District I
1625 N. French Dr., Hobbs, NM 88240
District II
811 S. First St., Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
District IV
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources
Department
Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-144
Revised August 1, 2011

For temporary pits, closed-loop systems, and below-grade tanks, submit to the appropriate NMOCD District Office.
For permanent pits and exceptions submit to the Santa Fe Environmental Bureau office and provide a copy to the appropriate NMOCD District Office.

Pit, Closed-Loop System, Below-Grade Tank, or Proposed Alternative Method Permit or Closure Plan Application

Type of action:
- [x] Permit of a pit, closed-loop system, below-grade tank, or proposed alternative method
- [ ] Closure of a pit, closed-loop system, below-grade tank, or proposed alternative method
- [ ] Modification to an existing permit
- [ ] Closure plan only submitted for an existing permitted or non-permitted pit, closed-loop system, below-grade tank, or proposed alternative method

Instructions: Please submit one application (Form C-144) per individual pit, closed-loop system, below-grade tank or alternative request

Please be advised that approval of this request does not relieve the operator of liability should operations result in pollution of surface water, ground water or the environment. Nor does approval relieve the operator of its responsibility to comply with any other applicable governmental authority's rules, regulations or ordinances.

1.
Operator: **Devon Energy Production Company, LP** OGRID #: ~~15025~~ 6137
Address: **333 W. Sheridan Avenue, Oklahoma City, Oklahoma, 73102**
Facility or well name: **Turquoise 27-5**
API Number: 30-015-40583 OCD Permit Number:
U/L or Qtr/Qtr **A** Section **27** Township **19S** Range **29E** County: **Eddy**
Center of Proposed Design: Latitude **32.6362188 N** Longitude **104.054923W** NAD: [ ] 1927 [x] 1983
Surface Owner: [ ] Federal [x] State [ ] Private [ ] Tribal Trust or Indian Allotment

2.
[x] **Pit:** Subsection F or G of 19.15.17.11 NMAC
Temporary: [ ] Drilling [ ] Workover [x] Other Poseidon Concepts Atlantis Modular Impoundment
[ ] Permanent [ ] Emergency [ ] Cavitation [ ] P&A
[x] Lined [ ] Unlined Liner type: Thickness **30** mil [x] LLDPE [ ] HDPE [ ] PVC [ ] Other
[ ] String-Reinforced Diameter: 157' Height: 12'
Liner Seams: [x] Welded [x] Factory [ ] Other Volume: **41,000** bbl ~~Dimensions: L x W x D~~

3.
[ ] **Closed-loop System:** Subsection H of 19.15.17.11 NMAC
Type of Operation: [ ] P&A [ ] Drilling a new well [ ] Workover or Drilling (Applies to activities which require prior approval of a permit or notice of intent)
[ ] Drying Pad [ ] Above Ground Steel Tanks [ ] Haul-off Bins [ ] Other
[ ] Lined [ ] Unlined Liner type: Thickness mil [ ] LLDPE [ ] HDPE [ ] PVC [ ] Other
Liner Seams: [ ] Welded [ ] Factory [ ] Other

4.
[ ] **Below-grade tank:** Subsection I of 19.15.17.11 NMAC
Volume: bbl Type of fluid:
Tank Construction material:
[ ] Secondary containment with leak detection [ ] Visible sidewalls, liner, 6-inch lift and automatic overflow shut-off
[ ] Visible sidewalls and liner [ ] Visible sidewalls only [ ] Other
Liner type: Thickness mil [ ] HDPE [ ] PVC [ ] Other

5.
[ ] **Alternative Method:**
Submittal of an exception request is required. Exceptions must be submitted to the Santa Fe Environmental Bureau office for consideration of approval.

6.

Fencing: Subsection D of 19.15.17.11 NMAC *(Applies to permanent pits, temporary pits, and below-grade tanks)*

☐ Chain link, six feet in height, two strands of barbed wire at top *(Required if located within 1000 feet of a permanent residence, school, hospital, institution or church)*

☐ Four foot height, four strands of barbed wire evenly spaced between one and four feet

☑ Alternate. Please specify **Modular impoundment walls are 12' high; no fencing necessary**

7.

Netting: Subsection E of 19.15.17.11 NMAC *(Applies to permanent pits and permanent open top tanks)*

☐ Screen ☐ Netting ☐ Other_____

☐ Monthly inspections (If netting or screening is not physically feasible)

8.

Signs: Subsection C of 19.15.17.11 NMAC

☐ 12"x 24", 2" lettering, providing Operator's name, site location, and emergency telephone numbers

☒ Signed in compliance with 19.15.16.8 NMAC

9.

Administrative Approvals and Exceptions:

Justifications and/or demonstrations of equivalency are required. Please refer to 19.15.17 NMAC for guidance.

Please check a box if one or more of the following is requested, if not leave blank:

☑ Administrative approval(s): Requests must be submitted to the appropriate division district or the Santa Fe Environmental Bureau office for consideration of approval.

☐ Exception(s): Requests must be submitted to the Santa Fe Environmental Bureau office for consideration of approval.

10.

Siting Criteria (regarding permitting): 19.15.17.10 NMAC

Instructions: The applicant must demonstrate compliance for each siting criteria below in the application. Recommendations of acceptable source material are provided below. Requests regarding changes to certain siting criteria may require administrative approval from the appropriate district office or may be considered an exception which must be submitted to the Santa Fe Environmental Bureau office for consideration of approval. Applicant must attach justification for request. Please refer to 19.15.17.10 NMAC for guidance. **Siting criteria does not apply to drying pads or above-grade tanks associated with a closed-loop system.**

Ground water is less than 50 feet below the bottom of the temporary pit, permanent pit, or below-grade tank. - NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells	☐ Yes ☒ No
Within 300 feet of a continuously flowing watercourse, or 200 feet of any other significant watercourse or lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark). - Topographic map; Visual inspection (certification) of the proposed site	☐ Yes ☒ No
Within 300 feet from a permanent residence, school, hospital, institution, or church in existence at the time of initial application. *(Applies to temporary, emergency, or cavitation pits and below-grade tanks)* - Visual inspection (certification) of the proposed site; Aerial photo; Satellite image	☐ Yes ☒ No ☐ NA Yes
Within 1000 feet from a permanent residence, school, hospital, institution, or church in existence at the time of initial application. *(Applies to permanent pits)* - Visual inspection (certification) of the proposed site; Aerial photo; Satellite image	☐ ☐ No ☒ NA
Within 500 horizontal feet of a private, domestic fresh water well or spring that less than five households use for domestic or stock watering purposes, or within 1000 horizontal feet of any other fresh water well or spring, in existence at the time of initial application. - NM Office of the State Engineer - iWATERS database search; Visual inspection (certification) of the proposed site	☐ Yes ☒ No
Within incorporated municipal boundaries or within a defined municipal fresh water well field covered under a municipal ordinance adopted pursuant to NMSA 1978, Section 3-27-3, as amended. - Written confirmation or verification from the municipality; Written approval obtained from the municipality	☐ Yes ☒ No
Within 500 feet of a wetland. - US Fish and Wildlife Wetland Identification map; Topographic map; Visual inspection (certification) of the proposed site	☐ Yes ☒ No
Within the area overlying a subsurface mine. - Written confirmation or verification or map from the NM EMNRD-Mining and Mineral Division	☐ Yes ☒ No
Within an unstable area. - Engineering measures incorporated into the design; NM Bureau of Geology & Mineral Resources; USGS; NM Geological Society; Topographic map	☒ Yes ☐ No
Within a 100-year floodplain. - FEMA map	☐ Yes ☒ No

11.
Temporary Pits, Emergency Pits, and Below-grade Tanks Permit Application Attachment Checklist: Subsection B of 19.15.17.9 NMAC
Instructions: Each of the following items must be attached to the application. Please indicate, by a check mark in the box, that the documents are attached.

- ☐ Hydrogeologic Report (Below-grade Tanks) - based upon the requirements of Paragraph (4) of Subsection B of 19.15.17.9 NMAC
- ☒ Hydrogeologic Data (Temporary and Emergency Pits) - based upon the requirements of Paragraph (2) of Subsection B of 19.15.17.9 NMAC
- ☒ Siting Criteria Compliance Demonstrations - based upon the appropriate requirements of 19.15.17.10 NMAC
- ☒ Design Plan - based upon the appropriate requirements of 19.15.17.11 NMAC
- ☒ Operating and Maintenance Plan - based upon the appropriate requirements of 19.15.17.12 NMAC
- ☒ Closure Plan (Please complete Boxes 14 through 18, if applicable) - based upon the appropriate requirements of Subsection C of 19.15.17.9 NMAC and 19.15.17.13 NMAC

☐ Previously Approved Design (attach copy of design) API Number: _____ or Permit Number: _____

12.
Closed-loop Systems Permit Application Attachment Checklist: Subsection B of 19.15.17.9 NMAC
Instructions: Each of the following items must be attached to the application. Please indicate, by a check mark in the box, that the documents are attached.

- ☐ Geologic and Hydrogeologic Data (only for on-site closure) - based upon the requirements of Paragraph (3) of Subsection B of 19.15.17.9
- ☐ Siting Criteria Compliance Demonstrations (only for on-site closure) - based upon the appropriate requirements of 19.15.17.10 NMAC
- ☐ Design Plan - based upon the appropriate requirements of 19.15.17.11 NMAC
- ☐ Operating and Maintenance Plan - based upon the appropriate requirements of 19.15.17.12 NMAC
- ☐ Closure Plan (Please complete Boxes 14 through 18, if applicable) - based upon the appropriate requirements of Subsection C of 19.15.17.9 NMAC and 19.15.17.13 NMAC

☐ Previously Approved Design (attach copy of design) API Number: _____

☐ Previously Approved Operating and Maintenance Plan API Number: _____ *(Applies only to closed-loop system that use above ground steel tanks or haul-off bins and propose to implement waste removal for closure)*

13.
Permanent Pits Permit Application Checklist: Subsection B of 19.15.17.9 NMAC
Instructions: Each of the following items must be attached to the application. Please indicate, by a check mark in the box, that the documents are attached.

- ☐ Hydrogeologic Report - based upon the requirements of Paragraph (1) of Subsection B of 19.15.17.9 NMAC
- ☐ Siting Criteria Compliance Demonstrations - based upon the appropriate requirements of 19.15.17.10 NMAC
- ☐ Climatological Factors Assessment
- ☐ Certified Engineering Design Plans - based upon the appropriate requirements of 19.15.17.11 NMAC
- ☐ Dike Protection and Structural Integrity Design - based upon the appropriate requirements of 19.15.17.11 NMAC
- ☐ Leak Detection Design - based upon the appropriate requirements of 19.15.17.11 NMAC
- ☐ Liner Specifications and Compatibility Assessment - based upon the appropriate requirements of 19.15.17.11 NMAC
- ☐ Quality Control/Quality Assurance Construction and Installation Plan
- ☐ Operating and Maintenance Plan - based upon the appropriate requirements of 19.15.17.12 NMAC
- ☐ Freeboard and Overtopping Prevention Plan - based upon the appropriate requirements of 19.15.17.11 NMAC
- ☐ Nuisance or Hazardous Odors, including H_2S, Prevention Plan
- ☐ Emergency Response Plan
- ☐ Oil Field Waste Stream Characterization
- ☐ Monitoring and Inspection Plan
- ☐ Erosion Control Plan
- ☐ Closure Plan - based upon the appropriate requirements of Subsection C of 19.15.17.9 NMAC and 19.15.17.13 NMAC

14.
Proposed Closure: 19.15.17.13 NMAC
Instructions: Please complete the applicable boxes, Boxes 14 through 18, in regards to the proposed closure plan.
Type: ☐ Drilling ☐ Workover ☐ Emergency ☐ Cavitation ☐ P&A ☐ Permanent Pit ☐ Below-grade Tank ☐ Closed-loop System
☒ Alternative **Modular impoundment for temporary storage of treated produced water**
Proposed Closure Method: ☒ Waste Excavation and Removal
☐ Waste Removal (Closed-loop systems only)
☐ On-site Closure Method (Only for temporary pits and closed-loop systems)
☐ In-place Burial ☐ On-site Trench Burial
☐ Alternative Closure Method (Exceptions must be submitted to the Santa Fe Environmental Bureau for consideration)

15.
Waste Excavation and Removal Closure Plan Checklist: (19.15.17.13 NMAC) ***Instructions: Each of the following items must be attached to the closure plan. Please indicate, by a check mark in the box, that the documents are attached.***

- ☒ Protocols and Procedures - based upon the appropriate requirements of 19.15.17.13 NMAC
- ☒ Confirmation Sampling Plan (if applicable) - based upon the appropriate requirements of Subsection F of 19.15.17.13
- ☒ NMAC Disposal Facility Name and Permit Number (for liquids, drilling fluids and drill cuttings)
- ☒ Soil Backfill and Cover Design Specifications - based upon the appropriate requirements of Subsection H of 19.15.17.13 NMAC
- ☒ Re-vegetation Plan - based upon the appropriate requirements of Subsection I of 19.15.17.13 NMAC
- ☒ Site Reclamation Plan - based upon the appropriate requirements of Subsection G of 19.15.17.13 NMAC

16.

Waste Removal Closure For Closed-loop Systems That Utilize Above Ground Steel Tanks or Haul-off Bins Only: (19.15.17.13.D NMAC)

Instructions: Please indentify the facility or facilities for the disposal of liquids, drilling fluids and drill cuttings. Use attachment if more than two facilities are required.

Disposal Facility Name: _____ Disposal Facility Permit Number: _____

Disposal Facility Name: _____ Disposal Facility Permit Number: _____

Will any of the proposed closed-loop system operations and associated activities occur on or in areas that *will not* be used for future service and operations?

☐ Yes (If yes, please provide the information below) ☐ No

Required for impacted areas which will not be used for future service and operations:

☐ Soil Backfill and Cover Design Specifications - - based upon the appropriate requirements of Subsection H of 19.15.17.13 NMAC

☐ Re-vegetation Plan - based upon the appropriate requirements of Subsection I of 19.15.17.13 NMAC

☐ Site Reclamation Plan - based upon the appropriate requirements of Subsection G of 19.15.17.13 NMAC

17.

Siting Criteria (regarding on-site closure methods only): 19.15.17.10 NMAC

Instructions: Each siting criteria requires a demonstration of compliance in the closure plan. Recommendations of acceptable source material are provided below. Requests regarding changes to certain siting criteria may require administrative approval from the appropriate district office or may be considered an exception which must be submitted to the Santa Fe Environmental Bureau office for consideration of approval. Justifications and/or demonstrations of equivalency are required. Please refer to 19.15.17.10 NMAC for guidance.

Ground water is less than 50 feet below the bottom of the buried waste. - NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells	☐ Yes ☐ No ☐ NA
Ground water is between 50 and 100 feet below the bottom of the buried waste - NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells	☐ Yes ☐ No ☐ NA
Ground water is more than 100 feet below the bottom of the buried waste. - NM Office of the State Engineer - iWATERS database search; USGS; Data obtained from nearby wells	☐ Yes ☐ No ☐ NA
Within 300 feet of a continuously flowing watercourse, or 200 feet of any other significant watercourse or lakebed, sinkhole, or playa lake (measured from the ordinary high-water mark). - Topographic map; Visual inspection (certification) of the proposed site	☐ Yes ☐ No
Within 300 feet from a permanent residence, school, hospital, institution, or church in existence at the time of initial application. - Visual inspection (certification) of the proposed site; Aerial photo; Satellite image	☐ Yes ☐ No
Within 500 horizontal feet of a private, domestic fresh water well or spring that less than five households use for domestic or stock watering purposes, or within 1000 horizontal feet of any other fresh water well or spring, in existence at the time of initial application. - NM Office of the State Engineer - iWATERS database; Visual inspection (certification) of the proposed site	☐ Yes ☐ No
Within incorporated municipal boundaries or within a defined municipal fresh water well field covered under a municipal ordinance adopted pursuant to NMSA 1978, Section 3-27-3, as amended. - Written confirmation or verification from the municipality; Written approval obtained from the municipality	☐ Yes ☐ No
Within 500 feet of a wetland. - US Fish and Wildlife Wetland Identification map; Topographic map; Visual inspection (certification) of the proposed site	☐ Yes ☐ No
Within the area overlying a subsurface mine. - Written confirmation or verification or map from the NM EMNRD-Mining and Mineral Division	☐ Yes ☐ No
Within an unstable area. - Engineering measures incorporated into the design; NM Bureau of Geology & Mineral Resources; USGS; NM Geological Society; Topographic map	☐ Yes ☐ No
Within a 100-year floodplain. - FEMA map	☐ Yes ☐ No

18.

On-Site Closure Plan Checklist : (19.15.17.13 NMAC) ***Instructions: Each of the following items must be attached to the closure plan. Please indicate, by a check mark in the box, that the documents are attached.***

☐ Siting Criteria Compliance Demonstrations - based upon the appropriate requirements of 19.15.17.10 NMAC Proof of

☐ Surface Owner Notice - based upon the appropriate requirements of Subsection F of 19.15.17.13 NMAC

☐ Construction/Design Plan of Burial Trench (if applicable) based upon the appropriate requirements of 19.15.17.11 NMAC

☐ Construction/Design Plan of Temporary Pit (for in-place burial of a drying pad) - based upon the appropriate requirements of 19.15.17.11

☐ NMAC Protocols and Procedures - based upon the appropriate requirements of 19.15.17.13 NMAC

☐ Confirmation Sampling Plan (if applicable) - based upon the appropriate requirements of Subsection F of 19.15.17.13

☐ NMAC Waste Material Sampling Plan - based upon the appropriate requirements of Subsection F of 19.15.17.13 NMAC

☐ Disposal Facility Name and Permit Number (for liquids, drilling fluids and drill cuttings or in case on -site closure standards cannot be

☐ achieved) Soil Cover Design - based upon the appropriate requirements of Subsection H of 19.15.17.13 NMAC

☐ Re-vegetation Plan - based upon the appropriate requirements of Subsection I of 19.15.17.13 NMAC Site

☐ Reclamation Plan - based upon the appropriate requirements of Subsection G of 19.15.17.13 NMAC

19.
Operator Application Certification:

I hereby certify that the information submitted with this application is true, accurate and complete to the best of my knowledge and belief.

