each cemented casing string obtained during construction of each well.

(3) Cement Evaluation Logs

Conducted on surface, all intermediate and production casings after WOC of 72 hours and after attaining a compressive strength of 500 psi, unless an appropriate cement evaluation tool is not available for the larger diameter casings, in which case an alternative logging program shall be proposed by the Permittee.

3. Mechanical Integrity Demonstration Plan

The Permittee shall prepare a detailed plan to demonstrating that MI is included in the approved and enforceable Monitoring, Recording, and Reporting Plan in Attachment E of the permit. In preparing a plan that includes MI tests or demonstration methods allowed by the Director, the Permittee shall apply methods and standards generally accepted in the industry for conducting and evaluating the tests (40 CFR 146.8(e)).

4. Prohibition Without Demonstration

The Permittee shall not commence injection operations of any new well without:

a) Prior demonstration of MI, and

b) Receipt of the Director's written approval of the MI demonstration.

5. Loss of Mechanical Integrity

If the Permittee or the Director determines that a well fails to demonstrate MI, the Permittee shall:

a) Cease operation of the well immediately, and

b) Take steps to prevent losses of brine into USDWs, and

c) Within 90 days after loss of MI, restore MI or plug and abandon the well in accordance with a plugging and abandonment plan approved by the Director.

d) The Permittee may resume operation of the well after demonstration of MI and receiving written approval from the Director.

6. Mechanical Integrity Demonstration Requests

With just cause, the Director may at any time require, by written notice, the Permittee to demonstrate MI of a well.

7. Mechanical Integrity Demonstration Inspections

The Permittee shall allow the Director, or his representative, to observe any or all MI demonstrations. The Permittee shall notify the Director, in writing, of its intent to demonstrate MI, no less than 14 days prior to the intended demonstration.

I. WELL AND CAVERN CLOSURE AND ABANDONMENT (40 CFR § 146.10 and R317-7-10(10.5))

If a well or well/cavern system is required to be plugged and abandoned before it has been transferred to DOGM for regulatory oversight for operation and maintenance, The Permittee shall submit for the Director's approval a comprehensive plan for cavern evacuation, decommissioning and well abandonment that meets the requirements that are generally held to be closure and abandonment standards by the underground hydrocarbon storage industry. The document entitled "Cavern Well Abandonment Techniques Guidelines Manual," issued by the Solution Mining Research Institute (SMRI), provides guidance on the preparation of an appropriate Well and Cavern Closure Plan. At a minimum, the plan shall include monitoring of the cavern pressure and cavern volume during the waiting period required for the brine and cavern to reach static equilibrium before plugging and abandoning the well. The plan shall also include continued subsidence monitoring of the cavern for 10 years after the plugging and abandonment of the cavern well. The approved Well and Cavern Closure and Abandonment Plan shall become an enforceable attachment (Attachment G) to this permit.

J. FINANCIAL RESPONSIBILITY (Utah Admin. Code R317-7-9(9.1.24) and 40 CFR § 144.52)

1. Demonstration of Financial Responsibility

The Permittee is required to maintain financial responsibility and resources to close, plug, and abandon all wells and well/cavern systems. This requirement is demonstrated by submission of financial assurance instrument(s) acceptable to the Director and, if applicable, to the Director of DOGM to implement the approved Well and Cavern Closure and Abandonment Plan (Attachment) required by this permit. Evidence of adequate financial assurance is included in Attachment H of this permit.

In cases where the Division and DOGM share regulatory authority, as explained in Part I of this permit, the Permittee shall maintain adequate financial assurance with both agencies as named beneficiaries, requiring approval from both agencies before the release of financial responsibility, either through a single shared financial assurance instrument or two separate financial assurance instruments.

Additionally, the Permittee shall provide evidence of adequate financial assurance to cover the pressure and cavern capacity monitoring during the waiting period required for the cavern and brine to reach static equilibrium before the well is plugged and abandoned, and to cover the post-closure subsidence monitoring.

2. <u>Renewal of Financial Responsibility</u>

Every five (5) years, the Permittee shall demonstrate the adequacy of the financial assurance instrument to close, plug, and abandon all well/cavern systems that are not permanently closed and abandoned by the Permittee, in compliance with the closure and abandonment requirements of this permit.

3. <u>Alternate Financial Responsibility</u>

The Permittee must submit an alternate demonstration of financial responsibility acceptable to the Director within 60 days after any of the following events occur:

a) The institution issuing the financial assurance instrument files for bankruptcy; or

b) The authority of the institution issuing the financial assurance instrument is suspended or revoked; or

c) If a Certificate of Deposit (CD) is used to demonstrate financial responsibility, the CD is determined to be insufficient to cover well closure, plugging, and abandonment; or

d) If a Certificate of Deposit (CD) is used to demonstrate financial responsibility, the CD is suspended or revoked.

K. ADDITIONAL CONDITIONS (40 CFR § 144.52)

1. <u>Geomechanical Analysis and Reassessment</u>

Establishing and maintaining the stability of the caverns and adjacent salt pillars (salt web) is required. The initial geomechanical analysis is based on existing data and the proposed cavern mining plans. If new data is acquired that is significantly different than that used or assumed in the original analysis and/or if solution mining of the caverns deviates significantly from the original solution mining plan, a new geomechanical analysis and reassessment may be required to determine cavern and salt web stability in light of the new data and conditions.

Upon receiving written notification of significant deviations by the Director, the Permittee shall perform a geomechanical analysis and reassessment of the cavern field to verify the geomechanical stability of the caverns, salt web, and overburden when any of the following occurs:

a) When the spacing between any caverns is less than the Required Pillar Width,

b) When there is evidence of a roof fall and/or sidewall spalling,

c) When there is irregular mining of the cavern that deviates from the solution mining plan, which creates conditions that may compromise the stability of the cavern, such as a flat roof or sharp corners,

d) When, due to unforeseen or unplanned circumstances, the open cavern volume of any cavern exceeds the permitted cavern capacity by 15%,

e) Any anomalous behavior that may present a concern for cavern stability.

The Permittee shall be required to take appropriate action if the results of the analysis indicate such action is necessary.

2. <u>Change in Permit Area Boundary</u>

Changes to the permit area boundary may be made through a minor modification of the permit according to Part II.D.6.c.4 of this permit.

Attachment A

General Location Map of the ACES Delta Solution Mining, LLC Storage Project, Millard County

GENERAL LOCATION MAP

FIGURE
1

Attachment B

Map of the ACES Delta Solution Mining, LLC.
Area of Review (AOR) including the Class III Permit Area

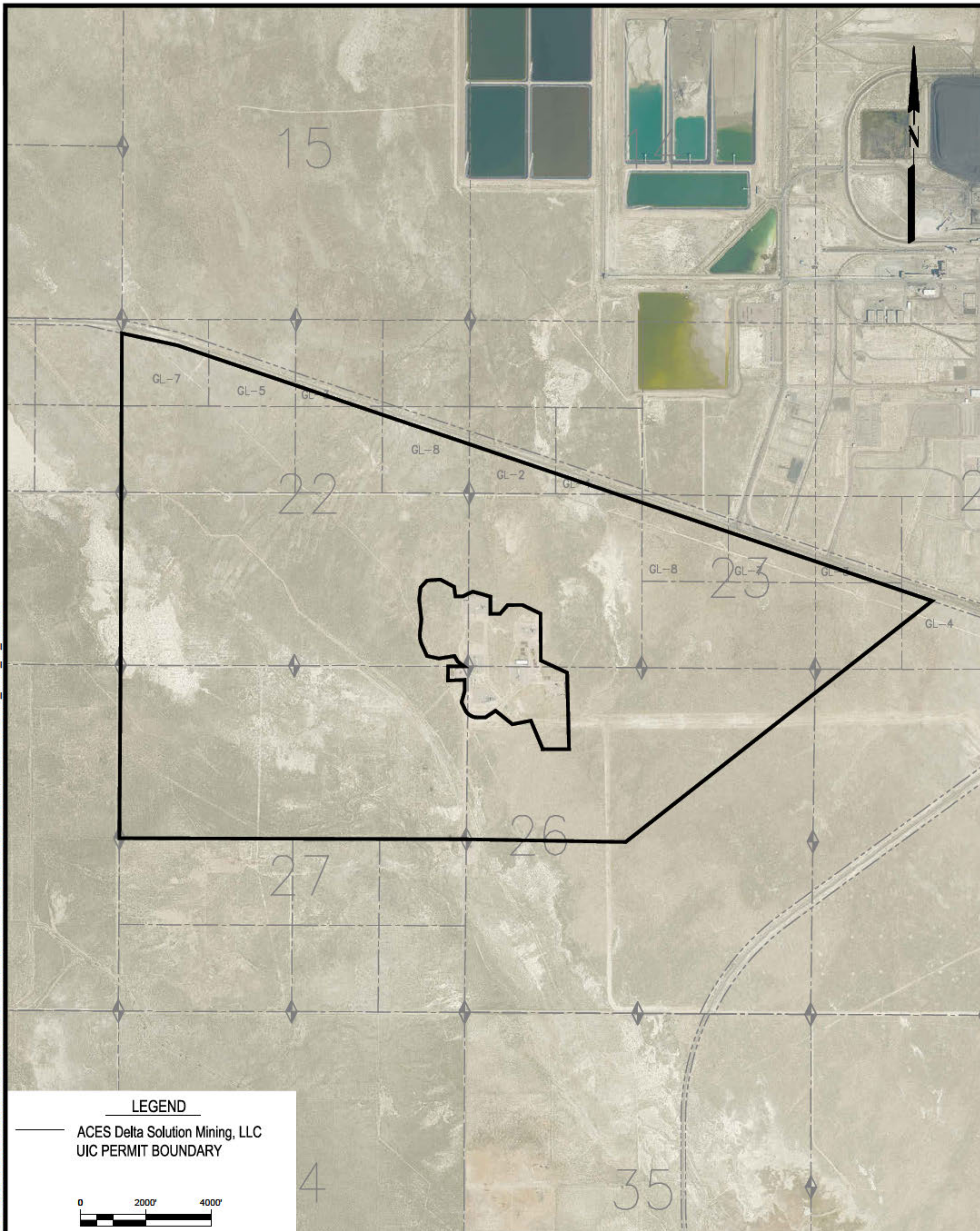
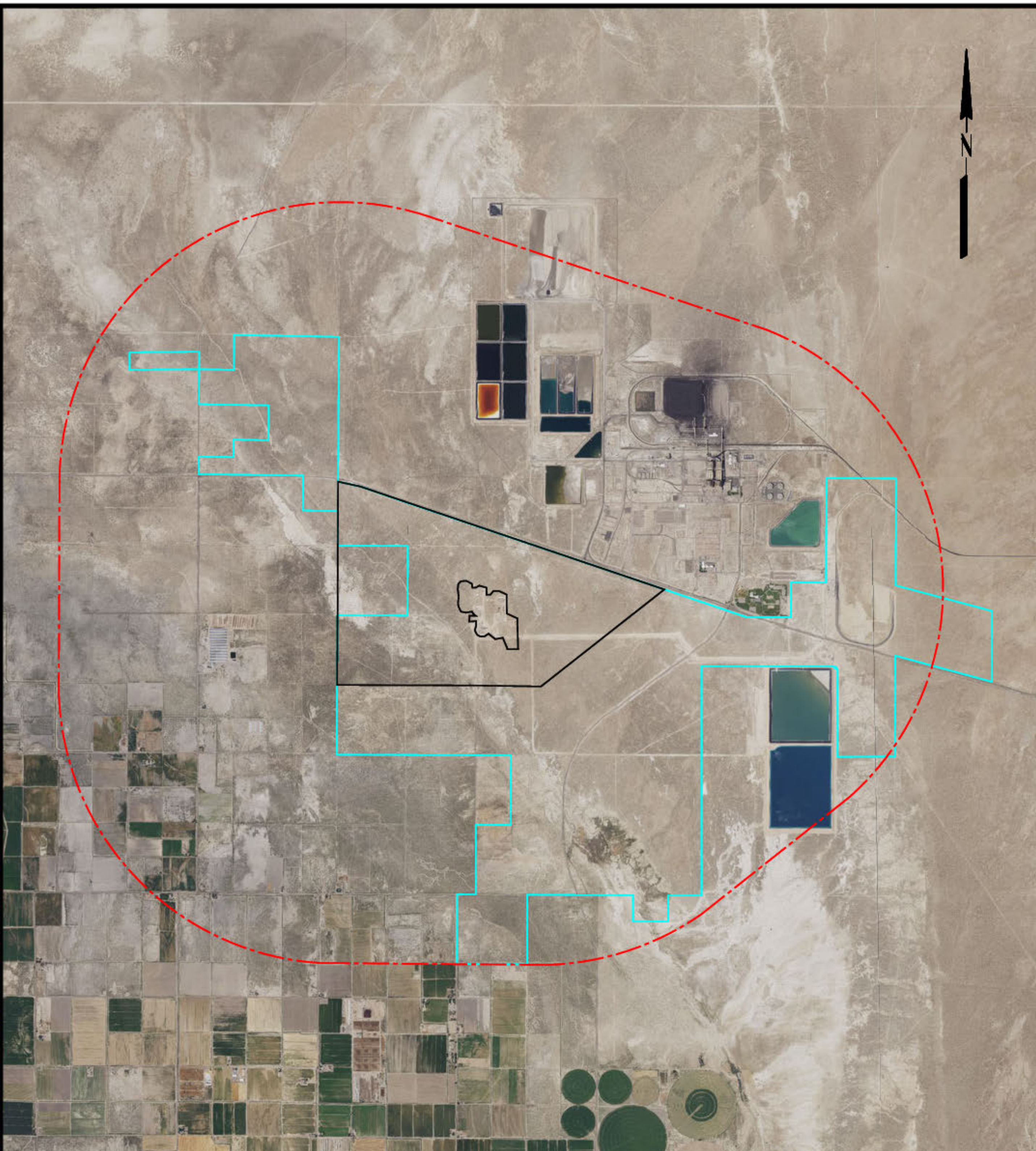