Name (Print): KALE JACKSON Title: DEVON ENGINEER

Signature: Date: 3-6-13

e-mail address: Kale.Jackson@dvn.com Telephone: (575) 513-8236

20.
OCD Approval: ☒ Permit Application (including closure plan) ☐ Closure Plan (only) ☐ OCD Conditions (see attachment)

OCD Representative Signature: **Approval Date:** 3/7/13

Title: Environmental Engineer **OCD Permit Number:**

21.
Closure Report (required within 60 days of closure completion): Subsection K of 19.15.17.13 NMAC

Instructions: Operators are required to obtain an approved closure plan prior to implementing any closure activities and submitting the closure report. The closure report is required to be submitted to the division within 60 days of the completion of the closure activities. Please do not complete this section of the form until an approved closure plan has been obtained and the closure activities have been completed.

☐ **Closure Completion Date:**

22.
Closure Method:

☐ Waste Excavation and Removal ☐ On-Site Closure Method ☐ Alternative Closure Method ☐ Waste Removal (Closed-loop systems only)

☐ If different from approved plan, please explain.

23.
Closure Report Regarding Waste Removal Closure For Closed-loop Systems That Utilize Above Ground Steel Tanks or Haul-off Bins Only:

Instructions: Please indentify the facility or facilities for where the liquids, drilling fluids and drill cuttings were disposed. Use attachment if more than two facilities were utilized.

Disposal Facility Name: Disposal Facility Permit Number:

Disposal Facility Name: Disposal Facility Permit Number:

Were the closed-loop system operations and associated activities performed on or in areas that *will not* be used for future service and operations?

☐ Yes (If yes, please demonstrate compliance to the items below) ☐ No

Required for impacted areas which will not be used for future service and operations:

☐ Site Reclamation (Photo Documentation)
☐ Soil Backfilling and Cover Installation
☐ Re-vegetation Application Rates and Seeding Technique

24.
Closure Report Attachment Checklist: ***Instructions: Each of the following items must be attached to the closure report. Please indicate, by a check mark in the box, that the documents are attached.***

☐ Proof of Closure Notice (surface owner and division)
☐ Proof of Deed Notice (required for on-site closure)
☐ Plot Plan (for on-site closures and temporary pits)
☐ Confirmation Sampling Analytical Results (if applicable)
☐ Waste Material Sampling Analytical Results (required for on-site closure)
☐ Disposal Facility Name and Permit Number
☐ Soil Backfilling and Cover Installation
☐ Re-vegetation Application Rates and Seeding Technique
☐ Site Reclamation (Photo Documentation)

On-site Closure Location: Latitude Longitude NAD: ☐ 1927 ☐ 1983

25.
Operator Closure Certification:

I hereby certify that the information and attachments submitted with this closure report is true, accurate and complete to the best of my knowledge and belief. I also certify that the closure complies with all applicable closure requirements and conditions specified in the approved closure plan.

Name (Print): Title:

Signature: Date:

e-mail address: Telephone:

devon

Turquoise PWU 27-5H

Kale Jackson
Engineer
575.513.8236

March 6, 2013

Mr Jones,

Thank you for your time and efforts spent on this project with Devon Energy over the past months. I believe the continuity we have displayed between State and operator will be looked upon as a success. Attached is Devon's final proposal.

The Turquoise PWU 27-5H was recently TD'd 3/3/2013. We are hoping to begin our setup process ASAP. I hope that all the information attached is what was required of Devon Energy.

Again, thanks for making this project feasible and helping Devon Energy strive to become one of the leaders in water conservation.

Sincerely,

Kale Jackson

CH2M HILL
12301 Research Blvd
Building 4, Suite 250
Austin, Texas
78759
Tel 512-453-1980
Fax 512-453-4109

March 7, 2013
459109

Mr. Brad Jones
New Mexico
Oil Conservation Division
1220 S. St. Francis Drive
Santa Fe, NM, 87505

Subject: Turquoise 27-5 Modular Impoundment (Atlantis system) for temporary storage of treated produced water

Dear Brad:
For the above referenced modular impoundment, we submit for your review:

1. A C-144 Form
2. Supplemental information to support the C-144

Please contact me with any questions or comments at 512-249-3338

Sincerely,

Ken Nichols
CH2M HILL

Permit Package

C-144 Permit Package for the Turquoise 27-5: Temporary Storage of Treated Produced Water- Modular Impoundment Section 27 T19S R29E Eddy County, NM

Prepared for

Devon Energy

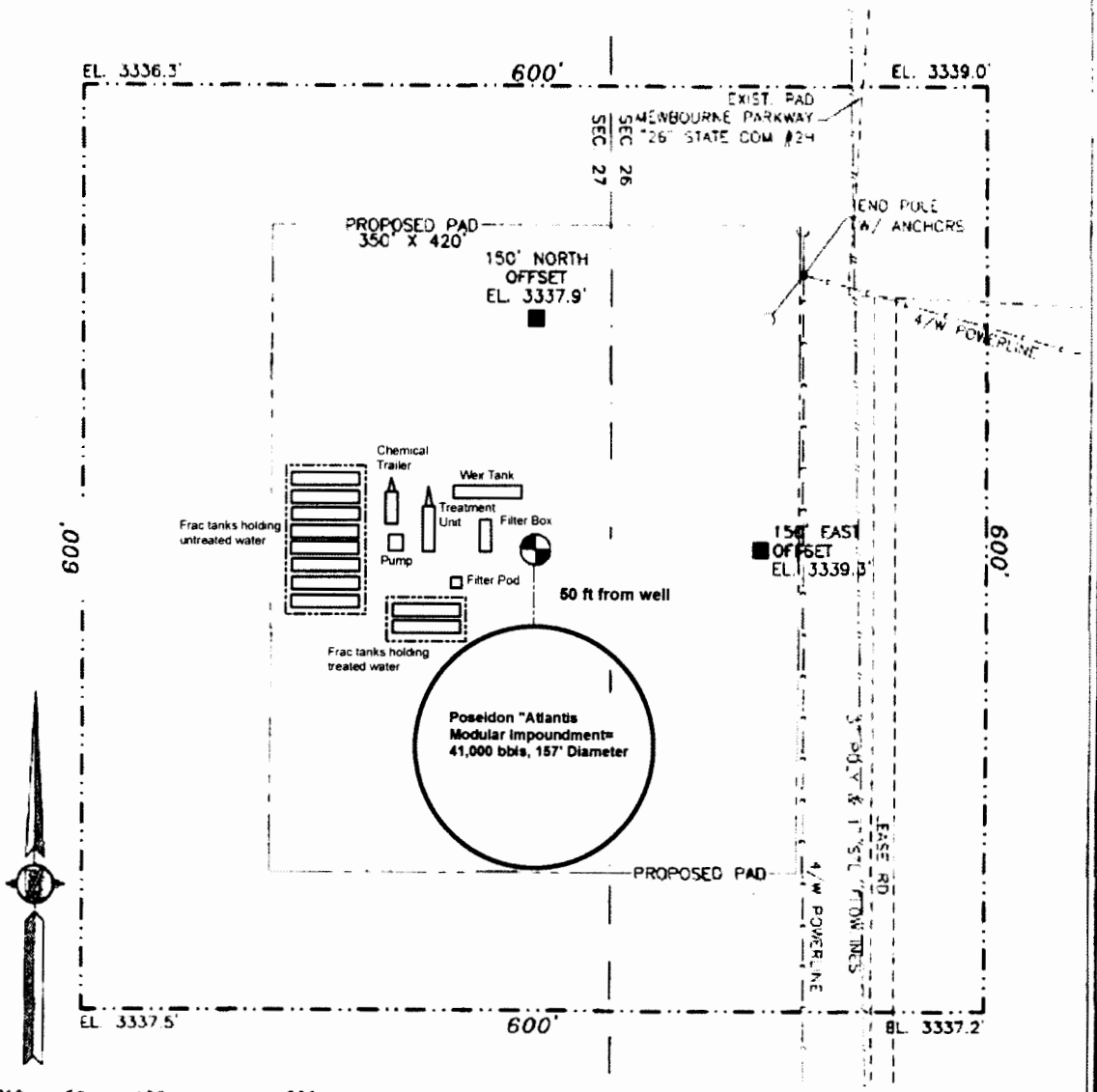
November 2012

CH2MHILL®

12301 Research Blvd
Building 4; Suite 250
Austin, Texas
787459

Survey Information

SECTION 27, TOWNSHIP 19 SOUTH, RANGE 29 EAST, N.M.P.M.
EDDY COUNTY, STATE OF NEW MEXICO



0 10 50 100 200

SCALE 1" = 100'

DIRECTIONS TO LOCATION

FROM THE INTERSECTION OF CR 210 (OLD LOCO) AND CR 235 (CURRY COMB) GO SOUTHEAST ON CR 235 FOR APPROX. 2.8 MILES. GO SOUTH APPROX. 0.4 OF A MILE. GO NORTHWEST APPROX. 0.7 OF A MILE TO MEWBOURNE PARKWAY "26" STATE COM #2H. LOCATION IS APPROX 500 FT SOUTHWEST.

DEVON ENERGY PRODUCTION COMPANY, L.P.

TURQUOISE PWU "27" #5H

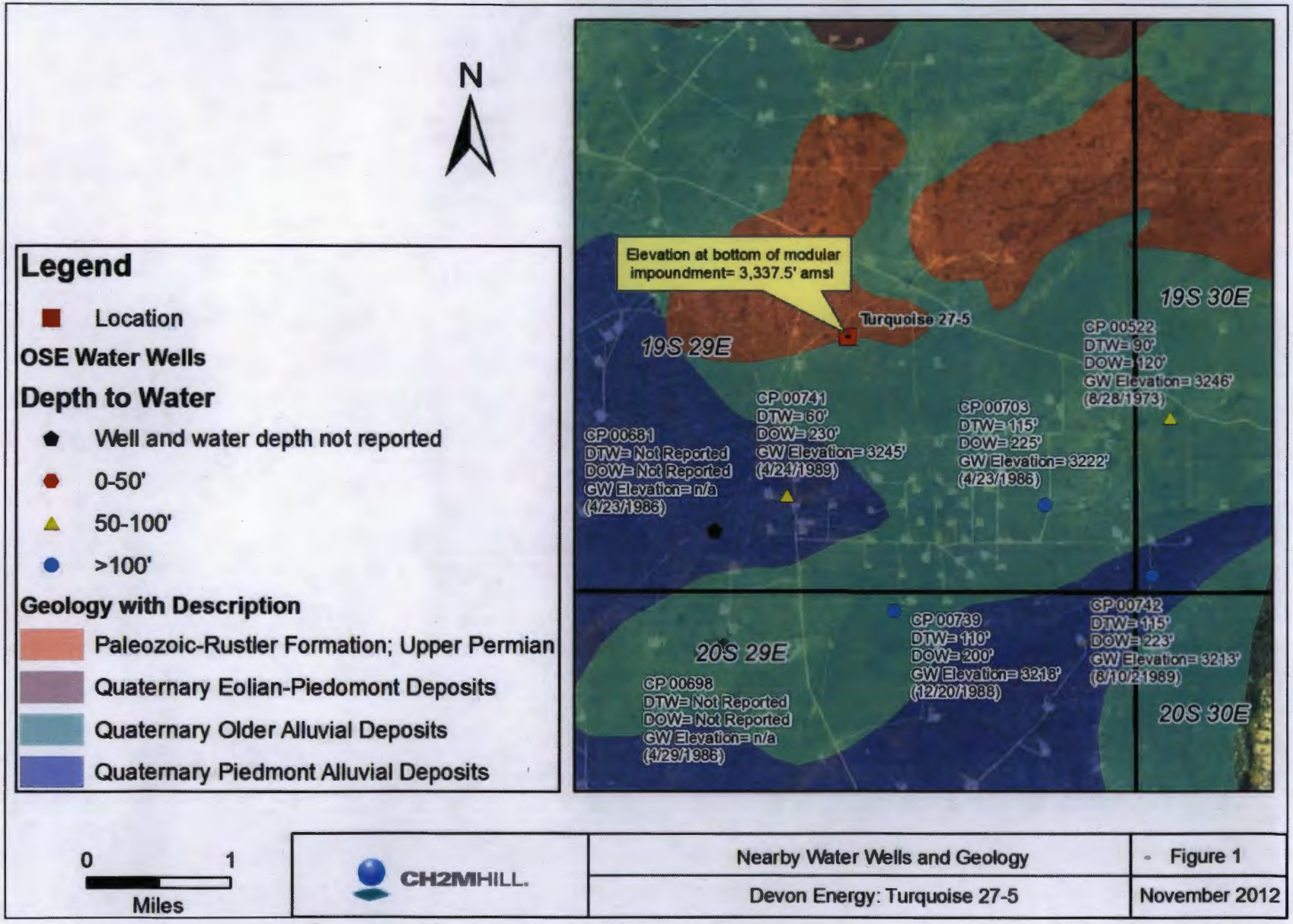
LOCATED 990 FT. FROM THE NORTH LINE AND 50 FT. FROM THE EAST LINE OF SECTION 27, TOWNSHIP 19 SOUTH, RANGE 29 EAST, N.M.P.M. EDDY COUNTY, STATE OF NEW MEXICO

MAY 4, 2012

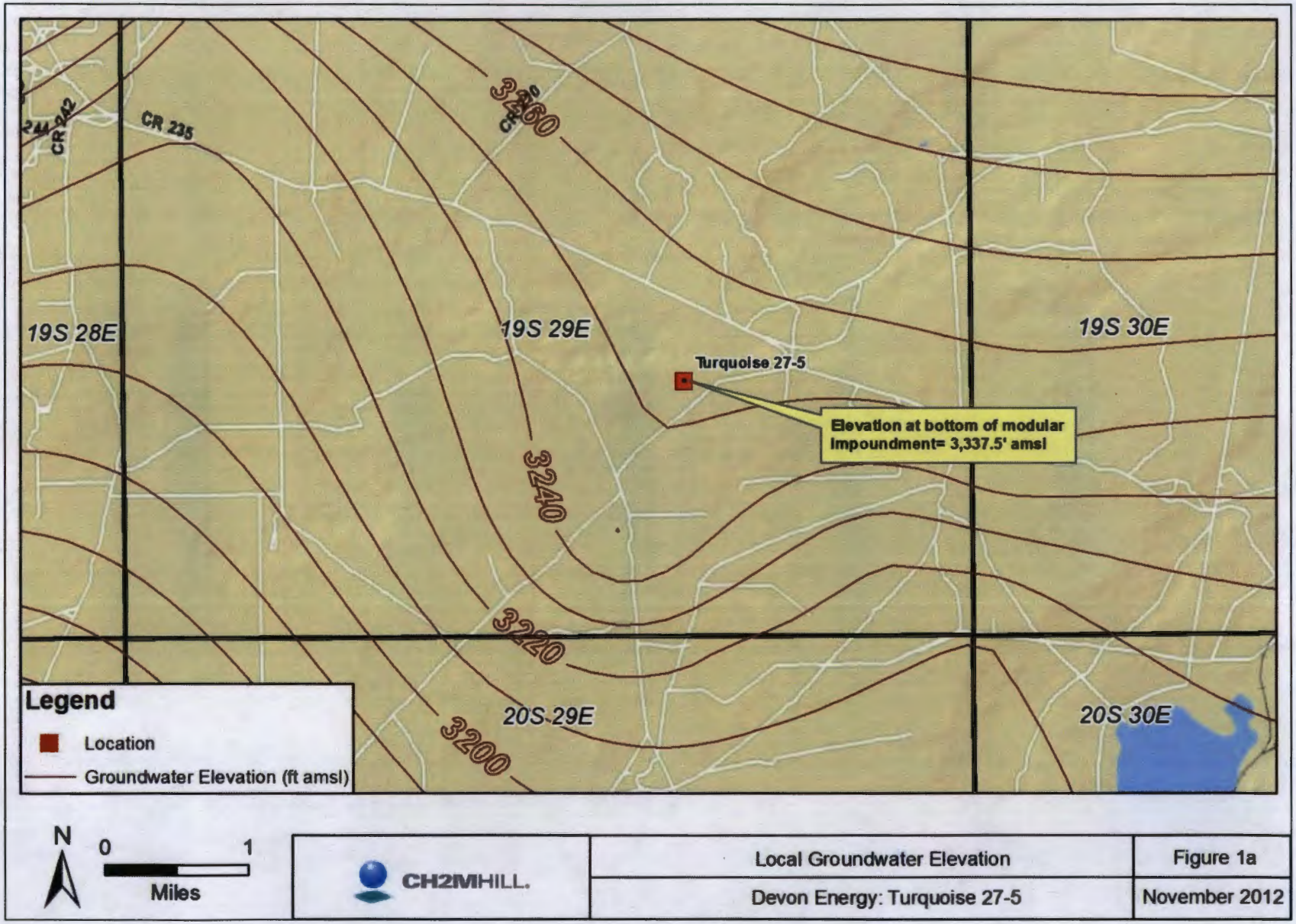
SURVEY NO. 964

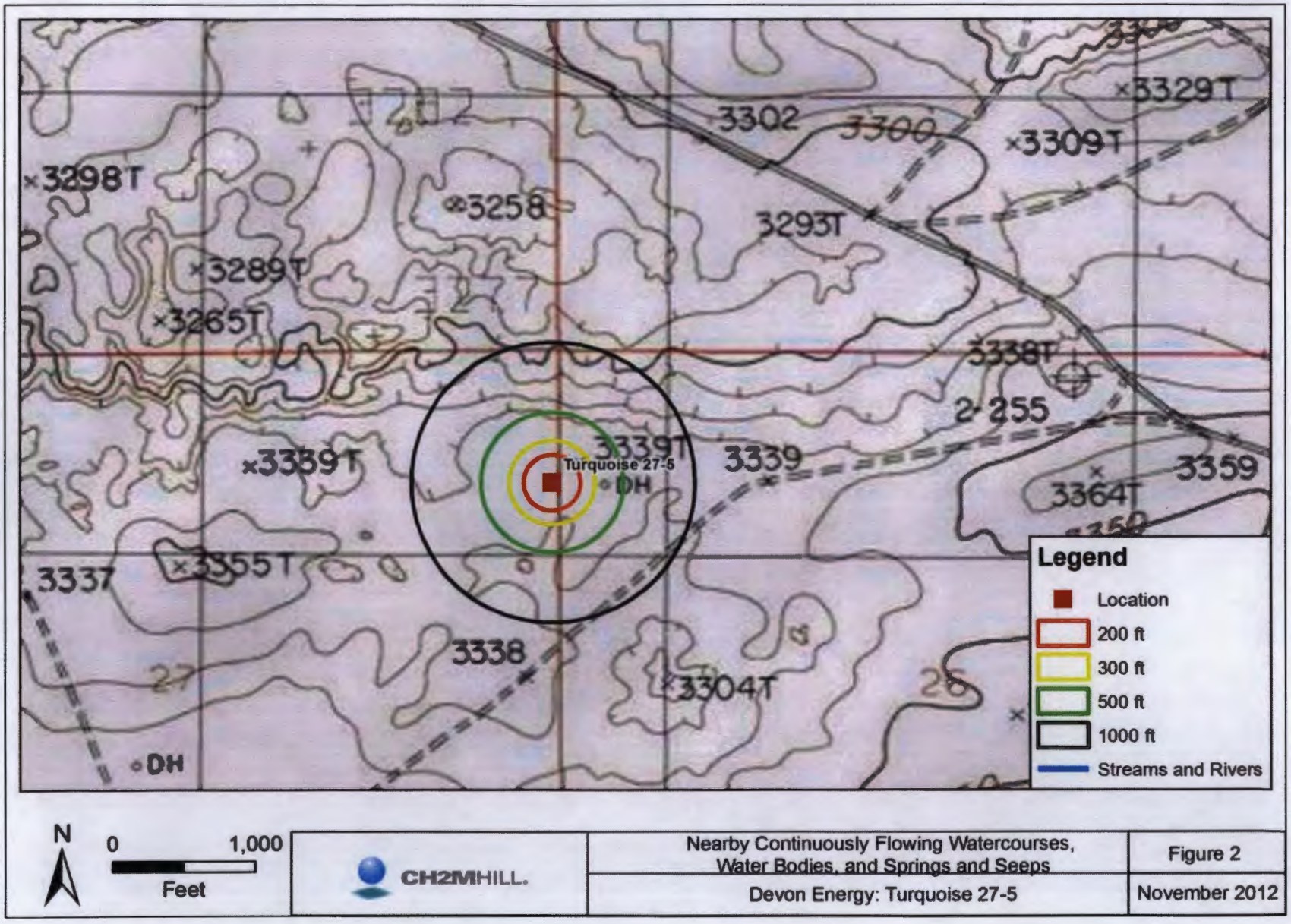
MADRON SURVEYING, INC. 301 SOUTH CANAL (575) 234-3341 *CARLSBAD, NEW MEXICO*