FIGURE:	UIC PERMIT BOUNDARY	ACES DELTA 3165 E. MILLROCK DR, SUITE 330 HOLLADAY, UTAH 84121 PHONE: (801) 993-7001 www.westernenergyhub.com	DRAWING DATA DRAWN BY: DESIGNED BY: CHECKED BY: APPROVED: DATE: SCALE: DIMENSIONS:	No.	DATE	DESCRIPTION

Filename: C:\USERS\DROBINSON\MAGNUM DEVELOPMENT\CAD ARCHIVES - DOCUMENTS\07-SUNRISE\UIC 2019\UIC_2024_03_20.DWG



LEGEND

ACES Delta Solution Mining, LLC
UIC PERMIT BOUNDARY

PROJECT BOUNDARY

AREA OR REVIEW

FIGURE:

UIC PERMIT BOUNDARY

ACES DELTA
3165 E. MILLROCK DR, SUITE 330
HOLLADAY, UTAH 84121
PHONE: (801) 993-7001
www.westernenergyhub.com

DRAWING DATA		No.	DATE	DESCRIPTION
DRAWN BY:				
DESIGNED BY:				
CHECKED BY:				
APPROVED:				
DATE:				
SCALE:				
DIMENSIONS:				

Filename: C:\USERS\DROBINSON\MAGNUM DEVELOPMENT\CAD ARCHIVES - DOCUMENTS\07-SUNRISE\UIC 2019\UIC_2024_03_20.DWG

ACES Delta Solution Mining, LLC

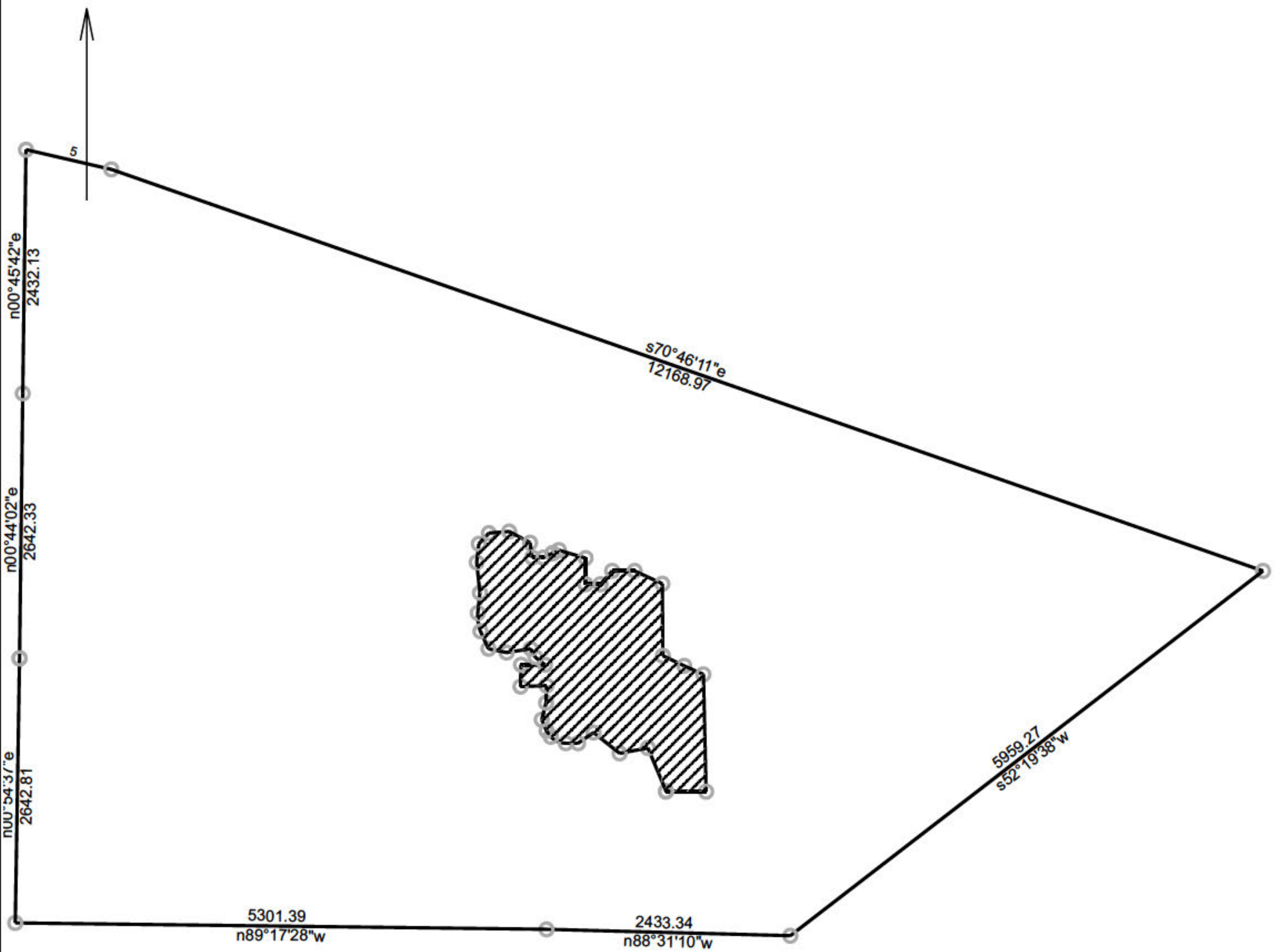
New UIC Boundary

Commencing at the Southeast corner of Section 22, Township 15 South, Range 7 West, Salt Lake Meridian; thence North 89°17'52" West 2655.50 feet along section line to the South quarter corner of said Section 22; thence North 89°19'02" West 2654.79 feet along section line to Southwest corner of Section 22; thence North 00°44'02" East 2642.33 feet along section line to the West quarter corner of said Section 22; thence North 00°45'42" East 2432.13 feet along section line to its intersection with the southerly right-of-way line of Brush Wellman Road; thence South 77°07'04" East 874.24 feet along said right-of-way; thence South 70°46'11" East 12168.97 feet along said right-of-way; thence South 52°19'38" West 5959.27 feet; thence North 88°31'10" West 2433.34 feet to the East quarter Corner of Section 27, Township 15 South, Range 7 West, Salt Lake Meridian; thence North 89°17'28" West 5301.39 feet along quarter section line to the West quarter corner of said Section 27; thence North 00°54'37" East 2642.81 feet along section line to the POINT OF BEGINNING. Contains 62716123 square feet or 1439.764 acres, more or less.

LESS AND EXCEPTING - Commencing at the Southwest corner of Section 23; Township 15 South, Range 7 West, Salt Lake Meridian; thence North 00°18'23" East 1111.06 feet along section line to the POINT OF BEGINNING; thence North 64°34'46" East 73.91 feet; thence South 73°49'13" East 279.34 feet; thence South 00°00'19" West 263.15 feet; thence North 89°42'45" East 146.57 feet; thence North 41°28'46" East 177.23 feet; thence North 89°34'42" East 225.12 feet; thence South 64°31'09" East 305.28 feet; thence South 00°23'34" East 717.88 feet; thence South 65°16'04" East 235.54 feet to a point on the northerly line of Section 26, T15S, R7W, SLM; thence continuing in said section 26 South 65°16'04" East 207.43 feet; thence South 01°23'26" East 1169.62 feet; thence West 401.20 feet; thence North 4.28 feet; thence North 22°43'27" West 467.23 feet; thence South 79°11'34" West 288.07 feet; thence North 51°06'56" West 329.45 feet; thence South 56°39'43" West 187.05 feet; thence South 89°59'34" West 122.48 feet to a curve to the right having a radius of 209.79 feet, a central angle of 45°07'59" and a chord that bears North 67°26'27" West 161.02 feet; thence along said curve northwesterly an arc distance of 165.26 feet to a point on the easterly line of Section 27, T15S, R7W, SLM; thence continuing in said Section 27 along the arc of said curve to the right having a radius of 209.79 feet, a central angle of 20°06'21", and a chord that bears North 34°49'17"

West 73.24 feet; thence North 24°46'07" West 122.64 feet; thence North 15°42'36" East 172.98 feet; thence North 00°34'51" East 174.69 feet; thence South 87°34'12" West 258.30 feet; thence North 01°33'30" East 219.21 feet to the southerly line of Section 22, T15S, R7W, SLM; thence South 89°50'49" East 239.59 feet along section line; thence in Said Section 22 North 52°10'01" West 120.19 feet; thence North 30°04'41" West 97.90 feet; thence South 80°30'37" West 242.82 feet; thence North 77°33'20" West 185.78 feet; thence North 24°20'04" West 190.91 feet to a curve to the right having a radius of 350.00 feet, a central angle of 30°50'30" and a chord that bears North 08°54'49" West 186.13 feet; thence along said curve northerly an arc distance of 188.40 feet; thence North 06°30'26" East 200.06 feet; thence North 06°22'38" West 309.11 feet; thence North 06°38'54" East 184.56 feet; thence North 43°13'03" East 145.85 feet; thence North 85°51'44" East 204.23 feet; thence South 61°59'15" East 237.38 feet; thence South 07°46'26" East 147.72 feet; thence South 89°44'16" East 110.58 feet; thence North 64°34'46" East 98.93 feet to the POINT OF BEGINNING. Contains 3388367 square feet or 77.786 acres, more or less.

PROFESSIONAL LAND SURVEYOR
03/26/24
No. 189369
DALE J.
ROBINSON
STATE OF UTAH



3/20/2024

Scale: 1 inch= 1597 feet | File: UICBndry-REV4-2024.ndp

Tract 1: 1439.7641 Acres, Closure: s80.5633w 0.01 ft. (1/999999), Perimeter=34454 ft.
Tract 2: 77.7828 Acres, Closure: s15.0334e 0.02 ft. (1/418887), Perimeter=9691 ft.

Tract Data and Deed Calls: File= UICBndry-REV4-2024.ndp

Tract 01: 1439.7641 Acres, Closure: s80.5633w 0.01 ft. (1/999999), Perimeter=34454 ft.
Tract 02: 77.7828 Acres, Closure: s15.0334e 0.02 ft. (1/418887), Perimeter=9691 ft.
Tract 02: 77.7828 Acres, Closure: s15.0334e 0.02 ft. (1/418887), Perimeter=9691 ft.