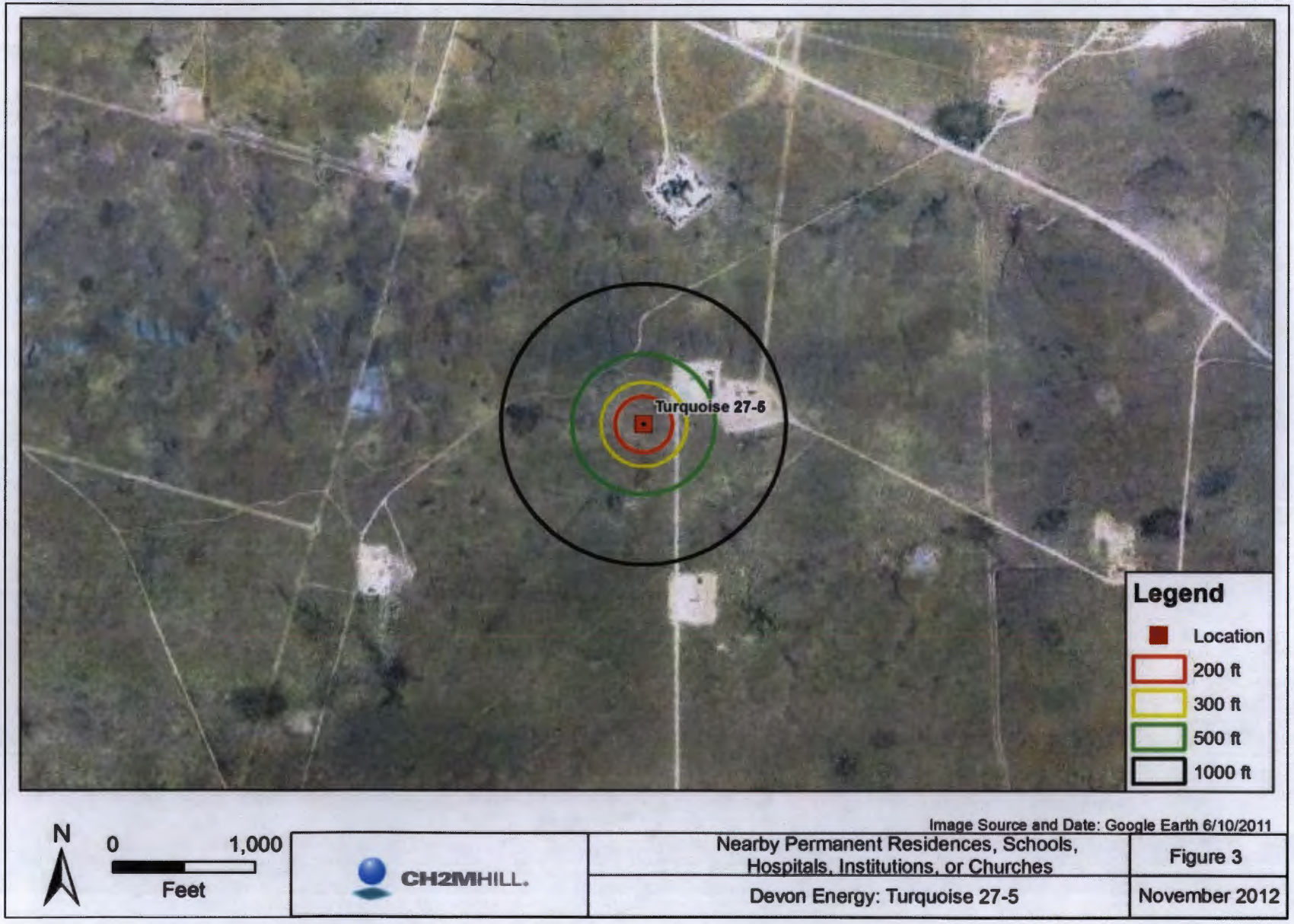
Site Specific Information

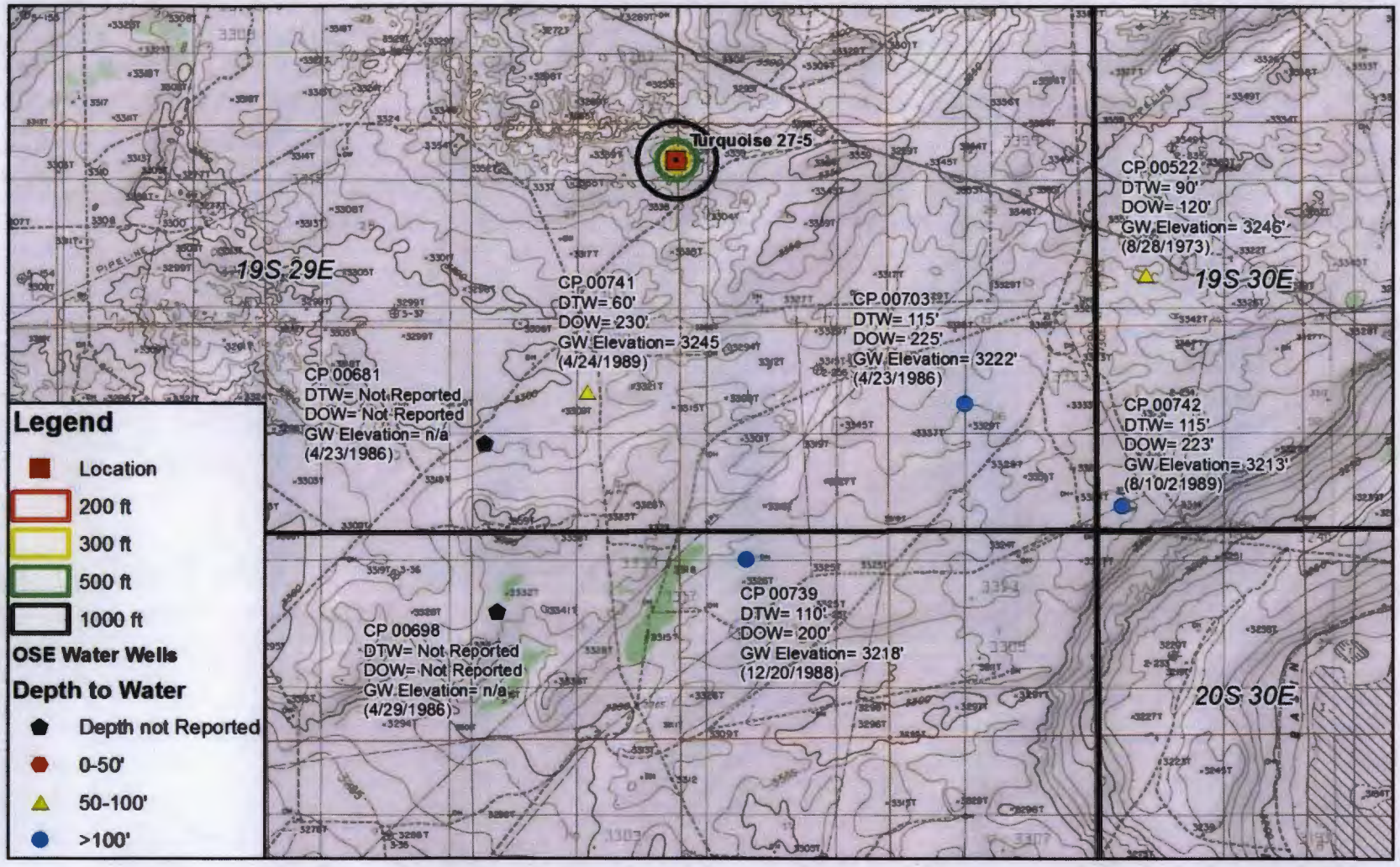


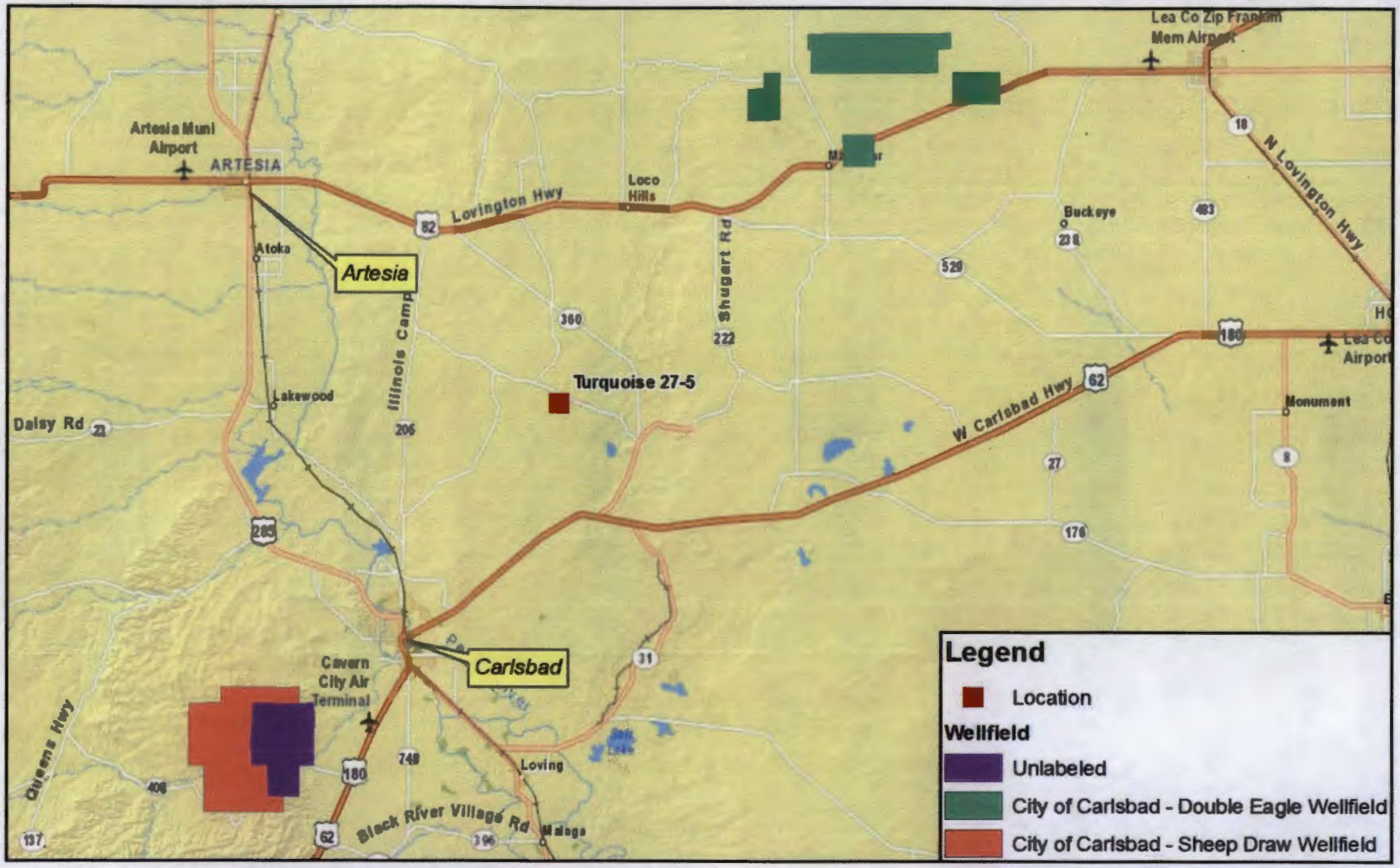
CH2MHILL.	Nearby Water Wells and Geology	Figure 1
	Devon Energy: Turquoise 27-5	November 2012


CR 242
CR 235
CR 230
3260
19S 28E
19S 29E
19S 30E
Turquoise 27-5
Elevation at bottom of modular impoundment= 3,337.5' amsl
3240
3220
3200
20S 29E
20S 30E
Legend
Location
Groundwater Elevation (ft amsl)
N
0
1
Miles
CH2MHILL.
Local Groundwater Elevation
Devon Energy: Turquoise 27-5
Figure 1a
November 2012


3302
3300
×3329T
×3309T
×3298T
3258
3293T
×3289T
×3265T
3338T
2255
×3339T
3339T
Turquoise 27-5
DH
3339
3359
3364T
3337
×3355T
3338
×3304T
27
26
DH
Legend
Location
200 ft
300 ft
500 ft
1000 ft
Streams and Rivers
N
0
1,000
Feet
CH2MHILL.
Nearby Continuously Flowing Watercourses, Water Bodies, and Springs and Seeps
Figure 2
Devon Energy: Turquoise 27-5
November 2012


Turquoise 27-5
Legend
Location
200 ft
300 ft
500 ft
1000 ft
N
0
1,000
Feet
Image Source and Date: Google Earth 6/10/2011
CH2MHILL
Nearby Permanent Residences, Schools, Hospitals, Institutions, or Churches
Figure 3
Devon Energy: Turquoise 27-5
November 2012


Turquoise 27-5
19S 29E
19S 30E
20S 30E
CP 00741
DTW= 60'
DOW= 230'
GW Elevation= 3245
(4/24/1989)
CP 00703
DTW= 115'
DOW= 225'
GW Elevation= 3222'
(4/23/1986)
CP 00681
DTW= Not Reported
DOW= Not Reported
GW Elevation= n/a
(4/23/1986)
CP 00522
DTW= 90'
DOW= 120'
GW Elevation= 3246'
(8/28/1973)
CP 00742
DTW= 115'
DOW= 223'
GW Elevation= 3213'
(8/10/21989)
CP 00739
DTW= 110'
DOW= 200'
GW Elevation= 3218'
(12/20/1988)
CP 00698
DTW= Not Reported
DOW= Not Reported
GW Elevation= n/a
(4/29/1986)
Legend
Location
200 ft
300 ft
500 ft
1000 ft
OSE Water Wells
Depth to Water
Depth not Reported
0-50'
50-100'
>100'
N
0
4,000
Feet
CH2MHILL.
Topographic and Groundwater Data
Devon Energy: Turquoise 27-5
Figure 4
November 2012



N

0 10

Miles

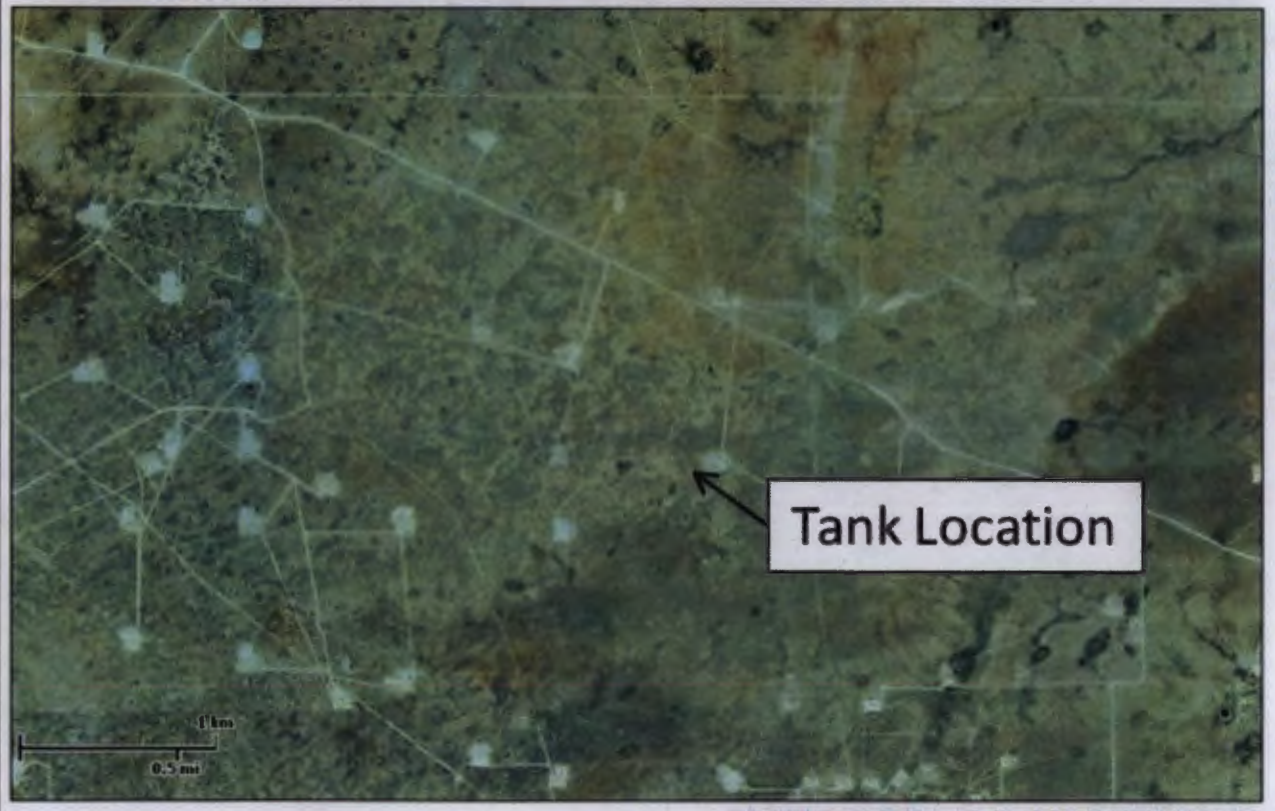
CH2MHILL

Nearby Municipal Areas and Wellfields	Figure 5
Devon Energy: Turquoise 27-5	November 2012