1: /n89.1752w 2655.5
2: /n89.1902w 2654.79
3: n00.4402e 2642.33
4: n00.4542e 2432.13
5: s77.0704e 874.24
6: s70.4611e 12168.97
7: s52.1938w 5959.27
8: n88.3110w 2433.34
9: n89.1728w 5301.39
10: n00.5437e 2642.81
11: @0
12: /n00.1823e 1111.06
13: n64.3446e 73.91
14: s73.4913e 279.34
15: s00.0019w 263.15
16: n89.4245e 146.57
17: n41.2846e 177.23
18: n89.3442e 225.12
19: s64.3109e 305.28
20: s00.2334e 717.88
21: s65.1604e 235.54
22: s65.1604e 207.43
23: s01.2326e 1169.62
24: s90w 401.2
25: n0e 4.28
26: n22.4327w 467.23
27: s79.1134w 288.07
28: n51.0656w 329.45
29: s56.3943w 187.05
30: s89.5934w 122.48
31: curve right radius 209.79 arc 165.26 chord dir n67.2627w chord dist 161.02
32: n34.4917w 73.24
33: n24.4607w 122.64
34: n15.4236e 172.98
35: n00.3451e 174.69
36: s87.3412w 258.3
37: n01.3330e 219.21
38: s89.5049e 239.59
39: n52.1001w 120.19
40: n30.0441w 97.9
41: s80.3037w 242.82
42: n77.3320w 185.78
43: n24.2004w 190.91
44: curve right radius 350 arc 188.4 delta 030.5030 chord dir n08.5449w chord dist 186.13
45: n06.3026e 200.06
46: n06.2238w 309.11
47: n06.3854e 184.56
48: n43.1303e 145.85
49: n85.5144e 204.23
50: s61.5915e 237.38
51: s07.4626e 147.72
52: s89.4416e 110.58
53: n64.3446e 98.93

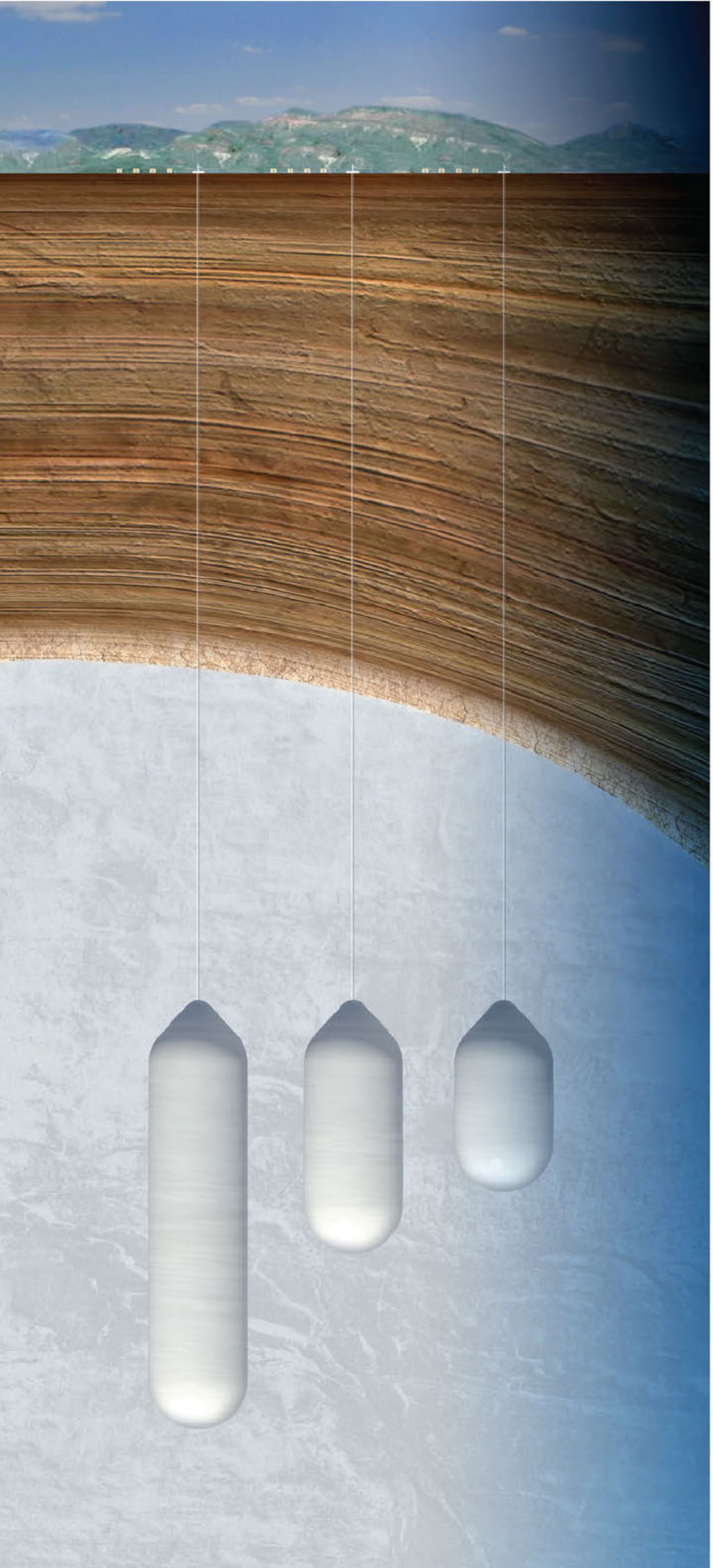
Attachment C

Corrective Action Plan for Artificial Penetrations into Injection Zone within Area of Review

As of the effective date of this permit modification there are no wells requiring corrective action.

Attachment D

Construction and Cavern Development Plan



Hydrogen Cavern Construction and Development Plan

Class III Underground Injection Control Permit UTU 27-AP-718D759

ACES DELTA

Hydrogen Cavern Construction and Development Plan

Class III Unground Injection Control Permit
UTU 27-AP-718D759

ACES Delta Solution Mining, LLC
Delta, Utah

APRIL 2024

Prepared by
ACES Delta, LLC
3165 E. Millrock Dr., Suite 330
Holladay, Utah 84121
Tel 801 993 7001   Fax 801 993 7025
www.westernenergyhub.com

Table of Contents

Tables

Figures

Section 1

Introduction

1.1 Purpose of the Plan

This Plan has been developed to outline clear processes and procedures for storage cavern construction (drilling and cavern well installation) and development (solution mining) at the ACES Delta Solution Mining, LLC (Company) Hydrogen Production and Storage facility (Facility). the. The construction (drilling), development (solution mining) and operations of storage caverns are under the sole jurisdiction of the Utah Department of Environmental Quality (DEQ), the Division of Water Quality (DWQ). In addition to this Class III Underground Injection Control (UIC) Permit, the Company has also obtained a Class V UIC Permit from the DWQ for operation of the storage caverns and the appropriate permits and authorizations required by the other state and local agencies with jurisdiction.

The Company has created this Plan, to meet the requirements for the solution mining of salt caverns under DWQ Class III UIC Permit UTU-27-AP-718D759. This Plan has been reviewed and approved by the DWQ. Any future modifications to this Plan requested by the Company are subject to approval by DWQ. DWQ may also modify the Plan after it receives new, previously unavailable information or after a review of the Plan. A copy of the Plan will be kept at the facility.

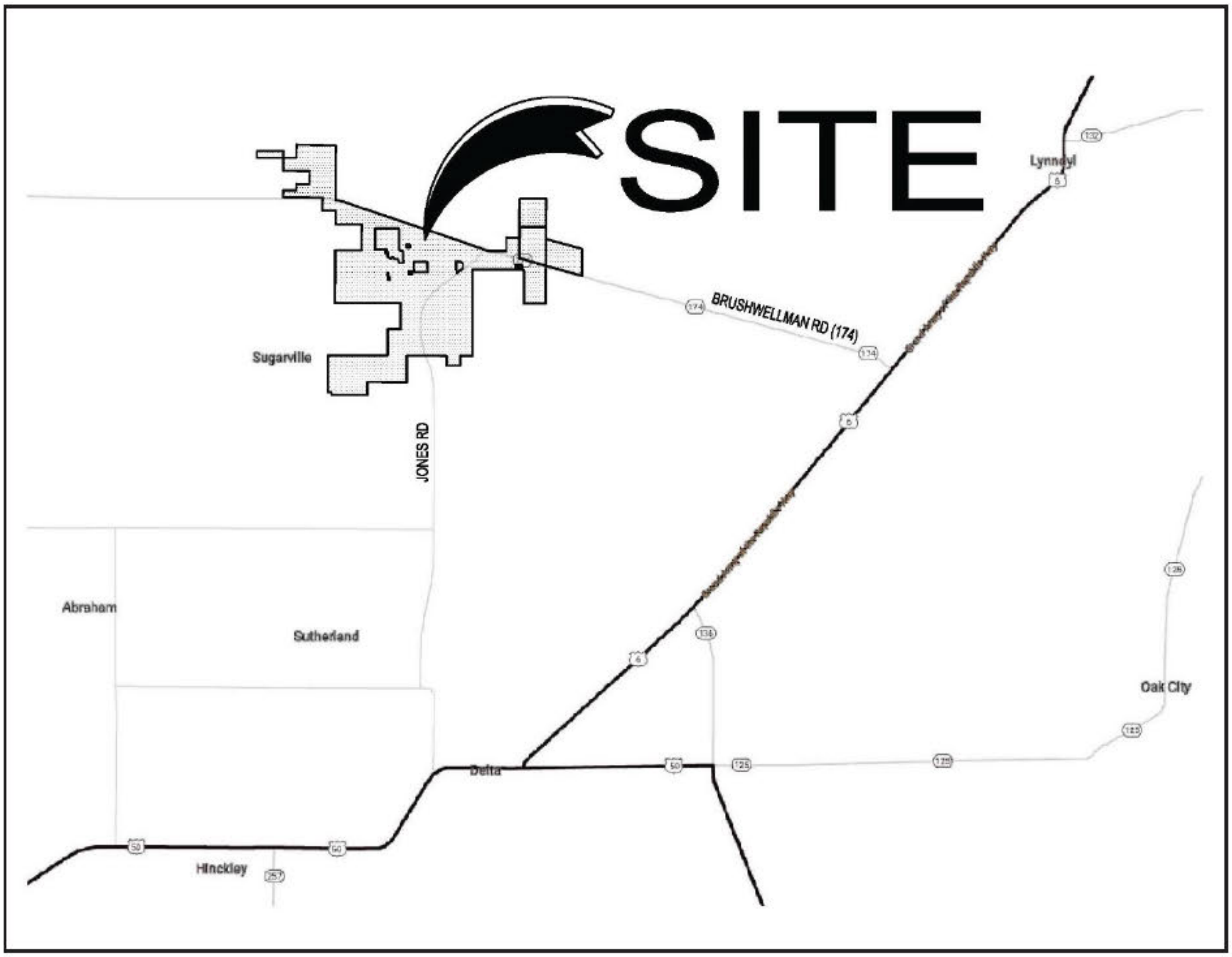
1.2 Facility Location

The Facility is located approximately eight miles north of Delta in Millard County and on lands leased from the Utah School and Institutional Trust Lands Administration (SITLA). As shown on Figure 1, it is situated west of Highway 6 near the intersection of Jones Road and Brush Wellman Road/SR-174.

1.3 Facility Description

The Facility is located above a salt dome that is approximately one mile thick, two miles in diameter and 3,000 feet below the ground surface. The Company will be solution mining storage caverns within the salt dome for the purpose of storing hydrogen gas. Figure 2 is a map depicting the storage facility layout as currently proposed. As shown, the facility components include a storage cavern field, two brine evaporation ponds, electrolyzer facilities to produce hydrogen and utilities interconnecting the components. The utilities interconnecting the components include brine pipelines, water pipelines and water wells, hydrogen gas pumping and pipeline systems, and power and communications lines. Eventually the facility will be capable of storing up to 180 million kilograms of hydrogen gas in up to 18, 5.5 million barrel (mmbbls) caverns. The timing of cavern construction of each cavern within the Storage Cavern Field will be dependent upon market demand.

Figure 1: Vicinity Map



1.4 Storage Cavern Field Description

This Plan specifically addresses the construction and development of cavern wells and storage caverns within the Storage Cavern Field. Figure 2 depicts the location of the Storage Cavern Field within the broader facility, the approximate locations and numbers of the first five storage caverns and cavern wells. The Storage Cavern Field currently includes plans for 18 hydrogen storage cavern and cavern well locations. The storage caverns within the Field are being constructed using conventional solution mining technology. Depending upon the cavern size, solution mining will take between 21 and 28 months to complete. The DWQ has previously approved the engineering design and plans for cavern well spacing, wellhead design, casing design, drilling plan, cementing plan, solution mining plan, and cavern operations as part of the Class III UIC permit application process.

Figure 2: Facility Plan

[redacted]

Filename: C:\USERS\DROBINSON\MAGNUM DEVELOPMENT\CAD ARCHIVES - DOCUMENTS\08-EXHIBITS\ACES\ACESDELTA-H2-CW2-UIC-FIGURE2.DWG

Geomechanical modeling will be completed for each cavern to demonstrate that a cavern meets spacing and depth requirements in order to maintain both cavern wall and roof integrity of the individual caverns and overall salt web. A maximum Web Factor of Safety Value of 2.00 or greater shall be maintained for each cavern. Site specific conditions and geomechanical modeling will dictate cavern geometry and siting within the salt formation.

Section 2

Cavern Well Construction

Cavern well construction entails both the development of an agency approved engineering design and the installation of the cavern well in accordance with that design. The installation of the cavern well also consists of several interrelated activities or parts that the agencies review and approve: drilling program; well conditioning procedures; formation testing program; welding procedures; and the cementing procedure and specification. A detailed description of the typical cavern well design and cavern well installation process is provided in this section. Prior to the start of drilling each cavern, a detailed cavern specific design and installation process is also submitted to the agencies for review and approval.