U.S. Fish and Wildlife Service

National Wetlands Inventory

Nov 26, 2012



Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

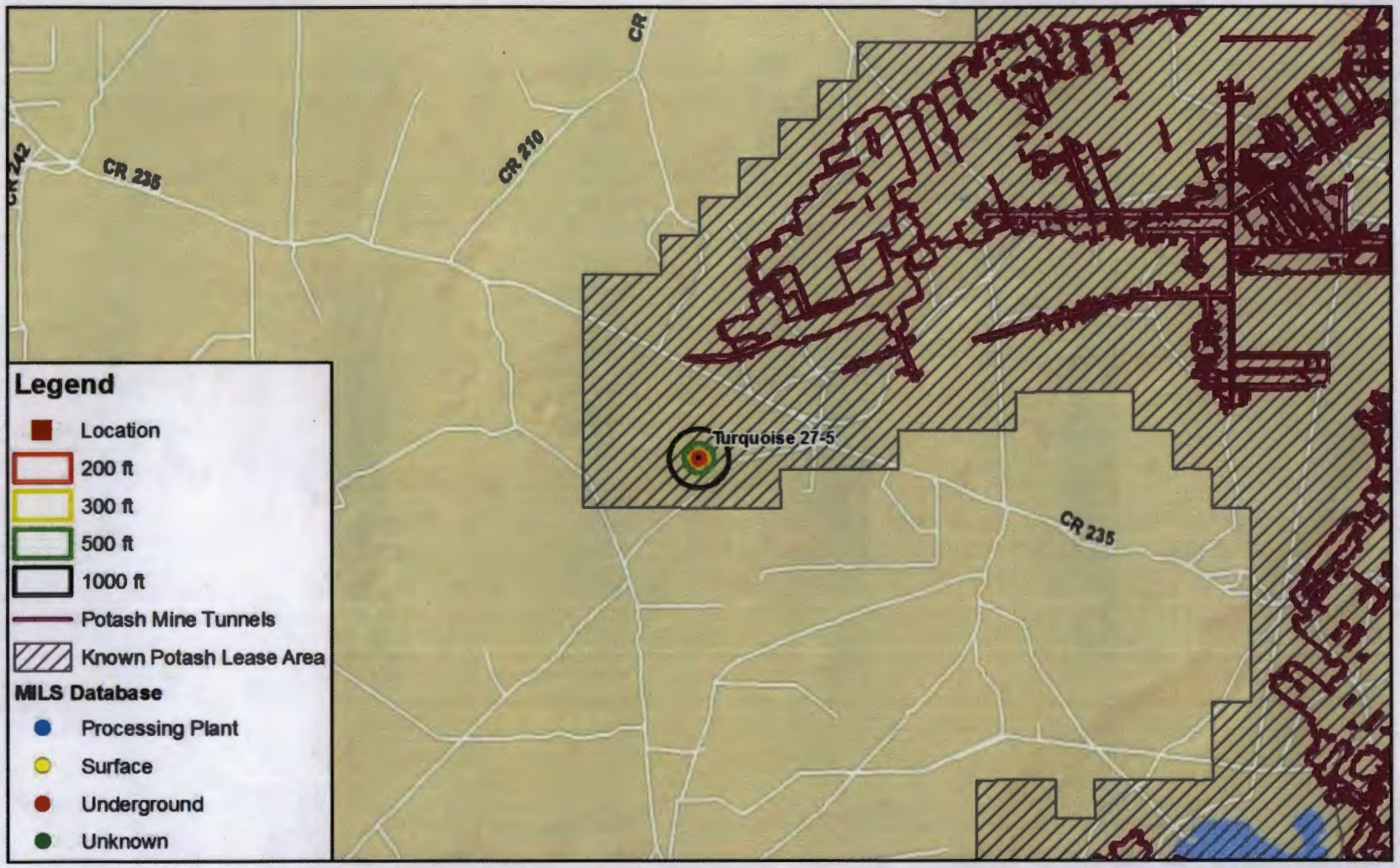
Riparian

- Herbaceous
- Forested/Shrub

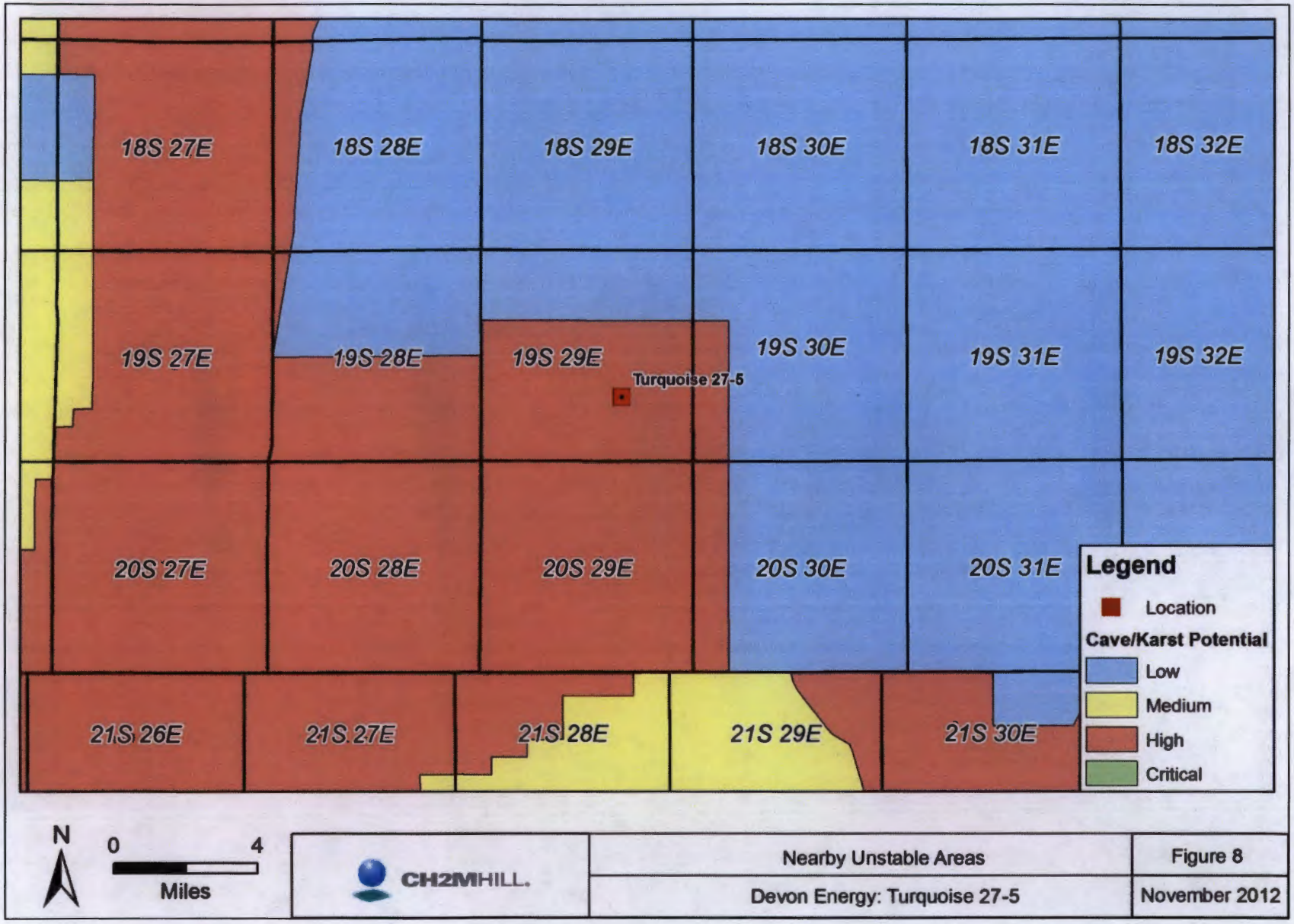
This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

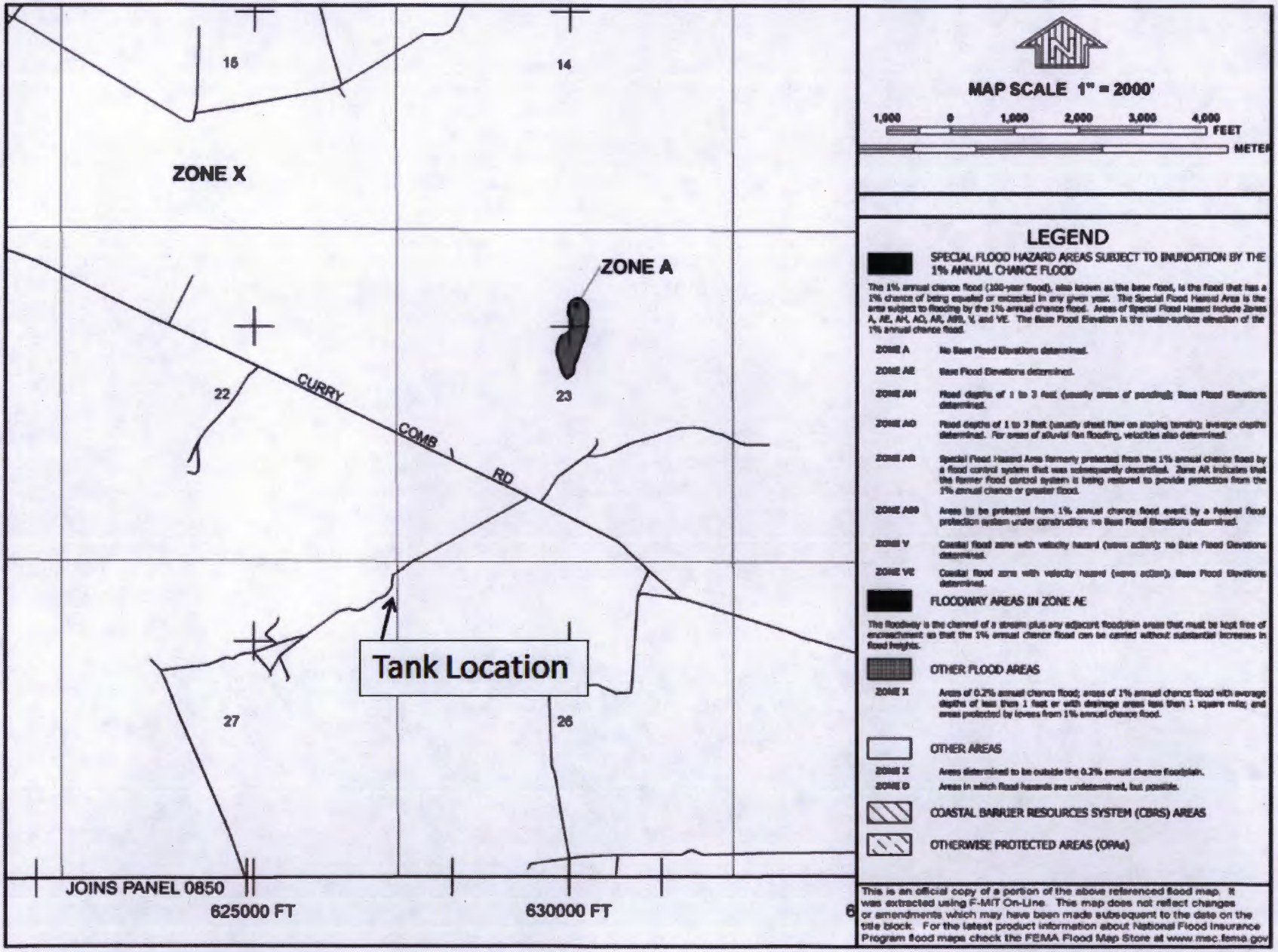
User Remarks:

Figure 6



CH2MHILL.	Nearby Mines and Potash Tunnels	Figure 7
	Devon Energy: Turquoise 27-5	November 2012


18S 27E
18S 28E
18S 29E
18S 30E
18S 31E
18S 32E
19S 27E
19S 28E
19S 29E
Turquoise 27-5
19S 30E
19S 31E
19S 32E
20S 27E
20S 28E
20S 29E
20S 30E
20S 31E
21S 26E
21S 27E
21S 28E
21S 29E
21S 30E
Legend
Location
Cave/Karst Potential
Low
Medium
High
Critical
N
0
4
Miles
CH2MHILL.
Nearby Unstable Areas
Devon Energy: Turquoise 27-5
Figure 8
November 2012



FEMA Flood Map Figure 9

FIGURE 10
Confirmation of Site Conditions

November 27, 2012

Mr. Brad Jones
New Mexico
Oil Conservation District
1220 S. St Francis Drive
Santa Fe, NM, 87505

Subject: Confirmation of field conditions assist with demonstrating compliance with the siting criteria outlined for temporary pit under 19.15.17.10 NMAC

Dear Brad:
I, Kale Jackson on this date of November 27, 2012, after observing the area surrounding the proposed location of the Atlantis modular impoundment at the Turquoise 27-5 well site, confirm the following site conditions:

- Presence of watercourses and/or water bodies
  - No watercourses, including rivers, creeks, arroyos, canyons, draws, washes, or other channels having definite banks and beds, which have a continuous flow were observed to be located within 300 feet of the modular impoundment location.
  - No significant watercourse having evidence of intermittent flows, nor any lakebeds, sinkholes, or playa lakes were observed within 200 feet of the modular impoundment location.
- No permanent residences, schools, hospitals, institutions, or churches were observed to exist within 300 feet of the modular impoundment location.
- Presence of water wells and/or springs
  - No water wells were observed to exist within 1000 feet from modular impoundment location.
  - No springs were observed to exist within 1000 feet from the modular impoundment location.
- No wetlands were observed to exist within 500 feet of the modular impoundment location.
- No evidence of kart features such as fissures, tubes, or caves was observed on the modular impoundment location.

Sincerely,

Kale Jackson

Devon Energy
11/27/12

Project Scope

Devon Energy is submitting this permit application for the purpose of obtaining authorization to operate an above-ground modular impoundment system under the terms and conditions set forth for a temporary pit by the New Mexico Oil Conservation Division and 19.15.17 of the NMAC.

A temporary pit is defined as a pit, including a drilling or workover pit, which is constructed with the intent that the pit will hold liquids for less than six months and be closed in less than one year.

The above-ground modular impoundment system which Devon Energy proposes to use, the Atlantis system from Poseidon Concepts, will hold treated produced water to be used in the stimulation of the Turquoise 27-5 well. Well stimulation, also called hydraulic fracturing, is classified separately from both drilling and well workovers. The Atlantis modular impoundment system will only store treated produced water while it is onsite.

Devon anticipates beginning this operation on approximately March 10, 2013. The project is expected to proceed over a period not exceeding 31 days. Site mobilization and set-up of the treatment equipment and frac tanks, and Poseidon modular impoundment erection will occur in approximately the first 8 days; produced water will begin to be trucked to the site on day 7 of the mobilization and set-up schedule. Following the mobilization and set up period, treatment of the produced water will commence and last for an estimated 9 days; Devon anticipates all produced water will be trucked to the site by the end of day 8 of the treatment process. Hydraulic fracturing of the well is expected to start once all water is transferred into the Poseidon unit and the two 500 bbl frac tanks; the frac job is anticipated to be completed in no more than 5 days. Immediately following the frac job, cleaning and waste removal, breakdown, and mobilization of all on-site treatment and storage equipment offsite will begin. Devon anticipates removing all treated and untreated produced water within 4 days following the end of the frac job. Breakdown and mobilization of all treatment and storage equipment offsite will occur during the last 5 days, thereby closing the project. **Table 1** presents a Gantt chart showing the general time requirements for the above mentioned activities.

TABLE 1
Project Schedule

Activity	Time (days)
	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Mobilization and Site Set-up	
Hauling of Produced Water to Site	
Treatment and Transfer to Storage	
Frac Job	
Equipment Cleanup and Produced Water Removal	
Complete Closure and Demobilize Equipment	

Siting Criteria (NMAC 19.15.17.10)

The following section consists of Devon's demonstration to meet siting criteria for the application of a temporary pit as set forth in the NMAC and C-144 application.

Hydrogeoloic Conditions and Data

Figure 1 and the hydrogeologic data presented below demonstrate that groundwater (fresh water as defined by NMOCD Rules that has a TDS ≤ 10,000 mg/L) at the location is between 50 and 100 feet below the bottom of the modular impoundment.

a. The location of the modular impoundment that shall temporarily store treated produced water is plotted as a red square with a black dot in the center (**Figure 1**).

b. Water wells in the OSE database are shown as color coded circles as defined by the reported depth to water. OSE well labels include the Point of Diversion number, depth to groundwater, depth of well, groundwater elevation in feet above mean sea level as determined from using depth of water and ground surface elevations obtained from the National Elevation Dataset (NED) and Digital Elevation Model (DEM) data, and date of measurement. Some OSE wells are incorrectly located in the iWATERS database as older wells are plotted in the center of the quarter quarter of the Section, Township and Range.