2.1 Cavern Well Design

The typical cavern well design outlined in this section has been reviewed and approved by the DWQ as part of the UIC permit review process. Prior to the construction of individual caverns, the Company will also submit a detailed cavern well design to the DWQ for review and approval as part of a comprehensive Drilling Program. The typical design provided in this plan is based on the detailed design for the first hydrogen storage cavern. It was developed to be the guide for all Company caverns at this location and meets the Utah state rules for drilling (R649-3-6) and casing testing (R649-3-13 and R649-3-4). The typical cavern well casing design is shown in Figure 3.

As shown in Figure 3, the typical design includes a well head, five casings and two hanging casing strings. The cavern well is specifically designed to provide a strong foundation for mechanical integrity of the cavern well and storage cavern as well as protect against the potential for groundwater contamination. The cavern well casing design consists of one casing driven in at the surface (Conductor); two cemented water protection casing strings, one cemented in the freshwater zone (Surface) and one across all freshwater bearing zones to the top of the salt transitional zone (1^{st} Intermediate); two additional casing strings cemented into the salt (2^{nd} Intermediate and Production); and two hanging strings (Outer and Inner Mining Strings).

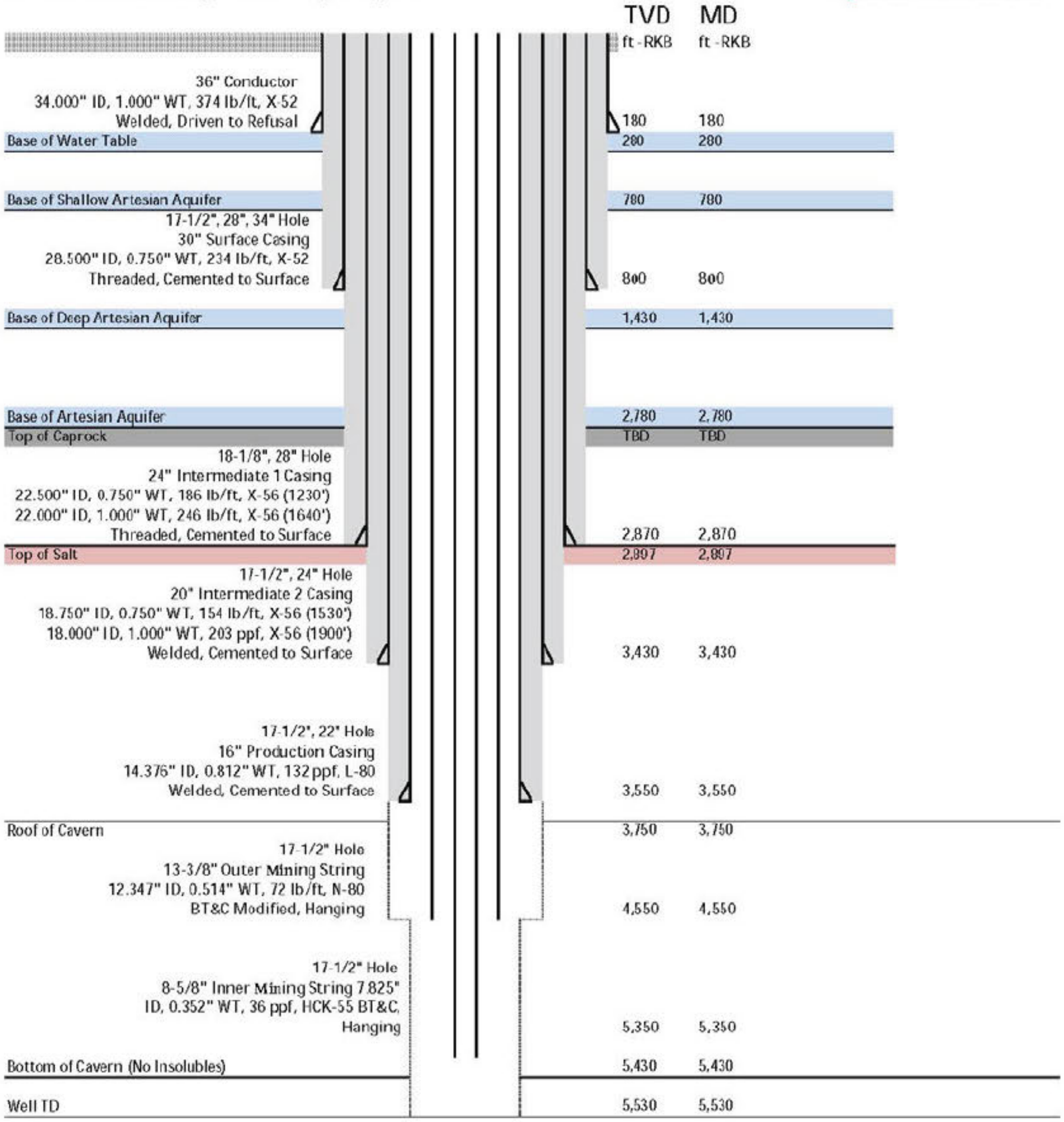
Table 1 and Table 2 below also provide a summary of both the casing design and the safety factors for the various loading scenarios by casing. In the event that these casing sizes are not available at the time each cavern well is drilled, the next higher grade or increased wall thickness should be chosen.

Figure 3: General Cavern Well Schematic

wsp

Wellbore Schematic - Proposed (16" Production Casing)
Magnum Cavern Well (Vertical Well)
Salt Cavern Storage Well - Hydrogen

Updated 1/13/2021



Assumptions/Notes:

- RKB is assumed at 30 ft
- Formation bases and tops are averages from Magnum CW-5, 6, 7, 8, and 9
- Conductor was driven to an average 151 ft-GL
- Surface casing will be set 30 ft below base of the Shallow Artesian Aquifer
- Intermediate 1 casing was set on average 120 ft above top of Salt
- Intermediate 2 casing is recommended to be set 300 ft into top of Salt
- Intermediate 2 casing is recommended to be welded for H2 well design
- Centralizers every other joint, bow in open hole, rigid in cased hole
- XMAC will determine final production casing setting depth
- A VSP is recommended to be run to TD (final well TD may change)
- 3 x 30 ft cores cut in production hole @ shoe, roof, and mid-cavern

Table 1. Summary of Typical Casings for Hydrogen Storage Well

Casing String	Size – inches	Weight – pounds/foot	Grade	Depth – feet
Conductor	36"	374	X-52	0 – 180
Surface	30"	234	X-52	0 – 800
1st Intermediate	24"	186	X-56	0 – 1,230
1st Intermediate	24"	246	X-56	1,230– 2,870
2nd Intermediate	20"	154	X-56	0 – 1,530
2nd Intermediate	20"	203	X-56	1,530 – 3,430
Production	16"	132	L-80	0 – 3,550
Outer Mining String	13-3/8"	72	N-80	0 – 4,550
Inner Mining String	8-5/8"	36	HCK-55	0 – 5,350

Table 2. Summary of Calculated Factors of Safety

Casing Strings	Safety Factor	
	Collapse – 1.125	Burst – 1.1
Conductor	N/A	N/A
Surface	1.23	1.57
1st Intermediate	1.51	1.57
1st Intermediate	1.2	1.57
2nd Intermediate	1.67	1.57
2nd Intermediate	1.42	1.57
Production	1.19	1.66

The guiding principles of the cavern well design are: 1) the need to support injection and production from the completed storage cavern at 3,300 gpm with a velocity about 16 feet per second; and, 2) sizing the casing to allow for the use of hanging casing strings for solution mining at rates of about 2,500 gpm. Consequently, the goal of the cavern well design is to specify casing sizes and grades that allow a safety factor of about 1.125 for collapse, 1.1 for burst and 1.8 for tensile forces based on published strength data. The various casing strings included in the typical design are therefore sized to withstand foreseeable collapse, burst and tensile forces that might act upon the casing.

In normal operations collapse forces generally are greatest during cementing of the casing string when the inside of the casing is filled with drilling mud and the annulus is filled with heavier cement slurry. In normal operations the collapse forces resulting from the weight difference between cement and drilling mud are low. At 4,000 feet this can amount to about 1,000 psi. However, in keeping with generally accepted practices, such as API 5L, the collapse pressures are calculated with the assumption that the annulus is filled with cement and the inside of the casing is air-filled.

In the case of the outer hanging casing string, the collapse pressures also result from the use of nitrogen as a blanket material. The nitrogen blanket pressure will be greatest at the start of mining when the nitrogen blanket is at its deepest location. At the worst case (for collapse calculations) the largest pressures occur during reverse mining when the cavern is shut-in. In this instance, water is in the outer tubing string, and the brine in the cavern is unsaturated and continues to dissolve salt. The continued dissolution increases space in the cavern so that the wellhead fluid pressures fall to a vacuum. If at the same time the borehole has closed around the hanging tubing, the nitrogen pressure will be locked in at its normal operating pressure. The full nitrogen pressure of about 3,600 psi will be acting against the 13-3/8outer hanging tubing with a vacuum on the inside. The tubing has been sized to withstand this event, however it is unlikely.

Burst forces again are generally greatest during cementing operations but are normally very low during normal operations. The worst case occurs if the casing has been run in the well, the float shoe/collar gets stuck shut and a gas blowout occurs at the bottom of the hole. In this event the full hydrostatic pressure of the drilling mud in the casing would be acting against a low-pressure gas-filled annulus. The pressure of the annulus was conservatively assumed to be “0” psi.

In the case of the final cemented casing, significant burst forces occur during mining operations due to the use of nitrogen as the blanket material. After mining is completed, lesser pressures will act inside the final cemented casing as a result of normal liquid storage operations.

The purpose of the heavier wall casing at the bottom of the 8-5/8” string is to have a compatible set of hanging casing strings (13-3/8” and 8-5/8”) that sonar caliper tools may be able to survey through. An intermediate sonar survey will be completed to determine if the hanging casing strings are compatible. In the event that the hanging casings strings are incompatible, then a workover to pull the strings will be required in order to obtain a cavern survey that meets the requirements of the UIC Permit

2.1.1 Drilling Procedure

A standardized drilling procedure will be followed for the installation of all hydrogen storage cavern wells. The approved cavern well design depicted in Figure 3 provides the foundation for the drilling procedure and meets the requirements of the Class III UIC Permit. In general, cavern wells will be drilled from the surface to about 2800 feet into the salt, generally between 5,000 and 6,000 feet bgs. The drilling procedure for the individual cavern wells will include the steps outlined below. As noted with the cavern well design, the drilling steps include depths that are approximate from ground level and the casing lengths, grades and wall thicknesses may change as determined by availability and actual drilling conditions in the individual storage cavern wells.

1. Construct a lined reserve pit with at least 5,500 barrel capacity.
2. Rig up drilling rig.
3. Drill 42” hole for or drive 36”, 1.0” wall thickness, conductor pipe to approximately 180 feet bgs. If drilled, cement to surface. If driven, clean out conductor with 33-1/2" hole opener.
4. Mix freshwater mud with bentonite and conditioners as recommended by mud consultant.
5. Drill a 17-1/2" hole to ±800 feet bgs.
6. Log hole with resistivity, SP, Induction, and gamma ray.
7. Open 17-1/2" hole up to 34" with hole openers as appropriate.
8. Run caliper log from TD to surface.
9. Run and cement 30" O.D., 0.75” wall thickness, threaded and coupled pipe to about 800 feet bgs. String weight about 183,000 pounds in air. Centralizers to be placed every other casing joint. Cement about 500 barrels.