Geology

The modular impoundment is located on the boundary between two separate formations: older Quaternary alluvial deposits and the Permian Rustler Formation (**Figure 1**). The elevation at the bottom of the modular impoundment is 3,337.5 feet amsl. In areas where it is not at the surface, the Rustler Formation underlies the older alluvial deposits. The Rustler is composed of anhydrite, gypsum, interbedded sandy clay and shale, and irregular beds of dolomite. (Hendrickson and Jones, 1952) The Rustler Formation overlies the Salado Formation.

Several water-bearing zones in the Rustler have been penetrated in the numerous potash test holes which were drilled into the Salado. The basal beds of the Rustler consist of porous gypsum in a large part of Nash Draw and southwest to Malaga Bend. (Hendrickson and Jones, 1952)

The most important aquifer above the basal brine aquifer in the Rustler is the 35-foot unit of dolomite and limestone at the top of the lower part of the Rustler. Water is generally confined in the limestone aquifer where it's overlain by the upper beds of the Rustler. (Hendrickson and Jones, 1952)

The location of the modular impoundment, as shown in **Figure 1**, is situated on a boundary between where the Rustler outcrops at the surface and overlying alluvial deposits.

Groundwater Elevation Data

Groundwater data from water wells near the modular impoundment location are shown in **Figure 1**; the data provided in the OSE well database includes well location, total well depth, and reported depth to groundwater. The depth to groundwater in the well database was compared to surface elevation data from USGS topo maps and DEMs to determine an approximate groundwater elevation. The nearest of the wells for which data was obtained are all located at distances greater than 1 mile from the Turquoise 27-5 site. A total of 7 wells were found in the near vicinity of the Turquoise 27-5 site; however, only 5 wells reported well depths and depths to water.

The nearest OSE well to the modular impoundment, CP 00741, is located approximately 1.2 miles southwest from the site. The depth to water in this well was reported (4/24/1989) to be 60 feet bgs (3245 feet amsl) and the total depth of the well was reported as 230 feet. The difference between groundwater elevation at this well and surface elevation at the modular impoundment is 92.5 feet.

Approximately 1.85 miles southeast of the modular impoundment, the OSE database lists well CP 00703 as being a well with a total depth of 225 feet and reporting (4/23/1986) a depth to water of 115 feet bgs (3222 feet amsl).

Approximately 2 miles south of the modular impoundment, the OSE database lists well CP 00739 as being a well with a total depth of 200 feet and reporting (12/20/1988) a depth to water of 110 feet bgs (3218 feet amsl).

Approximately 2.3 miles east-southeast of the modular impoundment, the OSE database lists well CP 00522 as being a well with a total depth of 120 feet and reporting (8/28/1973) a depth to water of 110 feet bgs (3246 feet amsl).

Approximately 2.75 miles southeast of the modular impoundment, the OSE database lists well CP 00742 as being a well with a total depth of 223 feet and reporting (8/10/1989) a depth to water of 115 feet bgs (3213 feet amsl).

Conclusion

Depth to water measurements for OSE wells CP 00741, CP 00703, and CP 0052 suggest that the direction of groundwater movement near the modular impoundment is to the southeast. The local groundwater elevation gradient appears to slope downward to the southwest; however, the local topography is relatively flat with a gradient of less than .5%. Groundwater data was obtained for all wells within the 19S-29E township and all adjacent townships. This data was, along with surface elevation data from USGS topo maps and DEMs, was used to create a contour map of local groundwater elevations presented in **Figure 1a,** which suggests that the groundwater elevation at the Turquoise 27-5 location is between 3250 and 3260 ft amsl. Comparing this groundwater elevation to the surface elevation at the bottom of the proposed modular impoundment, or 3337.5' amsl, a reasonable estimate of depth to groundwater at the Turquoise 27-5 site is determined to be between 75 and 95 feet. This estimate coincides with groundwater depth date published in the Lower Pecos Valley Regional Water Plan. Craig Shapard, geologist for the Artesia District of the NMOCD, in a telephone conversation verified that depths to groundwater in the 19S-29E township, per his knowledge and resources, are not less than 50 feet.

Siting Criteria Compliance Demonstration

The information identified in Item 10, "Siting Criteria" of the C-144 is presented below. The descriptions below are associated with the maps presented in **Figures 2 through 9**, attached. Written confirmation of site conditions as observed by Devon Energy during site reconnaissance are provided in **Figure 10.**

Figure 2- Demonstrate that the location is not within 300 feet of a continuously flowing watercourse, or 200 feet of any other significant watercourse or lakebed, sinkhole, or playa lake (measured form the ordinary high water mark)

a. Data from the USGS National Hydrography Dataset (NHD) shows no intermittent streams within a distance of at least ¾ miles from the proposed modular impoundment location. The USGS topographic overlay of the area does not show any water bodies or significant elevation changes, which may indicate the presence of a watercourse, within 300 feet of the impoundment site.

b. Sight reconnaissance identified no evidence of a watercourse, as defined by NMAC 19.15.2.7, having a continuous flow and located within a distance of at least 300 feet from the proposed modular impoundment location.

c. Site reconnaissance identified no other significant watercourses as defined by 19.15.2.7 NMAC, water bodies, springs, or seeps within 200 feet of the location.

Figure 3- Demonstrates that the location is not within 300 feet from a permanent residence, school, hospital, institution, or church in existence at the time of initial application. No nearby structures exist within 300 feet of the location.

a. As shown on the aerial photograph, no permanent residences, schools, hospitals, institutions, or churches exist within 300 feet of the location.

b. Site reconnaissance supports this conclusion.

Figures 2 and 4- Demonstrate that the location is not within 500 horizontal feet of a private, domestic freshwater well or spring that less than five households use for domestic or stock watering purposes, or within 1000 horizontal feet of any other fresh water well or spring, in existence at the time of initial application.

a. The USGS topographic map of the area surrounding the proposed impoundment does not show any water wells or springs within 1000 feet of the proposed modular impoundment site.

b. The closest water well listed by the OSE is approximately 1.2 miles southwest of the location. Sight reconnaissance confirms that no water wells are located within 1000 feet from the location.

c. Site reconnaissance confirms that no springs exist within 1000 feet from the modular impoundment location

Figure 5- Demonstrates that the location is not within incorporated municipal boundaries or within a defined a municipal fresh water well field covered under a municipal ordinance adopted pursuant to NMSA 1978, Section 3-27-3, as amended.

a. The closest incorporated municipality is Carlsbad, NM; approximately 18.2 miles southwest of the location.

b. The closest well field is approximately 21.8 miles northeast of the location.

Figure 6- Demonstrates the location is not within 500 feet of wetlands.

a. The US Fish and Wildlife Wetlands Inventory does not identify any wetlands within 500 feet of the location.

b. Site reconnaissance identified no wetlands within 500 feet of the location.

Figure 7- Demonstrates the site location is not within an area overlying a subsurface mine.

a. The project location is within a known potash leasing area. The closest potash mining tunnel is 0.6 miles due north of the location. The MILS database does not list any other sub-surface mines within 5 miles of the proposed impoundment location.

b. The composition of the production pad and the underlying dense clay provides engineered surface stability to ensure that the modular impoundment's integrity is not compromised.

Figure 8- Shows that the location lies in an area listed by the BLM as having a High Potential for caves and Karst formations; unstable area.

a. The location is located within an area having a high likelihood for karst/caves according to data from BLM. Site reconnaissance observed no evidence of karst features (fissures, tubes, or caves) near the location.

b. The above ground modular impoundment will be placed upon a 10 to 12 inch caliche production pad. The production pad will cover approximately 3.37 acres. Beneath the production pad is very dense clay.

c. The composition of the production pad and the underlying dense clay provides engineered surface stability to ensure that the modular impoundment's integrity is not compromised.

Figure 9- Demonstrates that the location is not within a 100-year floodplain.

a. The location is within Zone X of FEMA Flood Zone Designation. Zone X, represented by the unshaded areas of Figure 9, is defined as an area of minimal flood hazard and above the 500-year flood level.

Design and Construction Specifications (NMAC 19.15.17.11)

A. General Specifications

An operator shall design and construct a pit, closed-loop system, below-grade tank or sump to contain liquids and solids and prevent contamination of fresh water and protect public health and the environment.

Response

Devon Energy will construct a modular impoundment fluid storage system provided by Poseidon Concepts. The modular impoundment system model is the Atlantis. **Figure 11** is an example of Poseidon's modular impoundment. The modular impoundment shall be constructed according to manufacturer's specifications as described in Section 19.15.17.11.F.The modular impoundment is engineered to prevent contamination of fresh water and protect public health and the environment.

FIGURE 11

Example of Poseidon's Fluid Storage System (PoseidonConcepts.com)

The purpose of the modular impoundment is for temporary storage of treated produced water on-site at the Turquoise 27-5 location for well stimulation. The modular impoundment will be placed on the production pad for the Turquoise 27-5 well. At the time of this application, the production pad for the Turquoise 27-5 has not been constructed; however, it will be completed before any equipment required for well stimulation mobilizes to the site. The production pad will accommodate the modular impoundment without any additional site development.

B. Stockpiling of Topsoil

Prior to constructing a pit or closed-loop system, except a pit constructed in an emergency, the operator shall strip and stockpile the topsoil for use as the final cover or fill at the time of closure.

Response

The modular impoundment shall be constructed on a to-be-constructed production pad at the Turquoise 27-5. No additional surface disturbance shall occur. After the modular impoundment closure, the production pad will remain in-place until proper abandonment of the production well.

C. Signs

The operator shall post an upright sign not less than 12 inches by 24 inches with lettering not less than two inches in height in a conspicuous place on the fence surrounding the pit, closed-loop system, or below-grade tank, unless the pit, closed-loop system, or below-grade tank is located on a site where there is an existing well, signed in compliance with 19.15.16.8 NMAC, that is operated by the same operator. The operator shall post the sign in a manner and location such that a person can easily read the legend. The sign shall provide the following information: the operator's name, the location of the site by quarter-quarter or unit letter, section, township, and range, and emergency telephone numbers.

Response

The sign placed at the Turquoise 27-5 well in compliance with 19.15.16.8 NMAC will be used in conjunction with the modular impoundment. Such sign will include the well number, property name, the designation of Devon Energy as the operator, location by footage, quarter-quarter section, township and range, and well API number.

D. Fencing

The operator shall fence or enclose a pit or below-grade tank in a manner that prevents unauthorized access and shall maintain the fences in good repair. Fences are not required if there is an adequate surrounding perimeter fence that prevents unauthorized access to the well site or facility, including the pit or below-grade tank. During drilling or workover operations, the operator is not required to fence the edge of the pit adjacent to the drilling or workover rig.

The operator shall fence or enclose a pit or below grade tank located within 1000 feet of a permanent residence, school, hospital, institution or church with a chain link security fence, at least six feet in height with at least two strands of barbed wire at the top. The operator shall ensure that all gates associated with the fence are closed and locked when responsible personnel are not on-site.

The operator shall fence any other pit or below-grade tank to exclude livestock with a four foot fence that has at least four strands of barbed wire evenly spaced in the interval between one foot and four feet above ground level. The appropriate division district office may approve an alternative to this requirement if the operator demonstrates that an alternative provides equivalent or better protection. The appropriate division district office may impose additional fencing requirements for protection of wildlife in particular areas.

Response

As describe in Section 19.15.17.11.F, below, the modular impoundment is constructed with 12-foot high steel walls. Devon requests that the 12-ft impoundment walls serve as an alternative to the four foot barbed wire fence; the walls of the modular impoundment will provide equivalent or better protection against unauthorized access and exclude entry of livestock.

F. Temporary Pits

1. *The operator shall design and construct a temporary pit to ensure the confinement of liquids to prevent unauthorized releases.*

Response

The modular impoundment system is constructed from 5/8" thick steel welded to 4"x4"X144" vertical steel supports and is engineered to withstand the hydrostatic pressures exerted downwards and outwards by the weight of the fluid when full. The panels are connected with 1" thick steel plates that fit over solid steel "bosses" welded to the modular impoundment wall. These plates are then locked to the bosses with locking pins. The locking pins are secured with safety cotter pins. The 30 mil LLDPE liner is then clamped to the top of these walls, as shown in **Figure 12,** leaving an extra 2 feet of liner material hanging outside of the modular impoundment to provide a safety margin.

The impoundment system was designed and engineered by Beck Engineering, Ltd for Poseidon Concepts. A letter from Beck Engineering (see **Appendix B**) is stamped by a Professional Engineer and confirms that the modular impoundment is structurally designed to resist all anticipated forces on the modular impoundment panel connections from the start of erection to the complete filling of the modular impoundment. The modular impoundment is patented in Canada (see **Appendix C**). Patent is pending for the United States. Therefore,

Poseidon will not release schematics of the modular impoundment design until patenting in the United States is complete. During installation, a representative from Poseidon shall be present.

FIGURE 12
Clamping System Securing the Liner (PoseidonConcepts.com)

2. *A temporary pit shall have a properly constructed foundation and interior slopes consisting of a firm, unyielding base, and smooth and free of rocks, debris, sharp edges, or irregularities to prevent the liner's rupture or tear. The operator shall construct a temporary pit so that the slopes are not steeper than two horizontal feet to one vertical foot (2H:1V). The appropriate division district office may approve an alternative to the slope requirement if the operator demonstrates that it can construct and operate the temporary pit in a safe manner to prevent contamination of fresh water and protect public health and the environment.*

Response

The modular impoundment will be placed on the production pad for the Turquoise 27-5 well. At the time of this application, the production pad for the Turquoise 27-5 has not been constructed; however, it will be completed before any equipment required for well stimulation mobilizes to the site. The production pad will accommodate the modular impoundment without any additional site development. The proposed production pad will be constructed of approximately 10 to 12 inches of caliche overlying very dense clay. A plat of the production pad for the Turquoise 27-5 well has already been filed with the OCD.

Prior to installation of the impoundment, the production pad will be prepared to make it smooth and free of rocks. Devon Energy will remove any noticeable rocks with a diameter greater than ½ inches. A minimum of 10oz. per square foot nonwoven geotextile material from Brawler (see **Appendix D**) shall be placed between the production pad and liner of the modular impoundment to prevent liner rupture or tear form the underlying pad.

In lieu of slopes no greater than 2H:1V, Devon Energy asks for administrative approval for vertical slopes (steel walls) engineered for the modular impoundment. The modular impoundment's vertical steel walls are constructed from 5/8" thick steel welded to 4"x4"x144" vertical steel supports and is engineered to withstand the hydrostatic pressures exerted downward and outward by the weight of the fluid when full. The panels are connected with 1" thick steel plates that fit over solid steel "bosses" welded to the modular impoundment wall. These plates are then locked to the bosses with locking pins. The locking pins are secured with safety cotter pins. Modular impoundment integrity will not fail or collapse because of the engineered design specifications.

The inside of the panels will be foam insulated to reduce the concerns of the liner being punctured. The top lip of the impoundment, over which the liner will be clamped, will have rounded edges to prevent any stresses which

may cause the liner to tear. Additionally, geotextile will be installed such that the geotextile covers all surfaces of the impoundment with which the liner comes in contact, including the panel walls and rounded edge of the impoundment.

A sump area in the configuration of a "Y", with each leg approximately 15 feet long, shall be excavated into the production pad to accommodate the modular impoundment suction pipes. The sump area will be excavated 18" below the elevation of the production pad and each leg of the sump will have a width of approximately 16" in order to accommodate a 10" suction hose. The slope of the sump walls shall be no greater than 2H:1V. An additional layer of 10oz. per square foot nonwoven geotextile material will be placed in the sump and covered with a 30-mil LLDPE liner.

3. *The operator shall design and construct a temporary pit with a geomembrane liner. The geomembrane liner shall consist of 20-mil string reinforced LLDPE or equivalent liner material that the appropriate division district office approves. The geomembrane liner shall be composed of an impervious, synthetic material that is resistant to petroleum hydrocarbons, salts, and acidic and alkaline solutions. The liner material shall be resistant to ultraviolet light. Liner compatibility shall comply with EPA SW-846 method 9090A.*

Response

In lieu of a 20-mil string reinforced LLDPE liner, Devon Energy asks for administrative approval for a stronger and thicker 30-mil LLDPE liner. The liner material used for the modular impoundment is a 30-mil LLDPE material provded by GSE (see **Appendix E**). The liner is resistant to petroleum, salts and acidic, alkaline solutions, and ultraviolet light. The 30-mil GSE liner is equivalent to or better than a 20-mil string reinforced LLDPE liner.

4. *The operator shall minimize liner seams and orient them up and down, not across a slope. The operator shall use factory welded seams where possible. Prior to field seaming, the operator shall overlap liners four to six inches and orient seams parallel to the line of maximum slope, i.e., oriented along, not across, the slope. The operator shall minimize the number of field seams in corners and irregularly shaped areas. Qualified personnel shall perform field seaming. The operator shall weld field liner seams.*

Response

The liner is manufactured with factory welds and seams going in one direction. The east and west oriented liner panels have a maximum width of 25 feet with 5 inch seams. The interior panels shall be 24.6 feet wide; with the width of one of the two middle panels adjusted to ensure that the overall dimension of the liner is 190x190 feet. All factory welds are designed according to GSE manufacture specifications and are engineered to withstand the weight of the water.

The outermost east-west panel liner seams are approximately 7 feet on the north-south axis from the floor-wall junction of the modular impoundment. The seam pattern, panel widths, and seam orientation will minimize liner seams and will orientate the seams up and down, no across the slope (steel walls). As shown on the liner seam orientation diagram in **Appendix F**, all of the seams of the 25 foot wide panels are in an east-west orientation. Hence, all of the seams run up and down the vertical slopes rather than across the slopes. On the north-south axis, the closest east-west seam to the bottom wall corner is 7 feet.

5. *Construction shall avoid excess stress-strain on the liner.*

Response

In accordance with the set-up procedures (see **Appendix G**), a minimum of 10oz. per square foot geotextile material is placed on any "pinch point" where the liner could either have direct contact with the walls or become pinched between walls and/or the walls and the ground, the sump area, and the C-clamps holding the liner to the top of the modular impoundment.

As shown on the liner seam orientation diagram in **Appendix F**, all of the seams of the 25 foot wide panels are in an east-west orientation. Hence, all of the seams run up and down the vertical slopes rather than across the slopes. On the north-south axis, the closest east-west seam to the bottom wall corner is 7 feet. This seam orientation prevents undue stresses and strain on the liner material and seams.