10. Allow the cement to set a minimum of 18 hours. Pressure test the casing to 400 psi and hold for 60 minutes. If pressure falls more than 40 psi (10%), repressure and restart the test.
11. After the cement sets, cut off the 30" casing and attach appropriate mud piping. Top off annulus as needed.
12. Drill a 18-1/8" hole to about 2,870 feet bgs, or at least 100 feet into the gypsum layer or top of cap rock above the top of salt structure estimated to be ± 2,780 feet.
    a. Run deviation surveys every 90 feet. Allowable deviation is less than 1.5°.
    b. Lost circulation may occur over this interval; control as necessary by the use of lost circulation material, cement plugs, or drill without returns for short intervals.
13. Run gamma ray, neutron, density, SP induction and resistivity logs as specified.
14. Open the 18-1/8" hole to 28" with hole openers of increasing size.
15. Run X-Y caliper log.
16. Run and cement ± 1640 feet of 24" O.D. 1.00" wall thickness and ± 1,230 feet of 24" O.D., 0.75" wall thickness, threaded and coupled pipe to 2,800 feet within the gypsum layer above the top of salt structure. *Casing string weight is approximately 600,000 pounds in air.* Use the stab-in cementing method. Centralizers to be placed every other casing joint. Cement about 650 barrels.
17. After the cement sets for 48 hours, pressure test the casing to approximately 1000 psi and hold for one hour. If pressure falls more than 100 psi (10%), repressure the casing and restart the test.
18. Cut off the 24" casing and connect appropriate mud flow equipment. Top off cemented annulus as needed.
19. Nipple up BOP on 24" casing.
20. Drill out cement and shoe with 22" bit.
21. Switch to salt saturated mud with conditioners as specified by mud consultant after drilling out cement.
22. Drill a 17-1/2" hole with a steerable bit to ± 5,530 feet bgs.
    a. Run deviation surveys every 90 feet. Allowable deviation is less than 1.0°.
    b. Trip out bit and change to 4" coring tools at 3,400 feet for a 30 foot core, 3,540 feet for a 30 foot core, and 3,820 feet to retrieve 60 feet of core.
23. Log cuttings and check for loss of drilling fluid indicating a porous formation is encountered. If so, perform a tightness test over this interval.
24. If no gas has been encountered, nipple down BOP.
25. Run gamma ray, neutron, sonic or VSP, 3-D imager, and bulk density logs as specified.
26. If logs indicate a porous or weak zone in the salt section, perform tightness test over the zone.
27. Open the 17-1/2" hole to 24" to about 3,430 feet bgs (or as determined by logs run in the hole) with hole openers and underreamers.
28. Run X-Y caliper log to 24" casing shoe.
29. Pump a hi vis pill and open hole cement plug at about 3,600 feet depth bgs prior to running 20"

30. Run and cement 1,900 feet of 20", 1.0" wall thickness and 1,530 feet of 20”, 0.75” wall thickness threaded and coupled pipe. The upper 400 feet of casing should be welded. Casing string weight is approximately 586,000 pounds in air. Use the stab-in cementing method. Centralizers to be placed on each of the first 10 joints and then on every other casing joint.
31. Allow the cement to set a minimum of 72 hours.
32. Start welding pairs of joints of the 16” casing for later use.
33. Cut off the 20" casing and weld on a 26-3/4" 3M flange. Nipple up an annular BOP or blind flange for testing. Top off cemented annulus as needed.
34. Pressure test the casing to approximately 1100 psi and hold for one hour. If pressure falls more than 110 psi (10%), repressure the casing and restart the test.
35. Drill out cement, shoe and about 5 feet of formation. Pressure test the shoe to approximately 650 psi and hold for one half hour. If pressure falls more than 65 psi (10%), repressure the casing and restart the test.
36. Open the 17-1/2" hole up to 22" to about 3,550 feet depth bgs using hole openers and underreamers.
37. Run X-Y caliper log to 20” casing shoe.
38. Confirm that open hole plug previously placed is still in place.
39. Run and cement approximately 3,550 feet (set at 3,520 feet bgs) of 16”, 0.812” wall thickness welded casing. Casing string weight is approximately 469,000 lbs. in air. Use the stab-in cementing method. Centralizers to be placed every casing joint.
40. Allow the cement to set a minimum of 96 hours. Top off cemented annulus as needed.
41. Install blowout preventer on 16” casing. Pressure test the casing to approximately 1000 psi and hold for one hour. If pressure falls more than 100 psi (10%), repressure the casing and restart the test.
42. Remove BOP.
43. Drill out plug and ten feet of salt formation.
44. Pressure test the shoe to approximately 1100 psi and hold for one half hour. If pressure falls more than 110 psi (10%), repressure the casing and restart the test.
45. Open hole from 16” casing shoe to total depth with 17-1/2” hole opener.
46. Open hole from 16” casing shoe to about 4,600 feet with 24” hole opener.
47. Clean out hole to total depth by circulating well with clean brine.
48. Run X-Y caliper log.
49. Run casing inspection and cement bond logs in 16” casing from 16” shoe to surface.
50. Run in approx. 4,550 feet of 13-3/8” 0.514” wall thickness, 72 lb./ft. N-80, BT&C modified pipe.
51. Install and test the upper wellhead assembly. Pressure test seals to 3,000 psi.
52. Run in approximately 5,350 feet of 8-5/8”, 0.352” wall thickness, 36 lb./ft. HCK-55, BT&C pipe. Pressure test seals to 3,000 psi.
53. Install remainder of wellhead.
54. Rig down and move rig off location.
55. Clean up location.

As a supplement to this CCDP and generalized procedure, the Company will submit to the DWQ for review and approval a specific Drilling Program for each individual cavern prior to the start of drilling. In accordance with R649-3-4, the Drilling Program will include a detailed casing and cementing plan, welding procedure formation testing plan and logging and testing plan consistent with the standard procedures provided below.

2.2 Well Conditioning

Before commencing drilling (spudding the well) and prior to cementing the casings, the driller will condition the well hole of all hydrogen storage cavern wells. The procedures for drilling mud conditioning will ensure that the drilling mud in the well has been displaced at least one time (circulated bottoms up) after completion of drilling to displace drill cuttings before tripping out the drill string. After running in the casing string to the desired depth, the mud volume will again be circulated bottoms up. This "pre-flush" procedure will ensure that the wellbore is properly conditioned for cementing operations in accordance with recommendations from the cementing contractor. The process will entail the circulation of drilling fluids to sweep cuttings out of the hole and obtain consistent fluid properties as well as adjust the fluid viscosity and density in an attempt to prevent cement channeling through the fluid.

2.2.1 Formation Testing Program

In addition to well conditioning, formation testing will also be completed during the drilling of all hydrogen storage cavern wells. It is known that zones, or interbeds, of softer rock exist within the salt formation. Interbeds in general are characteristic of salt domes and when identified the typical mitigation is to adjust the solution mining plan or cavern well design to account for the location of the zone within the final storage cavern. As part of the engineering design for the Facility, the Company has evaluated the known interbeds to determine the composition of the material and what engineering design mitigation could be implemented if a zone is identified during the drilling of individual caverns. The findings of the evaluation determined the zones are normal interbeds of insoluble materials resulting from natural depositional forces and do not impact the stability of storage caverns during construction or operations. The evaluation also indicated that the identification of an interbed within an intended cavern well bore can be mitigated by adjusting the casing seat or cavern roof if a zone is identified in those proposed locations and the solution mining plan can also be adjusted to account for the dissolution of the salt in the vicinity of the interbed.

Based on these results, and in accordance with the Class III UIC Permit, the Company has developed a formation testing program. The purpose of the formation testing program is to systematically evaluate the individual storage cavern well bores as they are drilled to determine the top of salt, the correct placement of the casing seat and cavern roof and verify the proposed solution mining plan with the in situ conditions of the salt body where the cavern is placed. This will ensure the safety and integrity of the cavern design in the event a zone is identified.

The formation testing program consists of an evaluation process that involves both the interpretation of wire line logs that are taken in the pilot hole that is drilled to the total depth of the well and the evaluation of cores taken at the time of the pilot hole drilling. The cores that will be taken are three 3-ft x 30-ft cores at the intended locations of the casing shoe, cavern roof, and cavern midsection. If an interbed is identified in the cores, the zone will be tested by isolating it from the rest of the wellbore. The isolated section will be pressurized to determine if it is permeable and then further pressurized to determine its fracture pressure. Based on these tests, the casing seat of the final cemented casing and the roof of the cavern may need to be adjusted so that the interbed does not intersect the casing seat or cavern roof area. In addition, the solution mining plan may be adjusted to account for the location of the interbed in the final storage cavern size and shape.

2.2.2 Welding Protocols

The standardized welding protocols outlined below will be followed for the installation of all hydrogen storage cavern wells. The protocols correspond to the approved storage cavern well design and meet the requirements of the Class III UIC Permit.

1. Lift ring welding and inspection shall be performed in accordance with AWS (American Welding Society) D1.1 Structural Welding Code. Nondestructive testing (NDT) shall be performed on the welds using ultrasonic shear wave equipment as specified in AWS D1.1, latest edition and interpreted by a NDT Level II or III Certified Technician who is qualified under ASNT CP-189, Standard for Qualification and Certification for Nondestructive Testing Personnel, 2020 Edition and CP-105, ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel, 2020 Edition.
2. Casing double joint welding shall be performed in accordance with API Standard 1104 Welding of Pipelines and Related Facilities, latest edition. The carbon equivalency of the Casing base material shall be computed from the material composition as written in the Material Test Report (MTR) that is provided when the pipe is purchased. The welding contractor shall provide a Welding Procedure Specification (WPS) that matches the base material and Procedure Qualification Report (PQR) and welders who are qualified to the WPS with Welders Qualification Report (WQR). The welding contractor shall provide the WQR for each potential welder prior to beginning production welding. The field supervisor shall verify that the WQR and welder’s photo identification match. Perform nondestructive testing (NDT) on the butt welds using radiography as specified in API Standard 1104, latest edition and interpreted by a NDT Level II or III Certified Technician who is qualified under ASNT CP-189, Standard for Qualification and Certification for Nondestructive Testing Personnel, 2020 Edition and CP-105, ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel, 2020 Edition. Each completed girth, butt weld shall be radiographically tested to API Standard 1104 qualifications. The radiograph methods and qualifications shall comply with API Standard 1104, “Certification of Nondestructive Testing Personnel” and “Acceptance Methods for Nondestructive Testing Personnel,” latest edition. The final production casing material selection and construction shall conform to ASME, B31.12 – 2019 Edition, Hydrogen Piping and Pipelines Code as applicable to piping in gaseous and liquid hydrogen service and to pipelines in gaseous hydrogen service, and ANSI/NACE MR0175/ISO 15156-1, Technical Circular 1, Edition 2017, Part 1: General Principles for Selection of Cracking-Resistant Materials.
3. Casing rig welding shall be performed in accordance with API Standard 1104 Welding of Pipelines and Related Facilities, latest edition. The carbon equivalency of the Casing base material shall be computed from the material composition as written in the Material Test Report (MTR) that is provided when the pipe is purchased. The welding contractor shall provide a Welding Procedure Specification (WPS) that matches the base material and Procedure Qualification Report (PQR) and welders who are qualified to the WPS with

Welders Qualification Report (WQR). The welding contractor shall provide the WQR for each potential welder prior to beginning production welding. The field supervisor shall verify that the WQR and welder's photo identification match. Perform nondestructive testing (NDT) on the butt welds using radiography as specified in API Standard 1104, latest edition and interpreted by a NDT Level II or III Certified Technician who is qualified under ASNT CP-189, Standard for Qualification and Certification for Nondestructive Testing Personnel, 2020 Edition and CP-105, ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel, 2020 Edition. Each completed girth, butt weld shall be nondestructively tested to API Standard 1104 qualifications, latest edition. The test methods and qualifications shall comply with API Standard 1104 "Certification of Nondestructive Testing Personnel" and "Acceptance Methods for Nondestructive Testing Personnel", latest edition. The final production casing material selection and construction shall conform to ASME, B31.12 – 2019 Edition, Hydrogen Piping and Pipelines Code as applicable to piping in gaseous and liquid hydrogen service and to pipelines in gaseous hydrogen service, and ANSI/NACE MR0175/ISO 15156-1, Technical Circular 1, Edition 2017, Part 1: General Principles for Selection of Cracking-Resistant Materials.

2.3 Cementing Procedure and Specification

The individual casings within each hydrogen storage cavern well will be cemented as part of the cavern construction process. The procedure and specifications correspond to the approved storage cavern well design and meet the requirements of the Class III UIC Permit. Cementing operations are conducted by a land rig and will be visually verified at the time of the cementing via the observance of cement rising within the outer well annulus to the surface. The casing cement jobs will also be documented by an affidavit from the cementing company showing the amount and type of cementing materials and the method of placement. Three samples of the cement slurry for each of the salt casings shall be collected in suitable sized and shaped containers so that the hardened cement can be tested for compressive strength. A cement evaluation log will also be completed for the 16" cemented casing after a 96-hour curing period and further drilling and completion activities. The results of these tests will be included in the Well Completion Report.

Table 3 provides a summary of the typical cementing procedure and specification for the hydrogen storage cavern wells.

Table 3. Typical Cementing Program

Table 3: Typical Cementing Program				
Hole Size	**34-inch**	**28-inch**	**24-inch**	**22-inch**
Casing Size	**30-inch**	**24-inch**	**20-inch**	16-inch
Mud Weight Type	8.8 ppg Fresh Water	8.8 ppg Fresh Water	10.2 ppg Saturated Brine	10.2 ppg Saturated Brine
Slurry Weight	Lead 12.0 ppg Fresh Water Tail 15.0 ppg Fresh Water	Lead 12.0 ppg Fresh Water Tail 15.0 ppg Fresh Water	16.1 ppg Saturated Brine	16.1 ppg Saturated Brine
Cement Type	Class A Standard	Class A Standard	Class H Salt Saturated	Resin/Latex Salt Saturated
Cement Yield	Lead 2.46 cu ft/sk Tail 1.29 cu ft/sk	Lead 2.46 cu ft/sk Tail 1.29 cu ft/sk	1.29 cu ft/sk	1.33 cu ft/sk

The cementing process summarized in Table 3 will be completed for the individual casings per the steps outlined below:

Proposed wellbore configuration (depths are approximate bgs)
30-in Surface Casing: 0 - Approx. 800 feet (Approx. 34" Open Hole)
24-in 1st Intermediate Casing: 0 – 2,870 feet (Approx. 28" Open Hole)
20- in 2nd Intermediate Casing: 0 – 3,430 feet (Approx. 24" Open Hole)
16-in Production Casing: 0 – 3,550 feet (Approx. 22" Open Hole)
Top of Salt: Approx. 2,870 feet

1. Cement specifications for the 30" Surface casing. Cement job will be pumped through a stabbed-in drill pipe.
   Cement to surface: Class A (Standard) + Defoamer (if deemed necessary)
   Lead Slurry
   Slurry Weight 12.0 lbs./gal.
   Slurry Yield 2.46 cu. Ft./sack
   Tail Slurry
   Slurry Weight 15.0 lbs./gal.
   Slurry Yield 1.29 cu. ft./sack
   Excess 100% Open Hole Volume (Caliper Available)

2. Cement specifications for the 24" Intermediate. Cement job will be pumped through a stabbed-in drill pipe.
   Cement to surface: Class A (Standard) + Defoamer (as necessary).
   Lead Slurry
   Slurry Weight 12.0 lbs./gal.
   Slurry Yield 2.46 cu. Ft./sack
   Tail Slurry

Slurry Weight 15.0 lbs./gal.
Slurry Yield 1.29 cu. ft./sack
Excess 30% Open Hole Volume (Caliper Available)

3. Cement specifications for the 20" Next to Last Casing. Cement job will be pumped through a stabbed-in drill pipe.
   Cement to surface: Class H (Premium), Salt saturated cement with defoamer as needed with 37.5% salt
   Slurry
   Slurry Weight 16.1 lbs./gal.
   Slurry Yield 1.29 cu. ft./sack
   Excess 30% Open Hole Volume (Caliper Available) and 10% excess cased hole.

4. Cement specifications for the 16" Last Casing. Cement job will be pumped through a stabbed-in drill pipe.
   Cement to surface: Class H (Premium) Salt saturated resin/latex with 37.5% salt+ defoamer as needed
   Slurry
   Slurry Weight 16.1 lbs./gal.
   Slurry Yield 1.33 cu. ft./sack
   Excess 30% Open Hole Volume (Caliper Available) and 10% excess cased hole.

5. The casing cement jobs shall be documented by an affidavit from the cementing company showing the amount and type of cementing materials and the method of placement.

6. Three samples of the cement slurry for each of the intermediate and salt casings shall be collected in suitable sized and shaped containers so that the hardened cement can be tested for compressive strength.

Section 3

Cavern Development /Solution Mining Plan

3.1 Cavern Development Plan Methodology

Individual solution mining plans are developed for each cavern as part of the detailed design. The individual solution mining plans for the hydrogen storage caverns are developed using industry standard cavern simulation modeling programs, that simulate mining asymmetrically around the well. The general assumptions that will be used for each the hydrogen storage cavern models are provided below:

- The basic inputs for the model will consist of initial radii of the well, the depth of the water injection and brine production strings, the depth of the product level, water injection rates, and duration of mining. If a cavern exhibits a region of abnormal or non-symmetric growth, modeling cannot fully predict continued growth in such a region until after an initial sonar survey in the anomalous region has been conducted. However, the simulated growth can closely approximate future growth in regions of concern once shape data from a sonar survey of the cavern has been obtained and entered into the model.
- The casing size inputs will be a 16-in final cemented production casing, an 8-5/8-in inner mining string, and an 13-3/8" outer mining string. (Note the casing sizes do not impact the final solution mining plan, although they have some influence on the very early days of mining).
- The final cavern capacity will be up to approximately [redacted], geomechanical modeling and site specific geology will determine well design and final geometry of caverns.
- The typical production flow rate will be [redacted] gpm and a normal dissolution factor of one will be input for the salt with an assumed cavern brine temperature of 80° F. (Note changes in the flow rate will result in changes to the duration of mining).
- The average insoluble content will be input at 8% with a bulking factor of 1.3 for use in the modeling. This assumption is based on an approximately 8% insoluble content recorded during the mining of previous caverns in the salt body and chemical analyses completed by Sandia National Laboratories of MH-1 test well cores that also demonstrated an approximate 9% average insoluble content. (Note this assumption is not significant as long as the overall insoluble content is less than 12%).

As a supplement to this CCDP and generalized procedure, the Company will submit to the DWQ for review and approval a detailed Solution Mining Plan for each individual cavern prior to the start of solution mining.

3.2 Cavern Development Plan

3.2.1 Solution Mining Schedule

According to the model, the development of a storage cavern with a typical [redacted] capacity will require a total time of approximately 677 days to complete with a [redacted] water injection rate. The "total time" required to develop a cavern includes time for mining, workovers, unknown shutdown times, logging episodes, and mechanical integrity testing at the end. A summary of the total time to develop a hydrogen storage cavern is detailed in Table 4.

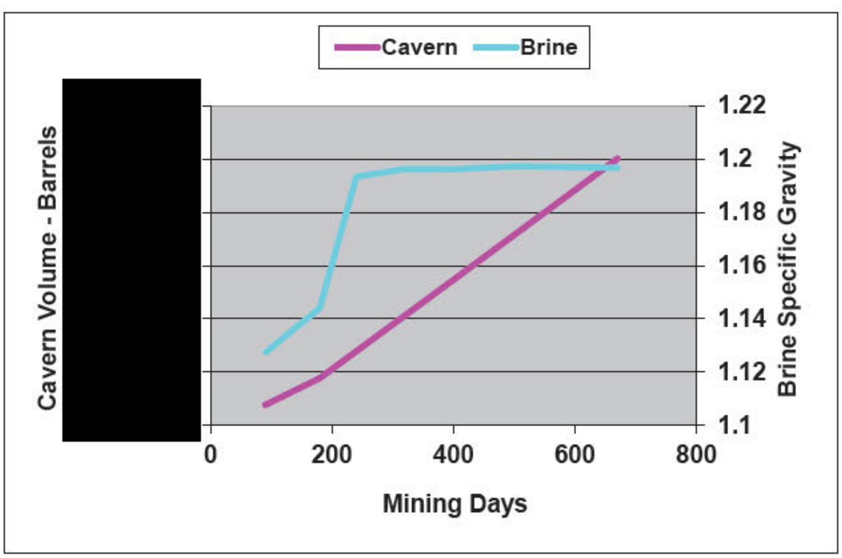
Table 4. Summary of Estimated Time to Develop a Typical Hydrogen Storage Cavern

Mining Plan	Solution Mining Time (days)	Workover Time (days)	10% Contingency (days)	Sonar, Logging and Blanket Movement Time (days)	Mechanical Integrity Test & Completion Workover Time (days)	Total Time (days)
[redacted] Cavern	540	15	54	18	50	677

As shown in Table 4, the actual "solution mining time" is only 540 days of the 677 total days required to complete a cavern. Solution mining time represents days when water is injected at [redacted] gpm without interruption for 24 hours. The additional activities included in Table 4 are activities that may or may not be required, such as a workover. A workover is not required at a specific time during the solution mining of a cavern, but it may be necessary sometime during mining to repair damaged tubing or to allow a sonar survey to be conducted. In order to create a conservative schedule, time for a workover has been included as well as a number of days for contingency, blanket movements, sonar surveys, and mechanical integrity testing.

Figure 4 shows both the rate of cavern development and the change in brine specific gravity through the development process, to include the change in the flow regime from direct to reverse circulation.

Figure 4: Rate of Cavern Development and Increase in Brine Specific Gravity for [redacted] Cavern



It is anticipated that approximately [redacted] of brine will be produced during the development of the [redacted] cavern. During mining the brine will have a specific gravity of less than 1.19, or about 95% saturation. During the initial hydrogen filling operations, the displaced brine will be saturated.

3.2.2 Allowable Operating Pressure Gradients

Minimum and maximum operating pressures for the cavern well and storage cavern will be maintained at all times during cavern construction and development. The typical operating pressure during cavern development is anticipated to be [redacted] pounds per square inch per foot of depth to the last cemented casing shoe. The Company, however, will adhere to the following pressure gradients limits for the hydrogen storage cavern field:

- Minimum Allowable Operating Pressure Gradient (MinAOPG) of [redacted] pounds per square inch per foot of depth;
- Maximum Allowable Operating Pressure Gradient MaxAOPG of [redacted] pounds per square inch per foot of depth; and,
- A Maximum Allowable Test Pressure of [redacted] pounds per square inch per foot of depth.

To ensure the highest level of safe operating parameters, these pressure gradient limits are based on both the results of geomechanical analyses specific to storing hydrogen in the salt formation and the requirements of the Class III UIC Permit. In cases where the pressure gradient limits established by the Class III UIC Permit were different than those recommended by the geomechanical analyses, the more conservative pressure gradient limit was adopted[1]. And while individual cavern wells and storage caverns may be generally operated at different maximum pressures due to design variations based on the in situ conditions of the salt, the Company will at no time subject the cavern wells or storage caverns to pressures outside the pressure gradient limits listed above.

3.2.3 Cavern Testing

Upon completion of drilling, the cavern well will be tested by a nitrogen/brine interface test. In accordance with the Class III UIC permit, the maximum allowable test pressure of [redacted] pounds per square inch per foot of depth to the last cemented casing shoe will be adhered to. The well will be tested again in a similar manner after completion of solution mining (or the initial stage of mining) and before storage of hydrogen begins. The detailed procedures for the testing will be provided to DWQ for review and approval before the testing starts.

[1] Specifically, geomechanical analyses completed for hydrogen storage indicated that caverns can be designed, built and operated with an upper pressure limit of [redacted] psi per foot of depth to the last cemented casing shoe. In contrast, the UIC Permit restricts that upper limit to a MaxAOPG of [redacted] psi per foot of depth to the last cemented casing shoe. In addition, the geomechanical analyses indicate that the lower pressure limit should not be below [redacted] psi per foot of depth to the last cemented casing shoe while the UIC Permit has a MinAOPG of [redacted] psi per foot of depth to the last cemented casing shoe. The lower limit allowed under the Class III UIC Permit is supported by an earlier geomechanical study of the salt formation that was used to establish general guidelines that could be then supplemented by additional product-specific gemechanical studies. Establishing limits based on the more restrictive pressure limit gradients for this Plan provides the Company with a greater safety factor.

Section 4

Cavern Capacity Expansion Plan

4.1 Cavern Capacity Expansion Schedule

The schedule for new cavern construction and the initial cavern size of new caverns is heavily dependent upon the demand for storage in the hydrogen gas market. Consequently, caverns may be developed and placed into service with a capacity that is less than the total [redacted] permitted capacity. As market demand increases for storage, the Company plans to complete additional solution mining to increase the capacity of individual storage caverns to the maximum permitted size. After a cavern has been placed into operation, cavern expansion can only be completed during periods of product storage when the caverns are mostly empty. Some product will be left in the cavern to protect the cavern roof.

This section provides an overview of the two methods that are utilized in the salt cavern storage industry to enlarge the caverns. The overview does not provide detailed procedures, just the basic principles. In the event that the Company would like to expand the capacity of a cavern after a cavern has been placed into service, a specific Cavern Expansion Plan will be developed that takes into account the size and shape of the individual cavern when the enlargement is planned to start. The Company will submit this plan to DWQ for approval and inclusion in the well specific files prior to the initiation of any cavern expansion.

4.2 Cavern Capacity Expansion Options

There are two basic options for expanding capacity or enlarging the storage caverns:

- Using freshwater to displace the gas, and
- Conducting "normal" solution mining.

The preferred method for any particular cavern will depend upon the:

- Shape of the existing cavern,
- Configuration of the well (hanging strings, roof, depth),
- Amount of stored product in the well during the enlargement operation, and
- Time frame in which the capacity expansion is to be completed.

4.2.1 Freshwater Displacement

Conceptually the simplest method to expand the capacity of existing storage caverns is through freshwater displacement. Freshwater can be used to displace hydrogen gas when it is removed from the cavern. The freshwater then dissolves more salt. There is no need to change the completion plans for the wells or perform any workover to ready the cavern for mining or to return it to storage configuration. However, the success of this method is dependent upon the:

- Shape of the cavern;

- Spacing to adjacent caverns;
- Time available to complete the enlargement; and,
- Operational mode of product movement.

The shape and size of the cavern to be enlarged and adjacent caverns must be such that a sufficiently strong web will remain between them after enlarging a cavern. The shape and spacing of the cavern must be consistent with the shape that will be developed using freshwater for product displacement.

The time available to enlarge the cavern may impact the feasibility of freshwater displacement for enlargement. The freshwater that can be used to enlarge the cavern is limited in volume to the volume of product displaced. Assuming that the freshwater dissolves sufficient salt to become saturated brine (an assumption that is dependent upon the time between emptying the cavern and then refilling it), the cavern will grow by about 15% of volume of water injected during each cycle.