6. *Geotextile is required under the liner where needed to reduce localized stress-strain or protuberances that may otherwise compromise the liner's integrity.*

Response

A minimum of 10 oz. per square foot nonwoven geotextile will be installed such that the geotextile covers all surfaces of the impoundment with which the liner comes in contact. In accordance with the set-up procedures (see **Appendix G**), a minimum of 10oz. per square foot geotextile material is placed on any "pinch point" where the liner could either have direct contact with the walls or become pinched between walls and/or the walls and the ground, the sump area, and the C-clamps holding the liner to the top of the modular impoundment. An additional layer of 10oz. per square foot nonwoven geotextile material will be placed in the sump and covered with a 30-mil LLDPE liner

7. *The operator shall anchor the edges of all liners in the bottom of a compacted earth-filled trench. The anchor trench shall be at least 18 inches deep.*

Response

Devon Energy asks for administrative approval to utilize C-clamps and 24 inches of liner overlap in lieu of an anchor trench (**Figure 12**). The purpose of the clamps and liner overlap is to prevent the liner material from falling in and comprising the ability of the modular to contain fluids.

Each 3-foot clamp section is separated by three foot spacing. The sequence is repeated along the top of the modular impoundment. The liner and geotextile overlap the modular impoundment by at least 24 inches, providing a robust safety factor if the liner should need adjustment after installation.

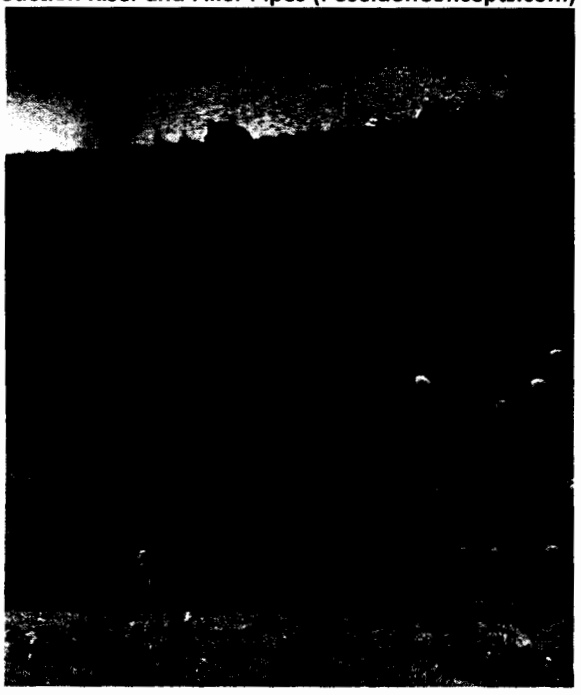
8. *The operator shall ensure that the liner is protected from any fluid force or mechanical damage at any point of discharge into or suction from the lined temporary pit.*

Response

The intake pipe for the suction system will sit on the floor in the sump area. The suction intake is a 15 foot long pipe with legs (to prevent rotation) and has horizontal slots for the fluid that are 4 inches up the side of the pipe. The suction pipe riser is a 10 inch pipe that mounts to the top of the modular impoundment and descends down the exterior wall and connects to a pump. **Figure 13** illustrates the placement of the suction and filler pipes on the modular impoundment.

FIGURE 13

Suction Riser and Filler Pipes (PoseidonConcepts.com)



The 4 inch filler pipes mount to the top of the modular impoundment in similar fashion to the suction pipe. The discharge end of the filler pipe is 4 inches from the bottom of the modular impoundment. One suction pipe and four filler pipes shall be installed on the modular impoundment.

9. *The operator shall design and construct a temporary pit to prevent run-on of surface water. A berm, ditch, proper sloping or other diversion shall surround a temporary pit to prevent run-on of surface water. During drilling operations, the edge of the temporary pit adjacent to the drilling or workover rig is not required to have run-on protection if the operator is using the temporary pit to collect liquids escaping from the drilling or workover rig and run-on will not result in a breach of the temporary pit.*

Response

A 2-foot high berm will be constructed around the perimeter of the modular impoundment to ensure that the frame of the modular impoundment is not compromised by the run-on of surface water. Since there will be no drilling or workover operations occurring while the modular impoundment is located at the site, the berm will surround the entire perimeter of the modular impoundment. The 12 foot high walls of the modular impoundment will prevent any surface run-on into the impoundment

10. *The volume of a temporary pit shall not exceed 10 acre-feet, including freeboard.*

Response

Devon will complete produced water treatment before well stimulation begins. The fluid holding capacity of the modular impoundment is 41,000 bbls (approximately 5.3 acre-ft); the volume of the impoundment less two feet of freeboard 34,100 bbls. The planned volume of treated produced water required for well stimulation is approximately 35,000 bbls. The difference in volume between the modular impoundment capacity (including freeboard) and the volume required for well stimulation of 900 bbls can be accommodated with the two 500 bbl frac tanks which are already designated to hold treated produced water after treatment and before transfer to the modular impoundment. Water transfer into the modular impoundment will only occur when personnel are onsite to ensure 2 feet of freeboard is maintained. High visibility markings will be placed on the liner to denote the maximum level for which water can rise inside the impoundment.

Operational Requirements (NMAC 19.15.17.12)

***Note**: The modular impoundment will contain treated produced water. Weekly inspections shall occur when there is 1 foot depth or less of treated produced water in the modular impoundment. Daily inspections shall occur when there is greater than 1 foot depth of treated produced water in the modular impoundment.*

A. General Specifications

Devon Energy shall maintain and operate the modular impoundment according to the manufacturer's operating and maintenance specifications as described in Section 19.15.17.12.A, below.

1. *The operator shall operate and maintain a pit to contain liquids and solids and maintain the integrity of the liner, liner system, or secondary containment system, prevent contamination of fresh water, and protect public health and the environment.*

Response

Devon Energy shall operate the modular impoundment for the temporary storage of treated produced water for on-site well stimulations. Devon Energy shall inspect the modular impoundment to ensure that a 2 foot freeboard is maintained. Devon Energy will also inspect the liner and liner system to make sure it is free from defects and leaks.

2. *The operator shall recycle, reuse, reclaim, or dispose of all drilling fluids in a manner, approved by division rules, that prevents the contamination of fresh water and protects public health and the environment.*

Response

Drilling operations will not occur during this project; therefore, this project will not require the use of any drilling fluids.

3. *The operator shall not discharge into or store hazardous waste in a pit, closed-loop system, below-grade tank, or sump.*

Response

Devon Energy shall operate the modular impoundment for the temporary storage of treated produced water for on-site well stimulation. Devon Energy shall not discharge hazardous waste into the modular impoundment.

4. *If any pit liner's integrity is compromised, or if any penetration of the liner occurs above the liquid's surface, then the operator shall notify the appropriate division district office within 48 hours of the discovery and repair the damage or replace the liner.*

Response

If the liner integrity is found to be compromised during an inspection, Devon Energy shall notify the appropriate division district office within 48 hours of the discovery and repair the damage or replace the liner.

5. *If a pit, below-grade tank, closed-loop system, or sump develops a leak, or if any penetration of the pit liner, below-grade tank, closed-loop system, or sump occurs below the liquid's surface, then the operator shall remove all liquid above the damage or leak line within 48 hour, notify the appropriate division district office within 48 hours of the discovery and repair the damage or replace the pit liner, below-grade tank, closed-loop system, or sump.*

Response

If the modular impoundment contains any volume of liquid and liner integrity is found to be compromised below the liquid's surface, Devon Energy shall remove all liquid above the damage or leak line within 48 hours, notify the appropriate division district office within 48 hours of the discovery and repair the damage or replace the modular impoundment's liner.

6. *The injection or withdrawal of liquids from a pit shall be accomplished through a header, diverter, or other hardware that prevents damage to the liner by erosion, fluid jets, or impact from installation and removal of hoses or pipes.*

Response

Inspections shall verify that suction (intake), riser and filler pipes are intact and properly connected and secured. The intake pipe for the suction system will sit on the floor in the sump area. The suction intake is a 15 foot long pipe with legs (to prevent rotation). The suction pipe riser is a 10 inch pipe that mounts to the top of the modular impoundment and descends down the exterior wall and connects to a pump. The 4 inch filler pipes mount to the top of the modular impoundment in similar fashion to the suction pipe. The discharge end of the filler pipe is 4 inches from the bottom of the modular impoundment bottom to prevent damage to the liner by discharging operations.

7. *The operator shall operate and install a pit, below-grade tank, or sump to prevent the collection of surface water run-on.*

Response

The modular impoundment's 12 foot high steel walls will prevent the collection of surface water run-on. A 2-foot high berm will be constructed around the perimeter of the modular impoundment to ensure that the frame of the modular impoundment is not compromised by the run-on of surface water.

8. *The operator shall install, or maintain on site, an oil absorbent boom or other device to contain and remove oil from a pit's surface.*

Response

Devon Energy shall verify that no oil is on the modular impoundment surface. If oil is observed, the oil shall be removed using an absorbent boom or other device and properly disposed at an approved facility.

B. Temporary Pits

An operator shall maintain and operate a temporary pit in accordance with the following additional requirements.

1. *Only fluids used or generated during the drilling or workover process may be discharged into a temporary pit. The operator shall maintain a temporary pit free of miscellaneous solid waste or debris. The operator shall use a tank made of steel or other material, which the appropriate division district office approves, to contain hydrocarbon based drilling fluids. Immediately after cessation of a drilling or workover operation, the operator shall remove any visible or measurable layer of oil from the surface of a drilling or workover pit.*

Response

The modular impoundment shall be used for the temporary storage of treated produced water for well stimulation. No other fluids other than treated produced water shall be discharged into the modular impoundment.

2. *The operator shall maintain at least two feet of freeboard for a temporary pit.*

Response

The modular impoundment shall be inspected daily by Devon Energy when containing more than 1 foot of treated produced water to ensure that a 2 foot freeboard is maintained. The fluid holding capacity of the modular impoundment is 41,000 bbls (approximately 5.3 acre-ft); the volume of the impoundment less two feet of freeboard 34,100 bbls. The planned volume of treated produced water required for well stimulation is approximately 35,000 bbls. The difference in volume between the modular impoundment capacity (including freeboard) and the volume required for well stimulation of 900 bbls can be accommodated with the two 500 bbl frac tanks which are already designated to hold treated produced water after treatment and before transfer to the modular impoundment. Water transfer into the modular impoundment will only occur when personnel are onsite to ensure 2 feet of freeboard is maintained. High visibility markings will be placed on the liner to denote the maximum level for which water is allowed to rise inside the impoundment.

3. *The operator shall inspect a temporary pit containing drilling fluids at least daily while the drilling or workover rig is on-site. Thereafter, the operator shall inspect the temporary pit weekly so long as liquids remain in the temporary pit. The operator shall maintain a log of such inspections and make the log available for the appropriate division district office's review upon request. The operator shall file a copy of the log with the appropriate division district office when the operator closes the temporary pit.*

Response

Devon Energy shall inspect the modular impoundment daily when containing more than 1 foot of treated produced water for: liner integrity, to ensure that a 2 foot freeboard is maintained, and to prevent the presence of oil on the fluid surface. When less than one foot or less of treated produced water is present in the modular impoundment, Devon Energy shall inspect weekly. A log of these inspections shall be maintained by Devon Energy and made available upon division request. The log shall be filed with the modular impoundment closure report.

4. *The operator shall remove all free liquids from a temporary pit within 30 days from the date that the operator releases the drilling or workover rig. The operator shall note the date of the drilling or workover rig's release on form C-105 or C-103 upon well of workover completion. The appropriate division district office may grant an extension of up to three months.*

Response

The purpose of the modular impoundment is to provide fluid for a single on-site well stimulation. The well stimulation will require approximately 35,000 bbls of treated produced water. The modular impoundment is not associated with a drilling or workover rig. After the stimulation is complete, Devon Energy will within 4 days remove any remaining treated produced water from the modular impoundment and mobilize the impoundment from the site. Since the modular impoundment is not associated with a drilling or workover rig, Devon Energy shall mark the transfer completion date on the C-144 and C-105 in lieu of rig release date.

Closure Requirements (19.15.17.13)

A. Time Requirements for Closure per NMAC 19.15.17.13

An operator shall close and other permitted temporary pit within six months from the date that the operator releases the drilling or workover rig. The appropriate division district office may grant an extension not to exceed three months.

Response

After the completion of the well stimulation, Devon Energy shall within 9 days close the modular impoundment. The modular impoundment is not associated with a drilling or workover rig.

B. Closure Methods for Temporary Pits

1. *Waste excavation and removal:*
    a. *The operator shall close the temporary pit by excavating all contents and, if applicable, synthetic pit liners and transferring those materials to a division approved facility.*

Response

Prior to disassembly of the modular impoundment, the impoundments liner will be power-washed with freshwater to remove any residual treated produced water. This comingled treated produced water will flow into the impoundment's sump where it will be pumped to a vacuum truck operated by Basic Energy Servces, LP. Basic Energy Services, LP is an approved OCD hauler (C133-401) and will transport all remaining produced water from the Turquoise-27-5 for disposal via injection at the SWD-964 (API 30-015-22955) or SWD-391 (API 30-015-21515) wells, both operated by Basic Energy Services, LP.

After the remaining fluid is removed, any solid materials associated with the Atlantis modular impoundment such as liners, pipes, etc., which upon inspection are identified as not suitable for reuse, shall be transported to one of the following division approved facilities and accompanied by a C-138 manifest:

- R360 Permian Basin, LLC NM-1-006/R-9166
- Lea Land, LLC NM-1-0035

    b. *The operator shall test the soils beneath the temporary pit to determine whether a release has occurred.*

        i. *For temporary pits where groundwater is between 50 and 100 feet below the bottom of the temporary pit or for cavitation pits allowed pursuant to Subparagraph (a) of Paragraph (1) of Subsection (A) of 19.15.17.10 NMAC, the operator shall collect, at a minimum, a five point, composite sample; collect individual grab samples from any area that is wet, discolored, or showing other evidence of a release; and analyze for benzene, total BTEX, TPH, the GRO, and DRO combined fraction and chlorides to demonstrate that benzene, as determined by EPA SW-846 method 8021B or 8260B or other EPA method that the division approves, does not exceed 0.2 mg/kg; total BTEX, as determined by EPA SE-846 method 8021B or 8260B or other EPA method that the division approves, does not exceed 50 mg/kg; TPH , as determined by EPA SW-846 method 418.1 or other EPA method that the division approves, does not exceed 2500 mg/kg; the GRO and DRO combined fraction, as determined by EPA SW-846 method 8015M, does not exceed 500 mg/kg; and chlorides, as determined by EPA method 300.1, does not exceed 500 mg/kg or the background concentration, whichever is greater. The operator shall notify the division of its results on form C-141. The division may require additional delineation upon review of the results*

Response

Devon Energy shall collect a five point composite sample comprised of samples taken from the center point of the modular impoundment footprint and 40 foot offsets to the North, South, East, and West of the centerpoint. Devon will also collect individual grab samples from any area under the liner that is wet, discolored, or showing other evidence of a release. All samples will be analyzed for benzene (EPA 8260B), total BTEX (EPA 8260B), TPH

(EPA 418.1), the GRO and DRO combined fraction (EPA SW-846 method 8015M) and chlorides (EPA 300.1). Devon Energy shall notify the division of its results on form C-141.

c. *If the operator or the division determines that a release has occurred, then the operator shall comply with 19.15.29 NMAC and 19.15.30 NMAC, as appropriate.*

Response
If the division or Devon Energy determines that a release has occurred, then the operator shall comply with 19.15.29 NMAC and 19.15.30 NMAC, as appropriate.

d. *If the sampling program demonstrates that a release has not occurred or that any release does not exceed the concentrations specified in Subparagraph (b) of Paragraph (1) of Subsection B of 19.15.17.13 NMAC, then the operator shall backfill the temporary pit excavation with compacted, non-waste containing earthen material; construct a division prescribed soil cover; recontour and re-vegetate the site. The division prescribed soil cover, recontouring, and re-vegetation requirements shall comply with Subsections G, H, and I of 19.15.17.13 NMAC*

Response
The modular impoundment is an above the ground modular impoundment, no backfilling is necessary except for the "Y" shaped sump area that has an excavated depth of 18 inches. The sump area will be filled and compacted with non-waste containing clay and topped with 10 to 12 inches of caliche to match existing production pad construction and grade. Devon will reclaim the site of the modular impoundment as an active production pad. Because this production pad is associated with an active well, the production pad will remain in place until the well site is closed, at which point construction of division prescribed soil cover, recontouring, and re-vegetation of the site will occur.

G. Reclamation of Pit Locations, On-Site Burial Locations, and Drying Pad Locations

1. *Once the operator has closed a pit or trench or is no longer using a drying pad, below-grade tank, or an area associated with a closed-loop system, pit, trench, or below grade tank, the operator shall reclaim the pit location, drying pad location, below-grade tank location, or trench location and all areas associated access roads to a safe and stable condition that blends with the surrounding undisturbed area. The operator shall substantially restore the impacted surface area to the condition that existed prior to oil and gas operations by placement of the soil cover as provided in Subsection H of 19.15.17.13 NMAC, recontour the location and associated areas to a contour that approximates the original contour and blends with the surrounding topography and re-vegetate according to Subsection I of 19.15.17.13 NMAC.*

Response
The modular impoundment will be located on the production pad for the Turquoise 27-5 well. Once the impoundment is removed, Devon will reclaim the location of the impoundment as an active production pad. This production pad will remain in place until the well is closed. As such, the impacted surface area will not be restored to conditions existing prior to oil and gas exploration operations until the well is closed.

2. *The operator may propose an alternative to the re-vegetation requirement if the operator demonstrates that the proposed alternative effectively prevents erosion, and protects fresh water, human health, and the environment. The proposed alternative shall be agreed upon by the surface owner. The operator shall submit the proposed alternative, with written documentation that the surface owner agrees to the alternative, to the division for approval.*

Response
Devon Energy will reclaim the location of the modular impoundment as a production pad for the Turquoise 27-5 well. Since this will be an active production pad, re-vegetation of the site will not occur until the time at which the well is closed. The proposed alternative to re-vegetation, along with written documentation from the State Land Office agreeing to the alternative, is included in **Appendix H.**

H. Soil Cover Designs

1. *The soil cover for closures where the operator has removed the pit contents or remediated the contaminated soil to the division's satisfaction shall consist of the background thickness of topsoil or one foot of suitable material to establish vegetation at the site, whichever is greater.*

Response

Devon Energy will reclaim the modular impoundment site as an active production pad for the Turquoise 27-5 well. Since this will be an active production pad, soil cover will not be applied to the site until the well is closed. Any contaminated material excavated during closure of the modular impoundment will be replaced with non-contaminated identical material in order to restore the production pad.

2. *The operator shall construct the soil cover to the site's existing grade and prevent ponding of water and erosion of the cover material.*

Response

Devon Energy will reclaim the modular impoundment site as an active production pad for the Turquoise 27-5 well. Soil cover will not be applied until the well is closed.

Re-vegetation

Response

Devon Energy asks the division to allow interim reclamation to reclaim the site as an active production pad in accordance to the alternative to re-vegetation agreement with the State Land Office, included in **Appendix H**.

I. Closure Notice

1. *The operator shall notify the surface owner by certified mail, return receipt requested, that the operator plans to close a temporary pit, a permanent pit, a below-grade tank, or where the operator has approval for on-site closure. Evidence of mailing of the notice to the address of the surface owner shown in the county tax records is sufficient to demonstrate compliance with this requirement.*

Response

Devon Energy shall notify the State Land Office by certified mail, return receipt requested, that Devon Energy plans to close a modular impoundment.

2. *The operator of a temporary pit or below-grade tank or an operator who is approved for on-site closure shall notify the appropriate division district office verbally or by other means at least 72 hours, but not more than one week, prior to any closure operation. The notice shall include the operator's name and the location to be closed by unit letter, section, township and range. If the closure is associated with a particular well, then the notice shall also include the well's name, number, and API number.*

Response

Devon Energy shall notify the appropriate division district office verbally or by other means at least 72 hours, but not more than one week, prior to any closure operation. The notice shall include the operator's name and the location to be closed by unit letter, section, township and range, the well's name, number, and API number.

J. Closure Report

Within 60 days of closure completion, the operator shall submit a closure report on form C-144, with necessary attachments to document all closure activities including sampling results; information required by 19.15.17 NMAC; a plot plan; and details on back-filling, capping and covering, where applicable. In the closure report, the operator shall certify that all information in the report and attachments is correct and that the operator has complied with all applicable closure requirements and conditions specified in the approved closure plan. If the operator used a temporary pit, the operator shall provide a plat of the pit location on form C-105 within 60 days of closing the temporary pit.

Response

Within 60 days of closure completion, Devon Energy shall submit a closure report on form C-144, with necessary attachments documenting all closure activities including sampling results; information required by 19.15.17 NMAC; a plot plan; and details on reclaiming the site as a production pad. In the closure report, Devon Energy shall certify that all information in the report and attachments and conditions specified in the approved closure plan. Devon Energy shall provide a plat of the pit location on form C-105 within 60 days of closing the modular impoundment.

Appendix A: Site Visit Photographs

Appendix B: Beck Engineering Letter

Beck
ENGINEERING (1992) LTD.

August 26, 2011
Doc. 11341M1101

Poseidon Concepts Ltd.
1100, 645 - 7th Ave SW
Calgary, Alberta T2P 4G8

Attention: To Whom It May Concern

Re: Atlantis, Poseidon & Triton Modular Tanks

This letter confirms that Beck Engineering (1992) Ltd. has designed and engineered the Poseidon Concepts modular tanks. Specifically, Beck Engineering has designed and reviewed the 6500m^3 "Atlantis", the 2900m^3 "Poseidon" and the 1440m^3 "Triton" models.

Beck Engineering has structurally designed the tank wall panels and panel connections to fully withstand all forces and stresses that the modular tank may be subject to during transport, erection, filling and emptying the tank. Hydrostatic forces, considering a specific gravity of 1.05 have been considered during design of all components. Further, the modular tanks system has been designed to withstand the forces and stresses generated by potential out-of-plumb and out-of-round installation conditions.

The modular tanks have been designed in accordance with accepted engineering principles with reference to CSA S16 "Limit States Design of Steel Structures" as applicable. The total (von Mises) stress condition has also been considered for all components within the modular tank system including the panel connections. All stresses within the modular tank system components have been limited to ensure a minimum Factor of Safety of 3.0 has been maintained throughout the modular system. Beck Engineering has also provided signed and sealed erection procedures and ground preparation requirements.

The Poseidon, Atlantis and Triton modular tanks models are structurally designed to resist all anticipated forces on the tank panels and panel connections from the start of erection to the complete filling of the tank. The modular tank systems have been designed considering all hydrostatic forces, the associated tension developed in the wall panels and the tension forces and associated out-of-plane and out-of-plumb forces developed within the panel connections. Further consideration has been given to the forces and stresses introduced during erection considering lifting and handling and wind forces during assembly.

Beck Engineering has provided Poseidon Concepts (via Open Range Energy Corp.) with signed and sealed drawings showing all required connection details and material specifications as necessary for fabrication of the 3 modular tank models described herein.

I trust this is the information you currently require. Beck Engineering would be pleased to provide further information as necessary within the limits of our confidentiality obligations to Poseidon Concepts.

Regards,
Beck Engineering (1992) Ltd.
APEGGA Permit No. 20[illegible]

Michael Hayden, P.Eng.

Appendix C: Canadian Patent and U.S. Patent Application

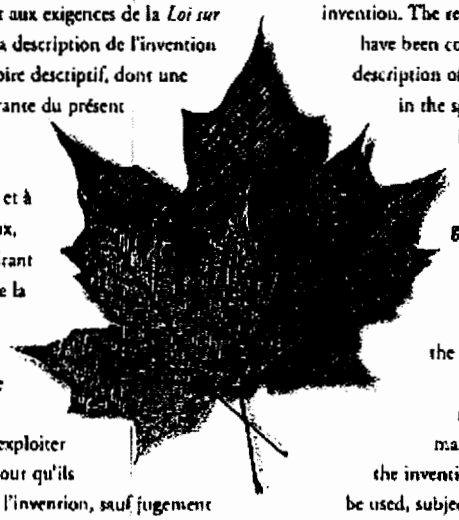
Office de la propriété intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An Agency of Industry Canada

Brevet canadien / Canadian Patent

♆ Le commissaire aux brevets a reçu une demande de délivrance de brevet visant une invention. Ladite requête satisfait aux exigences de la *Loi sur les brevets*. Le titre et la description de l'invention figurent dans le mémoire descriptif, dont une copie fait partie intégrante du présent document.

Le présent brevet confère à son titulaire et à ses représentants légaux, pour une période expirant vingt ans à compter de la date du dépôt de la demande au Canada, le droit, la faculté et le privilège exclusif de fabriquer, construire, exploiter et vendre à d'autres, pour qu'ils l'exploitent, l'objet de l'invention, sauf jugement en l'espèce rendu par un tribunal compétent, et sous réserve du paiement des taxes périodiques.



♆ The Commissioner of Patents has received a petition for the grant of a patent for an invention. The requirements of the *Patent Act* have been complied with. The title and a description of the invention are contained in the specification, a copy of which forms an integral part of this document.

The present patent grants to its owner and to the legal representatives of its owner, for a term which expires twenty years from the filing date of the application in Canada, the exclusive right, privilege and liberty of making, constructing and using the invention and selling it to others to be used, subject to adjudication before any court of competent jurisdiction, and subject to the payment of maintenance fees.

BREVET CANADIEN **2,692,016** CANADIAN PATENT

Date à laquelle le brevet a été accordé et délivré	**2011/07/19**	Date on which the patent was granted and issued
Date du dépôt de la demande	**2010/02/05**	Filing date of the application
Date à laquelle la demande est devenue accessible au public pour consultation	**2010/07/05**	Date on which the application was made available for public inspection

Commissaire aux brevets / Commissioner of Patents

Canada

3256 (CIPO 91) 01/06

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Office de la Propriété Intellectuelle du Canada
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Canadian Intellectual Property Office
An agency of Industry Canada

CA 2692016 C 2011/07/19

(11)(21) 2 692 016

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 2010/02/05

(41) Mise à la disp. pub./Open to Public Insp.: 2010/07/05

(45) Date de délivrance/Issue Date: 2011/07/19

(51) Cl.Int./Int.Cl. *B65D 5/42* (2006.01)
B65D 5/44 (2006.01)

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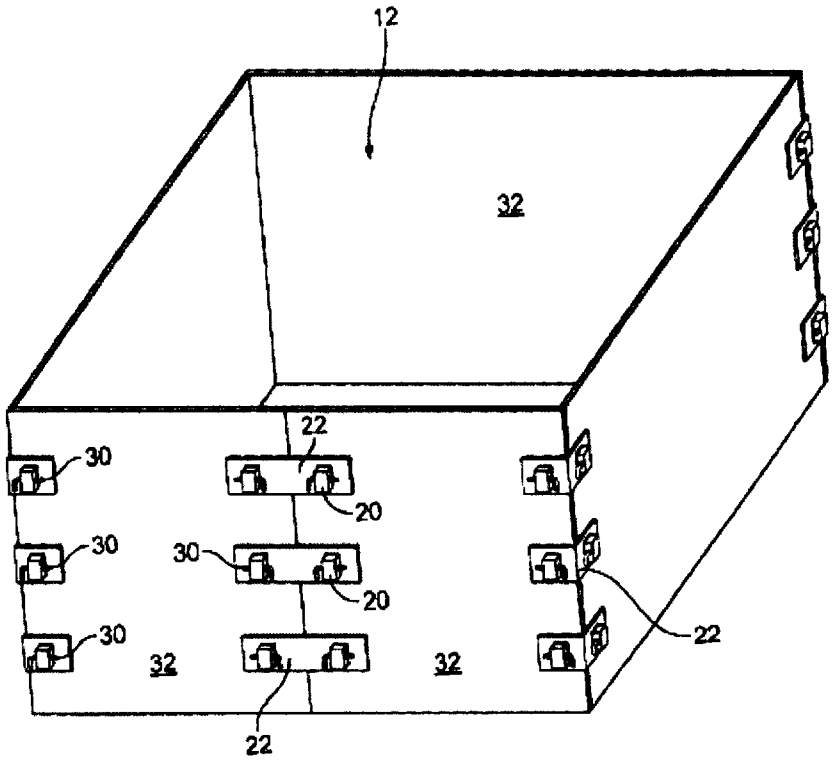
(54) Titre : ENSEMBLE DE FIXATION DE RECIPIENTS
(54) Title: CONTAINER FASTENING ASSEMBLY



(57) Abrégé/Abstract:
A connection arrangement for connection of vertically and/or horizontally arranged containers. Each of the containers provides bosses or projections over a collinear pair of which is placed a separate plate. The plate provides matched polygonal apertures to

(57) Abrégé(suite)/Abstract(continued):
receive the projections. Each of the projections provides an aperture there through to receive a retainer pin or bolt. the pin or bolt abuts the plate when engaged. The arrangement greatly expedites the separation of the containers when desired. The user need only tap out the retainer pin and pull off the plate. This obviates the use of fasteners which can freeze, rust or become otherwise inoperative or cumbersome.

ABSTRACT

A connection arrangement for connection of vertically and/or horizontally arranged containers. Each of the containers provides bosses or projections over a collinear pair of which is placed a separate plate. The plate provides matched polygonal apertures to receive the projections. Each of the projections provides an aperture there through to receive a retainer pin or bolt. the pin or bolt abuts the plate when engaged. The arrangement greatly expedites the separation of the containers when desired. The user need only tap out the retainer pin and pull off the plate. This obviates the use of fasteners which can freeze, rust or become otherwise inoperative or cumbersome.

CONTAINER FASTENING ASSEMBLY

TECHNICAL FIELD

The present invention relates to fasteners for modular containers/enclosures and more particularly , the present invention relate to a fastening assembly which is expeditiously removed and assembled to allow separation and assembly of the containers by the user without the need to unfasten bolts etc.

BACKGROUND OF THE INVENTION

Fastening assemblies of a broad variety have been used for some time in connecting modular containers and panels or segments making up the enclosures or containers. Contributory to the problem with the fastening arrangements known is that they are not designed for simplicity of use and with the least number of parts. It is well known that the nut and bolt or other mechanical arrangements are very often overly complex for the purpose of securing containers together. In the bolt system, the user is often faced with rusted connectors which are difficult if not impossible sometimes to disconnect. This often leads to complete destruction of the fastener and potential damage to the container which elevates costs for wasted time, materials and repairs.

As a further problem, the possibility of attempting to remove nuts from bolts etc. in inclement weather such as freezing weather becomes exceedingly difficult considering the clothing the user must wear to stay warm. The result is that the user often must at least remove hand protection to operate a wrench etc., thus introducing the possibility of frostbite or other exposure.

The prior art is replete with as many variations of fastening systems, all of which are not designed for user ease.

SUMMARY OF THE INVENTION

One object of the invention is to provide an improved fastening assembly for fastening adjacent containers.

A further object of one embodiment is to provide a connection assembly for connecting similar containers, comprising, in combination:

a first container and a second container in contact;

first cooperating engagement means projecting from each container of the containers, the first cooperating engagement means being in alignment on containers in contact;

second cooperating engagement means adapted for overlying releasable engagement with the first cooperating engagement means, the second cooperating means having a configuration matched in shape to the first cooperating engagement means, the first cooperating engagement means extending beyond the second cooperating engagement means when the second cooperating engagement means overlies the first cooperating engagement means;

third cooperating engagement means integral with the first cooperating engagement means; and

fourth cooperating engagement means adapted for releasable engagement with the third cooperating engagement means and for retaining the second cooperating engagement means when overlying the first cooperating engagement means, whereby when the first cooperating engagement means receives the second cooperating engagement means and the third cooperating engagement means receives the fourth cooperating engagement means, each container is connected and secured against substantial vertical and horizontal separation.

The arrangement has been found to be particularly simple to use in any weather conditions. The first cooperating engagement means in one embodiment comprises a polygonal boss or projection extending outwardly from each adjacently positioned container.

The second cooperating engagement means comprises, in one embodiment, a plate adapted to overly the bosses. The plate is provided with apertures matched in configuration to the bosses. It is preferred that the shape of the bosses and the plate apertures be selected from a polygonal repertoire; circular arrangements do not provide any protection for horizontal and/or vertical movement between adjacent containers. The polygonal shape is advantageous to avoid such potentially hazardous and damaging movement. Further, the distance between the bosses of contacted containers is identical to a vertical distance between the bosses of an individual container.

The bosses are horizontally and vertically collinear to allow any plate to be used over any projections.

With respect to the fourth cooperating engagement means, the same may comprise in one possible embodiment, a pin or L bolt which is simply inserted in to the aperture extending through each boss.

The arrangement is particularly convenient, since a user wishing to disconnect connected containers, simply pushes out the pin from each boss and pulls the plate free of the bosses.

A further object of one embodiment of the present invention is to provide a connection assembly for connecting similar containers, comprising, in combination:

a first container and a second container in contact;

a plurality of projections projecting from each container of the containers arranged in alignment on containers in contact;

a separate plate member adapted for overlying releasable engagement with the projections projecting from each container, the plate having apertures matched in shape to the projections, the projections extending beyond the plate when in overlying relation with the projections;

aperture means extending through the projections; and

retainer means adapted for releasable engagement with the aperture means, whereby when the projections receive the separate plate and the aperture means receives the retainer means, each container is connected and secured against substantial vertical and horizontal separation.

Yet another object of one embodiment of the present invention is to provide a modular container, comprising:

a plurality of separate container wall segments adapted for releasable connection with each other to form a container or enclosure;

first cooperating engagement means projecting from each container wall segment of the containers, the first cooperating engagement means being in alignment on each container wall segment;

second cooperating engagement means adapted for overlying releasable engagement with the first cooperating engagement means, the second cooperating

means having a configuration matched in shape to the first cooperating engagement means, the first cooperating engagement means extending beyond the second cooperating engagement means when the second cooperating engagement means overlies the first cooperating engagement means;

third cooperating engagement means integral with the first cooperating engagement means; and

fourth cooperating engagement means adapted for releasable engagement with the third cooperating engagement means and for retaining the second cooperating engagement means when overlying the first cooperating engagement means, whereby when the first cooperating engagement means receives the second cooperating engagement means and the third cooperating engagement means receives the fourth cooperating engagement means, each container wall segment is connected forming a container or enclosure and secured against substantial vertical and horizontal separation.

Advantageously, the use of the cooperating engagement means significantly reduces the time required to assemble and disassemble the enclosure or container and presents a marked benefit over existing arrangements.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of the container arrangement and fastening assembly according to one embodiment;

Figure 2 is an enlarged view of the assembly illustrated in Figure 1;

Figure 3 is an enlarged view of Figure 2;

Figure 4 is a section along line 4-4 of Figure 3;

Figures 5A through 5D illustrate alternate embodiments of Figure 3;

Figure 6 is an illustration of an alternate embodiment of the present invention; and

Figure 7 is an illustration of yet another alternate embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to Figure 1, shown is a perspective view of a first embodiment of the present invention. Numeral 10, generally refers to the arrangement. Large containers 12 for storage of, for example, water are desirably connected together for modulation at a site. The overall fastening assembly is referenced by numeral 14 and is more detailed in Figure 2.

Each container 12 is positioned for contact with an adjacent container 12 at an interface16. A wall or extension 18 is provided on each container 12 for abutment with a similar component from the adjacent container 12. Each wall 18 includes a plurality of projecting bosses 20 extending outwardly in parallel planar relation from wall 18. The bosses 20 function as a first cooperating engagement. The bosses 20 may be welded to the walls 18. The bosses 20 on an individual container 12 are arranged in collinear equidistant relation and are horizontally aligned when walls 18 are abutted between containers 12. The horizontal distance between bosses 20 of adjacent containers, in this embodiment is the same and this is true of the spacing of bosses on an individual container 12.

With reference to Figure 3, shown is an enlarged view of the arrangement. The bosses 20, shown in the example as having a rectangular shape, receive, in overlying relation, a second releasable cooperating engagement member 22. The member 22 is shown in the example as a plate. The plate 22 has spaced apart apertures 24 which receive the bosses 20. The boss 20 shape and aperture 24 are configured for cooperation.