The operational mode of product movements in the cavern is the principal unknown in developing a safe freshwater enlargement plan. In order to avoid preferential mining of portions of the cavern during the enlargement program, several operational limits need to be adhered to:

- A sufficient pool of brine must exist above the shoe of the hanging string when injecting water,
- An adequate amount of product must be left in the cavern to protect the roof until the cavern brine has become nearly saturated, and
- The product withdrawal time should not be interrupted by numerous or large episodes of product injection.

The brine pool between the end of the hanging string and the product/brine interface should be of a volume and height that allows the injected water to dilute within it and spread the new dissolution over the cavern wall to minimize growth of a wide disk at the injection level. If product has been stored within this safety zone, it should be moved by the injection of brine until the safety pool has been cleared of product.

The roof salt needs to be protected from being dissolved by undersaturated brine. During enlargement by freshwater displacement, freshwater injection needs to be stopped before the roof is exposed, leaving a minimum of 1,500 barrels of cavern space filled with hydrogen gas until the cavern brine is essentially saturated.

Once enlargement of the cavern has begun, the brine-filled portion of the cavern will be undersaturated. If the enlargement program is interrupted by product injections there is an increased risk of developing overly enlarged diameters as the brine is pushed downward and continues to mine portions of the cavern that have already been enlarged.

4.2.2 Conventional Solution Mining

Enlargement of a well by conventional mining techniques would require that a second hanging string be in the well. If two hanging strings are not in the well, a workover would need to be performed while the well is in storage mode to pull the existing brine string and to reinstall both the outer string and the brine string. A workover would require that all product be removed from the well prior to the workover.

Enlargement would then be accomplished by injecting freshwater in one string and producing brine from the second string. The direction of flow will be determined by the size and shape of the cavern being enlarged and the depth to the product/brine interface.

Section 5

Construction Reporting and Notices

5.1 Reporting

In addition to the Well Completion Report, the Company will provide the following reports during the drilling of individual cavern wells:

- 24-hour Spud Notice via email;
- Entity Action Form reported on Division of Oil, Gas and Mining's (DOGM) Form 6 within 5-days of sending the Spud Notice;
- Encounters with fresh water sand reported on DOGM Form 7;
- Report of Water Encountered During Drilling reported on DOGM Form 8;
- Monthly status report reported on DOGM Form 9 submitted by the 5th day of the following calendar month;
- Changes to the approved Drilling Program reported on DOGM Sundry Notice form; and,
- Formation testing reports for individual caverns within 30 days of completion.

5.2 Notices

The Company will submit the following 24-hour advanced notices to the DWQ to provide the ability to witness logging and testing activities on-site during the drilling of individual cavern wells:

- Casing cementing;
- Casing pressure testing;
- Cement bond logging; and,
- Mechanical Integrity Testing

Attachment E

Monitoring, Recording, and Reporting Plan

PART J
Monitoring, Recording, and Reporting Plan

Prior to receiving an authorization to drilling a cavern in the Permit Area, ACES will submit to the DWQ for approval by the Utah Division of Water Quality Director a dedicated Monitoring, Recording, and Reporting Plan (MRRP) for injection wells being drilled for the specific type of storage product (natural gas, CAES, refined products, crude, etc.). This requirement is in accordance with UIC Permit condition Part III E(2). The MRRP will comply with federal and state regulations 40CFR144.54 and R317-7-10.3(B) and industry standard API RP 1170 for the development of natural gas storage caverns. ACES will also comply with permit conditions that pertain to the drilling and construction of the well and to cavern development.

The purpose of the MRRP is to outline clear processes and procedures for the monitoring, reporting and recording of solution mining activities for storage caverns within the Permit Area. The MRRP will include detailed methods and type of equipment necessary to monitor, document, and report: the minimum and maximum operating pressures; the development of the cavern volume and shape; the brine/nitrogen interface and pressure, volume and temperature of the nitrogen blanket; the characterization of the injected fluids; the daily flow rate, saturation, pressure and temperature of injected water; the daily flow rate, saturation, pressure and temperature of produced brine; and, the weekly analysis of the composition of produced brine.

In addition, the MRRP will include detailed methods for the mechanical integrity testing of injection wells during drilling (casing pressure tests), prior to solution mining, and prior to the DWQ providing authorization to initiate storage operations. Once storage operations of a cavern have commenced, mechanical integrity will continue to be tested periodically in accordance with the requirements set forth by the DOGM. The schedule for the required reporting will also be included in the MRRP.

Once approved by the Director, the MRRP will become an enforceable attachment to the UIC Permit and any subsequent changes will have to be authorized by the agency.

Attachment F

Web Factor of Safety Geomechanical Analysis

3.6 THREE-DIMENSION FINITE DIFFERENCE MESH

The 3D finite difference meshes developed for this study were primarily based on the geological model described in Section 3.2. Figure 3-11 depicts the 3D finite difference mesh developed for Iteration 1. The model was subdivided into four material layers: the overburden, caprock, nonsalt interbed, and salt, centering on CW-2 and extending 6,000 ft in both the east-west and north-south directions to a depth of 8,000 ft. These distances were chosen to ensure the boundaries were sufficiently far from the ACES caverns, isolating the caverns' response from numerical boundary effects. Because the closest Sawtooth cavern is located at an S:D ratio of approximately 4.0, these caverns are unlikely to have a significant geomechanical effect on the ACES caverns. Therefore, the Sawtooth caverns were excluded from the model. This assumption should be re-evaluated after the caverns reach their final geometry.

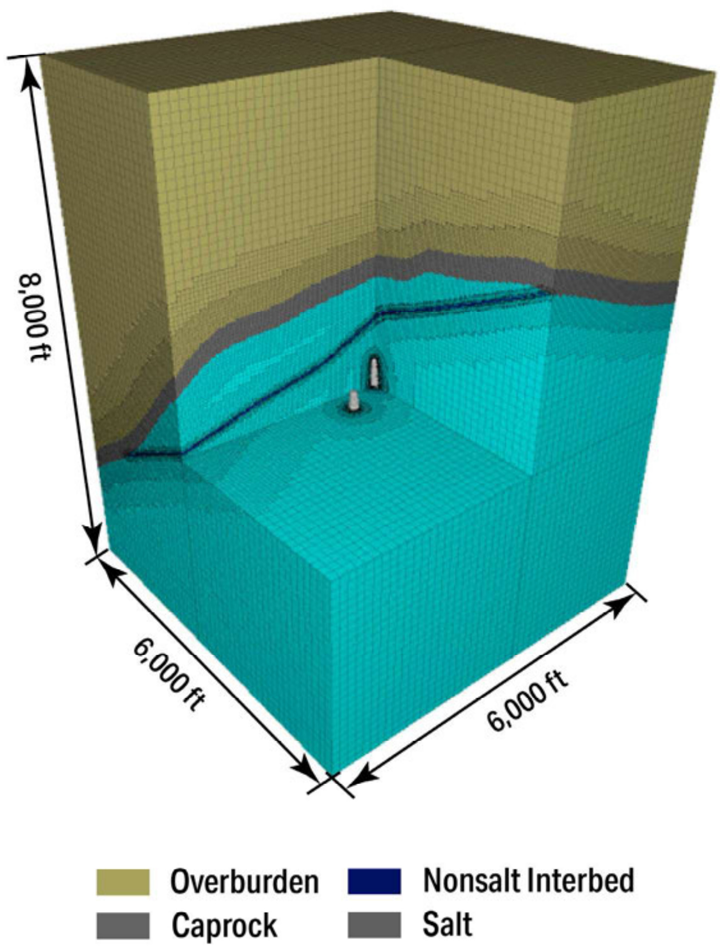


Figure 3-11. Three-Dimension Finite Difference Mesh Developed to Evaluate CW-2 and CW-23.

The zones near the caverns were finely discretized to approximately 2 ft by 2 ft by 2 ft. This high level of refinement was necessary to capture the significant stress gradients expected near a hydrogen cavern. As stress gradients decrease with distance from a cavern, zone size can increase without significantly compromising accuracy. Therefore, to optimize computational resources, the zone size in the model generally increased with distance from the caverns. The meshes developed for this study had approximately 10 million zones.

The other three meshes developed for Iterations 2 through 4 were quite similar to the mesh shown in Figure 3-11, with differences primarily in the cavern geometries.

3.7 ASSESSMENT CRITERIA

The geomechanical study's objectives were achieved by analyzing stress and strain distributions throughout the simulated storage operations. The following sections describe the criteria used to evaluate the models.

3.7.1 STRUCTURAL STABILITY

Shear stresses around a storage cavern are caused by the difference between cavern pressure acting upon the cavern walls and the in situ stresses in the surrounding rock. If the geological loads exceed the strength of the rock, the rock will become damaged. The structural stability of the caverns was assessed by evaluating three metrics: cavern stability, roof stability, and web stability throughout the simulated storage operations.

Cavern stability was assessed by evaluating the FS values with respect to salt dilation (Section 3.3.5) on the cavern surfaces. Instability in the salt on the cavern surface can, over time, lead to spalling from the walls or roof of the cavern. Dilation is expected when FS values fall below 1.0, with its severity increasing as FS values decrease; values above 1.0 indicate no dilation should occur.

Roof stability was analyzed by calculating FS values against dilation in the salt overlying the cavern and against shear fracturing in the nonsalt interbed overlying the cavern field. These formations support the weight of the overburden with reduced underlying support because of the excavated caverns. Instability in these overlying rocks can, over time, lead to significant roof falls or damage to the cemented casing, both of which should be prevented to ensure the long-term stability of the caverns.

Web stability was evaluated by assessing the salt dilation FS values in the salt webs between the caverns. A salt web (i.e., the salt between caverns) experiences unique stress conditions; its vertical stress typically increases because the web must bear the weight of the rock directly above and the additional load previously supported by the now-excavated cavern. Meanwhile, horizontal stresses near the cavern walls tend to be lower than the original in situ stresses. This combination of heightened vertical stress and reduced horizontal stress can create conditions conducive to salt dilation if the web is too narrow (i.e., if the caverns are not spaced far enough apart).

3.7.2 HYDRAULIC INTEGRITY

In the context of this study, hydraulic integrity refers to a salt cavern's capability to contain the fluid within it. If hydraulic integrity of a cavern is not maintained, hydraulic connections can develop between caverns or between a cavern and the surrounding strata. Hydraulic integrity was evaluated using two assessment criteria: the potential to develop (1) tensile fractures on the cavern surfaces and (2) tensile effective stress magnitudes that could allow hydrogen to migrate between caverns or between the caverns and a nearby nonsalt formation. The following sections describe these two criteria.

3.7.2.1 TENSILE FRACTURING

Like most geological materials, salt is fairly weak in tension, with tensile strengths that typically range from 100 to 300 psi. The absence of tensile stresses is highly desirable with respect to maintaining hydraulic integrity because tensile stresses are likely to cause salt fracturing and, in extreme cases, the cavern could lose its ability to contain the fluid within it. The least-compressive or maximum principal stress (σ_1) values were, therefore, calculated from the stress states predicted in the simulations and monitored for tensile values (i.e., positive values because compressive stresses are negative).

3.7.2.2 TENSILE EFFECTIVE STRESS

When cavern pressure increases, tensile effective stresses may develop. Here, effective stress is defined as the actual stress of the rock plus the fluid pressure in the pores of the rock. For a salt cavern, this quantity is defined easily at the cavern wall because the pore pressure is simply the cavern fluid pressure. The effective stress inside the rock mass is more difficult to define because the connected porosity and fluid pressure within the salt structure is not a straightforward calculation. The tensile effective stress criterion can be written as:

$$\sigma_{max} + P < T_0 \qquad (0\text{-}1)$$

where:

σ_{max} = maximum principal stress (least-compressive stress)

P = fluid pressure

T_0 = tensile strength

When determining the maximum allowable pressure in this study, the cavern pressure (fluid pressure) was limited to a value in which the cavern pressure would not exceed the compressive stress at the casing seat depth plus a tensile strength of 295 psi (determined from laboratory testing on salt retrieved from CW-2 and CW-23). The tensile effective stress criterion was applied in this study to limit the potential for hydraulic fracturing in the wellbore. The pore pressure in the rock was conservatively assumed to be equal to the pressure of the hydrogen in the cavern.

3.7.3 CAVERN CLOSURE

Creep closure progressively reduces the amount of hydrogen that can be stored in the cavern. Excessive closure may require the cavern to be taken out of storage service and releached to increase its volume. Cavern closure was assessed in the long-term hydrogen storage scenario by calculating the cavern's volume as a function of time and determining the percentage reduction from its initial volume. These volumetric closure estimates were derived from the deformed cavern volumes predicted by the simulations.

3.7.4 CASING STRAIN

Because salt continuously creeps and flows into the cavern, it can also pull the cemented casing downward, which can result in extensional strains in the casing. Assuming that the salt/cement and cement/casing interfaces remain perfectly bonded, elongation of the casing will continue until the tensile limit of the casing or casing connections is exceeded, which parts the casing and compromises its integrity. The cemented casings were not explicitly modeled in this study; however, the vertical strains predicted along the axis of symmetry above the cavern provide conservative estimates of the casing strains.

Previous studies performed by RESPEC (e.g., Osnes et al. [2007]) have indicated that cemented casings with a variety of completions and grades have failed when the predicted casing strains exceed 3.2 millistrain. Therefore, a value of 3.2 millistrain was chosen as the limiting strain at which tensile failure is likely to occur for the cemented casings.

APPENDIX B: DESCRIPTION OF THE MOHR-COULOMB FAILURE CRITERION

The 3D form of the Mohr-Coulomb failure criterion is stated by Equation B-1:

$$\sqrt{J_{2,f}} = \frac{\left(S_o \cos\varphi - \frac{\sigma_1 + \sigma_3}{2} \sin\varphi\right)}{\cos\psi} \tag{B-1}$$

where:

$J_{2,f}$ = value of J_2 at the onset of failure

$J_2 = \frac{1}{6}\left[\left(\sigma_1 - \sigma_2\right)^2 + \left(\sigma_1 - \sigma_3\right)^2 + \left(\sigma_2 - \sigma_3\right)^2\right]$

$\psi = \tan^{-1}\left[\frac{2\sigma_2 - \sigma_1 - \sigma_3}{\sqrt{3}\left(\sigma_1 - \sigma_3\right)}\right]$, lode angle

$\sigma_1, \sigma_2, \sigma_3$ = principal stresses $\left(\sigma_1 \le \sigma_2 \le \sigma_3\right.$, compression negative$\left.\right)$

S_0 = cohesion

φ = friction angle

The onset of shear failure within the nonsalt interbeds was evaluated by using FS values. FS with respect to shear failure as predicted by a Mohr-Coulomb failure criterion $\left(FS\right)$ is defined as the ratio between the shear strength $\left(S^f\right)$ and the applied shear stress $\left(S\right)$, as shown in Equation B-2:

$$FS = \frac{S^f}{S} \tag{B-2}$$

where:

FS = Mohr-Coulomb factor of safety

S^f = Mohr-Coulomb strength $= \sqrt{J_{2,f}}$

S = applied or predicted stress $= \sqrt{J_2}$

APPENDIX C

DESCRIPTION OF THE RESPEC DILATION CRITERION

APPENDIX C: DESCRIPTION OF THE RESPEC DILATION CRITERION

Unlike brittle rock types that suddenly lose their strength when they fail, evaporites such as salt tend to progressively lose strength as microfractures form, grow, and coalesce within the crystalline structure when the salt's shear strength is exceeded; this process is referred to as damage. Hence, as damage progresses in salt, the initiation and growth of microfractures cause porosity and permeability to increase and the volume of the salt to dilate (expand).

The dilatancy criterion, which was developed by RESPEC [DeVries et al., 2004][1] and is referred to as the RESPEC Dilation Criterion (RD Criterion), was used to define the potential for dilation of the Western Energy Hub salt. The criterion is based on a Mohr-Coulomb-type failure criterion to represent salt dilation as a function of shear stress, mean stress, and Lode angle. The RD Criterion simply states that if the shear stress along any plane in the rock exceeds the shear strength along that same plane, dilation will occur. Equation C-1 defines the RD Criterion boundary:

$$\sqrt{J_{2,dil}} = \frac{D_1\left(\frac{I_1}{\sigma_0}\right)^n + T_0}{\left(\sqrt{3}\cos\psi - D_2\sin\psi\right)} \tag{B-3}$$

where $J_{2,dil}$ is the second invariant of the deviatoric stress tensor at dilation; I_1 is the first invariant of the stress tensor and is equal to three times the mean stress $(I_1 = 3\sigma_m)$; the Lode angle (ψ) describes the relationship between the principal stresses and ranges between –30° and +30°; σ_0 is a dimensional constant equal to –145 psi; T_0 is the unconfined tensile strength; and n, D_1, and D_2 are parameter estimates that must be determined for each salt formation. The RD Criterion can predict both linear and nonlinear relationships for the dilation boundary in the $\sqrt{J_2}$ and I_1 stress space.

FS values were used to quantify the potential for dilation in the salt. A factor of safety (FS) is the ratio between the dilation strength, $\sqrt{J_{2,dil}}$, and the applied shear stress, $\sqrt{J_2}$. Dilation is expected to occur when the (FS) is less than 1, and its intensity will increase with decreasing (FS) values. At (FS) values greater than 1, salt is not expected to dilate, and the potential for dilation decreases with increasing (FS) values.

The RD Criterion parameter values that define the onset of dilation of the Western Energy Hub salt were determined based on fits to the constant mean stress (CMS) tests conducted on the salt samples from the CW-2 and CW-23 core; all the CMS tests were completed in triaxial compression (CMC; ψ = 30°). The CMS tests were performed at mean stresses of 1,000; 1,500; 2,000; 2,500; and 3,000 psi. These test conditions were selected to reflect the expected mean stress in the salt surrounding the ACES caverns. The parameter values that were determined from the fitting process are provided in Table C-1. The estimate for the dilation boundaries of the Western Energy Hub salt are illustrated by the solid lines in Figure C-1.

[1] **DeVries, K. L., K. D. Mellegard, and G. D. Callahan, 2004.** "Laboratory Testing in Support of a Bedded Salt Failure Criterion," *Solution Mining Research Institute Spring Meeting*, Wichita, KS, April 18–21.

Table C-1. RESPEC Dilation Criterion Parameter Values for the Western Energy Hub Salt

Parameter	Units	Value
D_1	psi	115.7
D_2	—	0.524
T_0	psi	295.2
n	—	0.693
σ_0	psi	−145

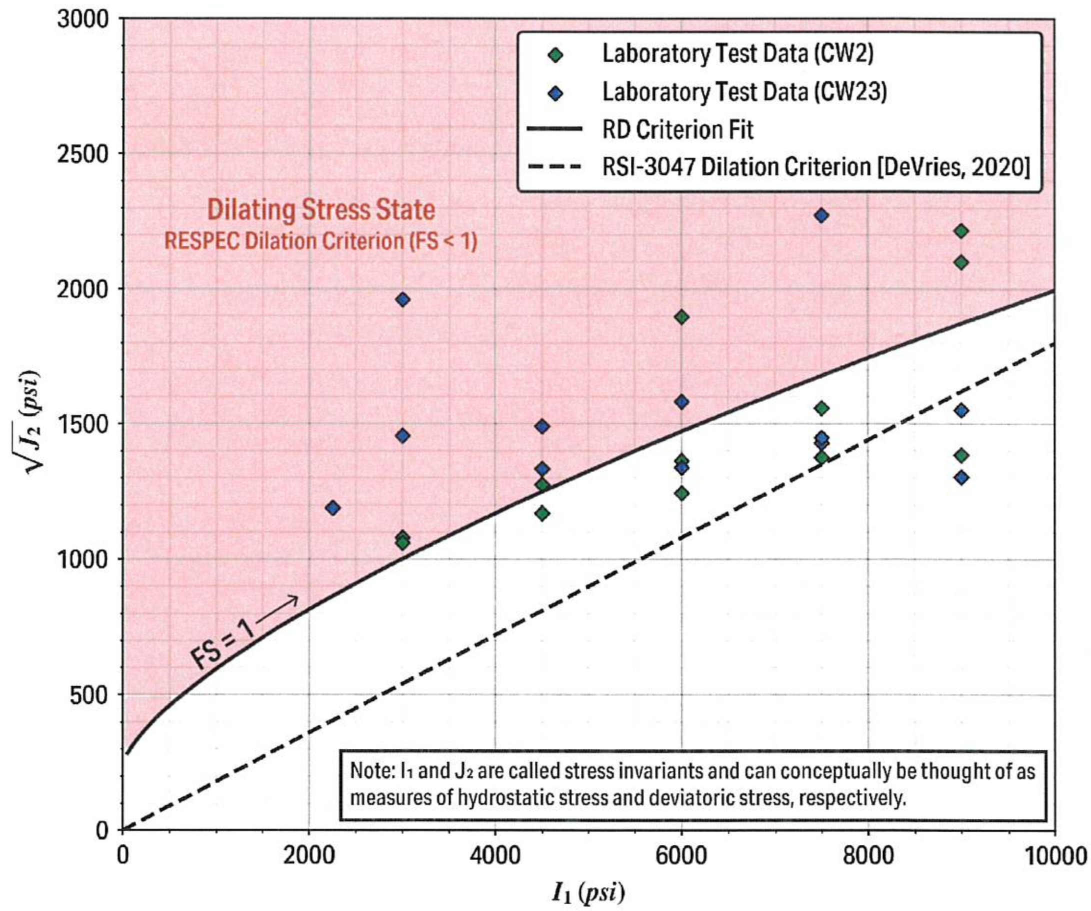


Figure C-1. RESPEC Dilation Criterion Boundary Fit to Constant Mean Stress Tests for the Western Energy Hub Salt [DeVries, 2020].[2]

2 **DeVries, K., 2020.** *Geomechanical Design Study of Magnum Hydrogen Storage Caverns at the Western Energy Hub Near Delta, Utah,* RSI-3047, prepared by RESPEC, Rapid City, SD, for Magnum Development, L.L.C., Holladay, UT.

Attachment G

Well and Cavern Closure and Abandonment Plan

Plan for Plugging and Abandonment of Class III Solution Mining Wells and Caverns before Gas Storage

The following procedures are provided as a general guideline. Actual plugging measures would be submitted in advance to DWQ (prior to commencement of gas storage).

1. At least 45 days before the planned plugging, ACES will notify the DWQ Executive Secretary of the proposed plugging with a Well Condition Report and a well-specific Plugging and Abandonment Plan.
2. The Well Condition Report will include a discussion of the following:
   a. The results of the well's most recent mechanical integrity test,
   b. The location of any leaks or perforations in the casing,
   c. The location of any vertical migration of fluids behind the casing, and
   d. The adequacy of casing cement bonding across the salt formation, as determined from cement bond logs run at the time of well construction or just prior to well abandonment.
3. All nitrogen or other blanket material will be removed and the cavern will be filled with saturated brine water.
4. All free hanging tubing will be pulled from the well.
5. The exact depth to the bottom of the cemented production casing will be determined.
6. A drillable plug capable of supporting a cement plug will be installed in the cemented casing with the bottom of the plug within 10 feet of the end of the casing.
7. All cement plugs to be Class G cement with no additives and slurry weight of 14.5 pounds per gallon or more.
8. The entire wellbore from the bridge plug to surface will be filled with cement.
9. In the event the cemented casing is determined to be leaking, the casing will be perforated at the level of the leak and cement squeezed into the perforations.
10. An alternative technique which could be used involves setting the following plugs.
    a. Bottom plug: A 300-foot plug from the plug at the bottom of the production casing upward.
    b. Surface casing plug: A 150-foot plug from 75 feet below the bottom of the surface casing upward.
    c. Top plug: A 50-foot plug from 50 feet below surface grade upward to surface.
    d. The casing between each of the plugs shall be filled with a noncorrosive mud slurry of at least 10 pounds per gallon weight.
11. Upon completion of the plugging operation, all reports will be filed in accordance with DWQ rules as applicable.

Part L – 16-inch Injection Well Plugging and Abandonment Plan

The following procedures are provided as a general guideline. Actual plugging measures will be submitted in advance to DWQ (prior to commencement of product storage) or DOGM (after commencement of storage operations) for approval.

1. Form DOGM-9 will be submitted (after commencement of product storage) for procedural approval.
2. All stored product will be removed and the cavern will be filled with saturated brine water.
3. All free hanging tubing will be pulled from the well.
4. The exact depth to the bottom of the cemented production casing will be determined.
5. A drillable plug capable of supporting a cement plug will be installed in the cemented casing with the bottom of the plug within 10 feet of the end of the casing.
6. The following plugs will be placed. All cement plugs will be Class G cement with no additives and the slurry weight will be 14.5 pounds per gallon or more.
    a. Bottom plug: A 300-foot plug from the plug at the bottom of the production casing upward.
    b. Surface casing plug: A 150-foot plug from 75 feet below the bottom of the surface casing upward.
    c. Top plug: A 75-foot plug from 75 feet below surface grade upward to surface.
7. The casing between each of the plugs shall be filled with a non-corrosive mud slurry of at least 10 pounds per gallon weight.
8. An alternative technique that could be used involves filling the entire wellbore with cement.
9. Upon completion of the plugging operation, all reports will be filed in accordance with DWQ or DOGM rules as applicable.

Attachment H

Financial Responsibility