Plate 22 may comprise a similar material of which the containers 12 are made, such as steel. The plate 22 is dimensioned to overlie the interface of abutment, referenced by numeral 16, of the adjacent containers 12. The plate is also dimensioned to be of a lesser thickness than the height of the bosses 20. In this manner, the plate 22 can be loosely retained on the bosses 20 in a parallel plane to the walls 18.

In order to further assist in retaining the plate 22 on the bosses 20, a third releasably engageable cooperating means in the form of an aperture 28 (chain line) cooperates with a fourth releasably engageable cooperating means in the form of, for example, a pin or L-bolt 30. As is illustrated in the example, the pin 30 is received within the aperture

28. The reception is such that the pin 30 abuts the surface of the plate 22. This relationship ensures that the plate 22 remains snugly against the walls 18. The former relationship is depicted in Figure 4.

The Figures illustrate the boss 20 shape as a rectangle. This is useful when combined with a keyed or matched configuration in the plate 22 to reduce if not eliminate any vertical or horizontal movement of connected containers. Any suitable polygonal shape is envisioned as a possibility. Figures 5A through 5D illustrate a number of variations for the plate 22 in terms of the apertures 24 being diamond, square, hexagonal and generally square in shape. The bosses 20 would obviously have a keyed shape for cooperation. In addition, Figures 5A through 5D show variations on the shape and disposition of the pins or L bolts 30. The pins or bolts may be inserted into the aperture 28 of the bosses 20 vertically, horizontally or angularly. Further, the pins may be of a varying dimension, i.e. conical, straight, or bent. As a further variation, the plate 22 may comprise any suitable shape variations of which are shown in Figures 5C and 5D with a generally dumbbell configuration. Other variations will be appreciated by those skilled.

Referring now to Figure 6, shown is another alternate embodiment of the present invention.

In this embodiment, two bosses 20, a pair from each container 12 are connected by a modified plate 22'. In this embodiment, two plates are joined by joining members 32, shown in the example to be vertical arms. Any suitable configuration to achieve this end is possible and will be appreciated by those skilled. Further, any number of bosses 20 may be connected.

Referring now to Figure 7, shown is a further variation of the present invention. In this embodiment, the container 12 is formed of a plurality of individual wall segments 32. Each segment includes the bosses 20 which cooperate with an adjacent segment 32 in a manner similar to that discussed with respect to the previous embodiments. Plate 22 joins the adjacent segments. Conveniently, the intersection of two segments at a corner can be easily accommodated by modifying plate 22 by a right angle bend as shown in the illustration. In situations where the angle required is acute or obtuse, the plate will be modified accordingly.

Although embodiments of the invention have been described above, it is not limited thereto and it will be apparent to those skilled in the art that numerous modifications form part of the present invention insofar as they do not depart from the spirit, nature and scope of the claimed and described invention.

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WE CLAIM:

1. A connection assembly for connecting similar containers, comprising, in combination:

a first container and a second container in contact;

boss means integral with and projecting outwardly from an extension wall of each said container of said containers, said boss means being in horizontal alignment on containers to be connected;

a second cooperating engagement member for overlying releasable engagement with at least a pair of said boss means of containers to be connected, said second cooperating engagement member being independent of each said container, said second cooperating member having a configuration matched in shape to said boss means, said boss means extending beyond said second cooperating engagement member when said second cooperating engagement member overlies said boss means, said second cooperating engagement member when engaged with said boss means overlies a contact interface of connected containers;

third cooperating engagement means integral with said boss means; and

fourth cooperating engagement means adapted for releasable engagement with said third cooperating engagement means and for retaining said second cooperating engagement member when overlying said boss means, connection between containers being effected solely when said boss means receives said second cooperating engagement member and said third cooperating engagement means receives said fourth cooperating engagement means, each said container is connected and secured against substantial vertical and horizontal separation.

2. The combination as set forth in claim 1, wherein said second cooperating engagement member is separate and unconnected to each said container.

3. The combination as set forth in claim 1, wherein each container has a plurality of projecting boss means in vertical spaced relation.

4. The combination as set forth in claim 3, wherein said projecting boss means are in collinear arrangement.

5. The combination as set forth in claim 1, wherein said boss means of said first container and said second container are in a collinear arrangement.

6. The combination as set forth in claim 2, wherein said second cooperating engagement member comprises a removable plate.

7. The combination as set forth in claim 1, wherein a horizontal distance between said boss means between contacted containers is identical to a vertical distance between said boss means of an individual container of said first container and said second container.

8. The combination as set forth in claim 1, wherein at least a boss means between adjacent containers is connected.

9. The combination as set forth in claim 1, wherein said third cooperating engagement means comprises an aperture extending through said boss means.

10. The combination as set forth in claim 1, wherein said fourth cooperating engagement means comprises a separate member unconnected to said container.

11. The combination as set forth in claim 10, wherein said fourth cooperating engagement means comprises an L-shaped pin releasably connectable within said third cooperating engagement means.

12. The combination as set forth in claim 1, wherein said fourth cooperating engagement means, when engaged with said third cooperating engagement means, abuts said second cooperating engagement member.

13. The combination as set forth in claim 1, wherein said first container and said second container are arranged in horizontal disposition.

14. The combination as set forth in claim 1, wherein said first container and said second container are arranged in vertical disposition.

15. The combination as set forth in claim 1, wherein said boss means and said second cooperating engagement member have matched polygonal shapes.

16. A connection assembly for connecting similar containers, comprising, in combination:

a first container and a second container in contact;

a plurality of projections projecting from the walls of each container of said containers arranged in alignment on containers in contact;

a separate plate member for overlying releasable engagement with said projections projecting from each container, said separate plate member being independent of each said container, said plate having apertures matched in shape to said projections, said projections extending beyond said plate when in overlying relation with said projections;

aperture means extending through said projections; and

retainer means adapted for releasable engagement with said aperture means, connection between containers being effected solely when said projections receive said separate plate and said aperture means receives said retainer means, each said container is connected and secured against substantial vertical and horizontal separation.

17. A modular container, comprising:

a plurality of separate container wall segments adapted for releasable connection with each other to form a container or enclosure;

boss means projecting from each said container wall segment of said containers, said boss means being in alignment on each container wall segment;

a second cooperating engagement plate for overlying releasable engagement with at least a pair of said boss means of each juxtaposed wall, said second cooperating engagement member being independent of said container wall segments, said second cooperating plate having a configuration matched in shape to said boss means, said boss means extending beyond said second cooperating engagement means when said second cooperating engagement plate overlies said boss means of juxtaposed walls;

third cooperating engagement means integral with said boss means; and

fourth cooperating engagement means adapted for releasable engagement with said third cooperating engagement means and for retaining said second cooperating engagement member when overlying said first cooperating engagement means, formation of said container being effected solely by said boss means being received in said second cooperating engagement member and when said third cooperating engagement means is received in said fourth cooperating engagement means, whereby said container or enclosure is secured against substantial vertical and horizontal separation.

18. The container as set forth in claim 17, wherein said plate is planar.

19. The container as set forth in claim 17, wherein said plate is angular.

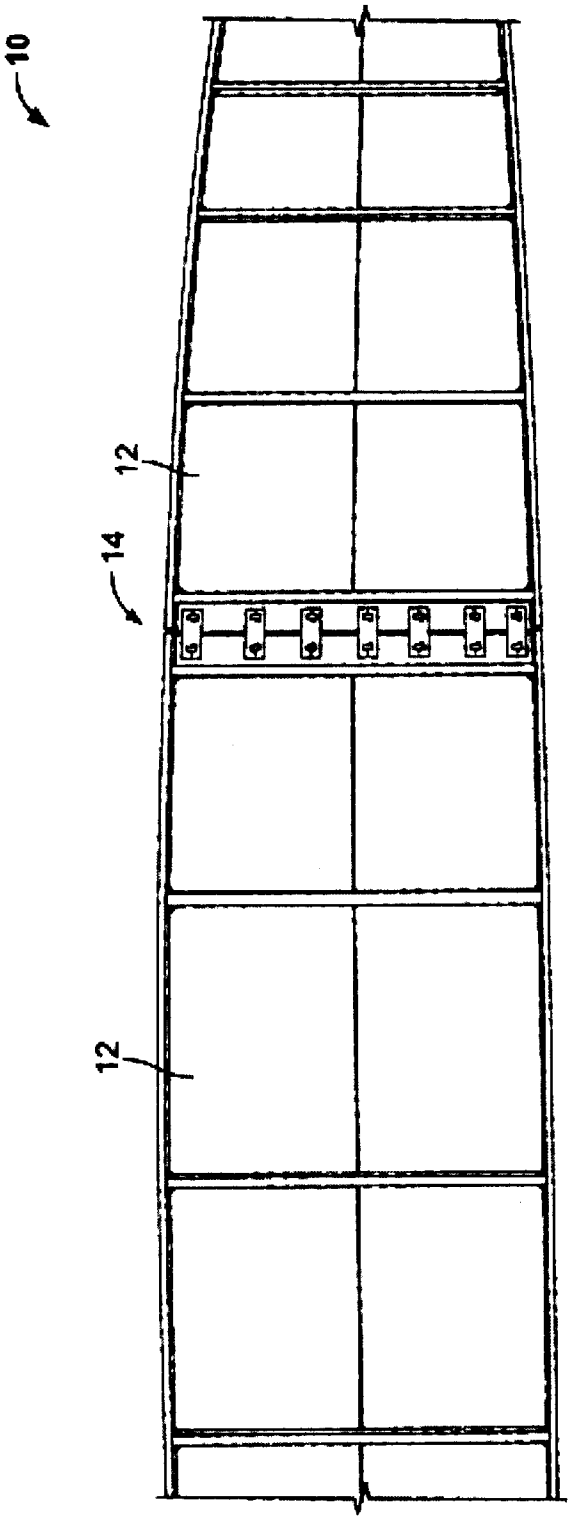

FIG. 1

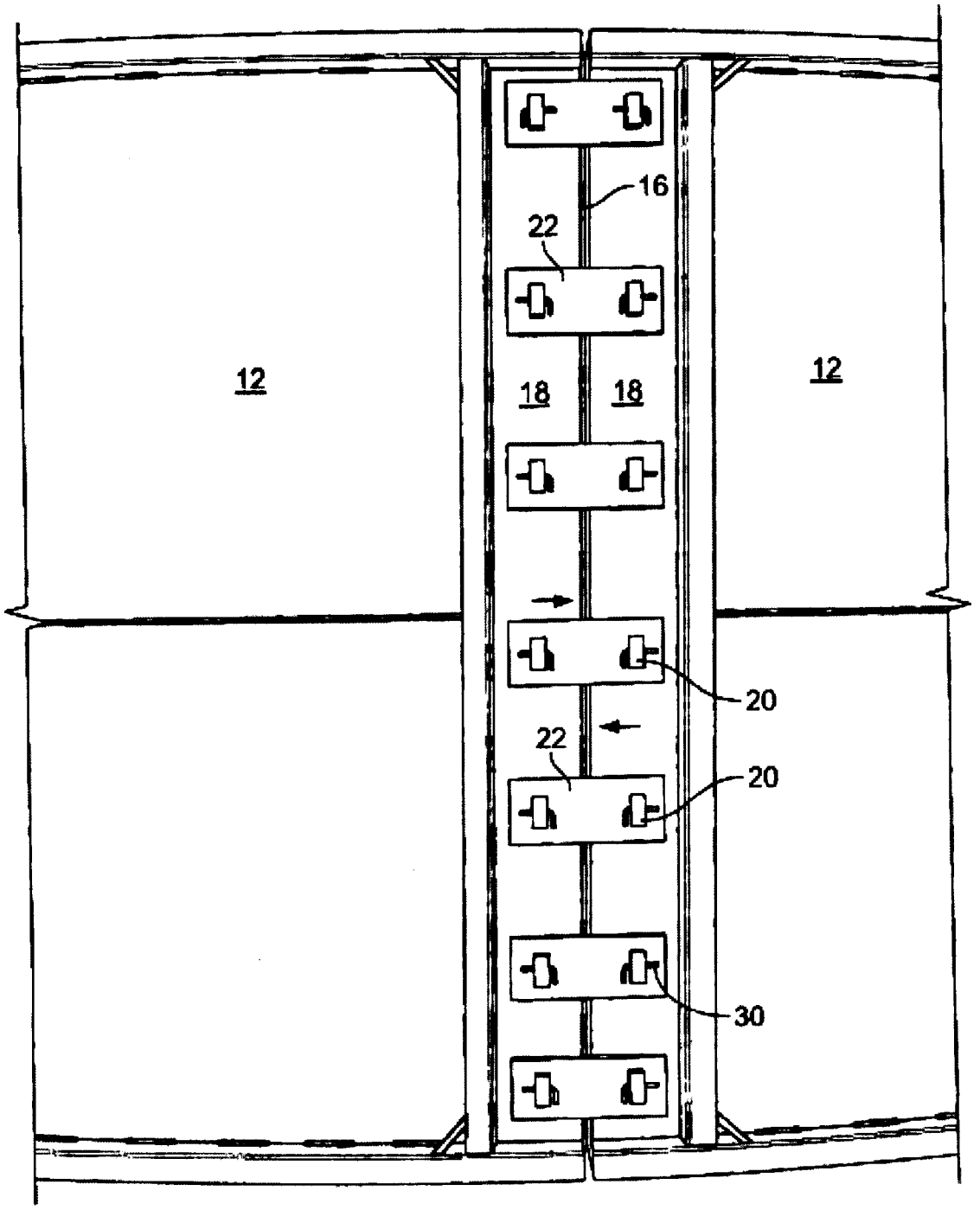

FIG. 2

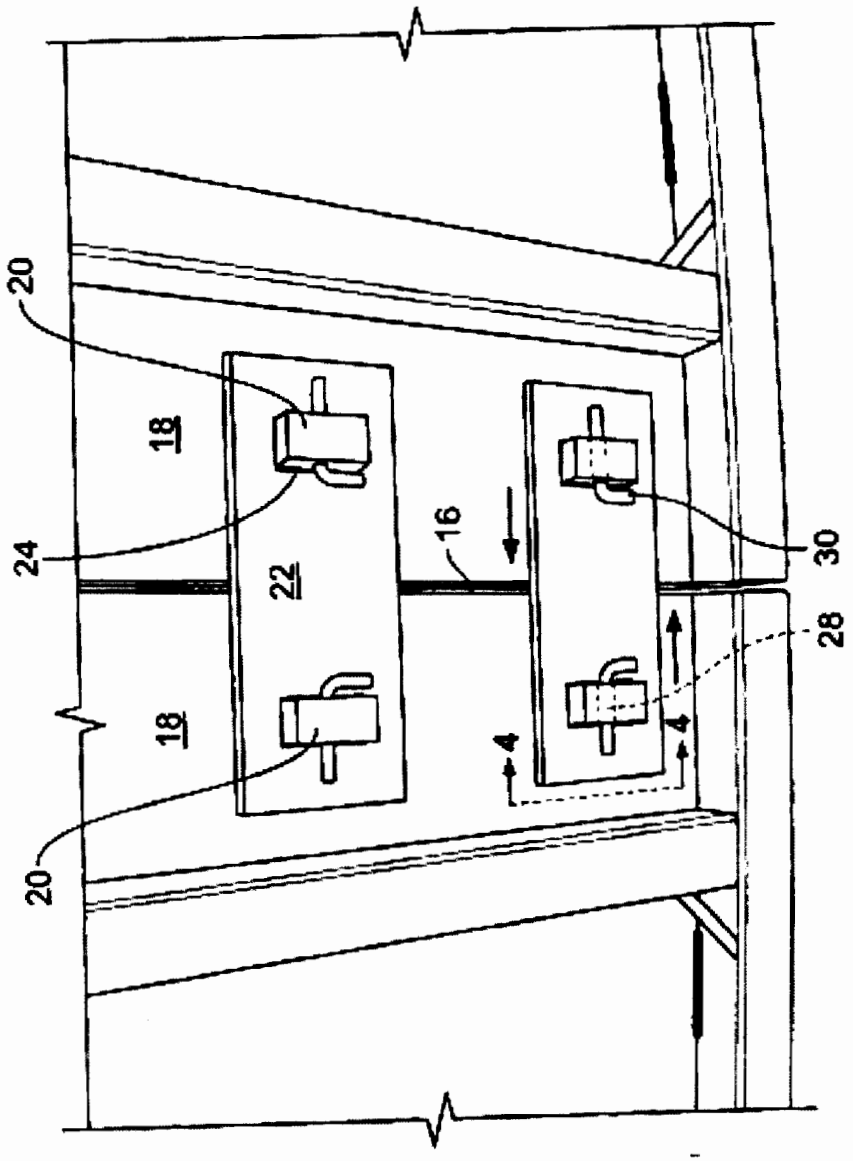

FIG. 3

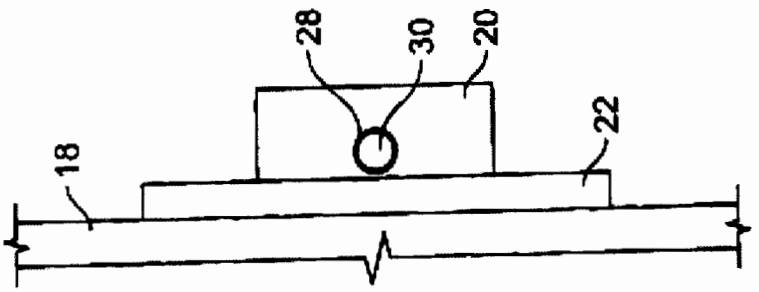

FIG. 4

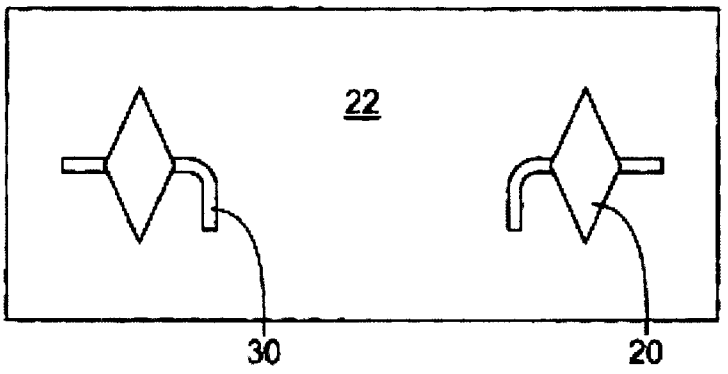

FIG. 5A

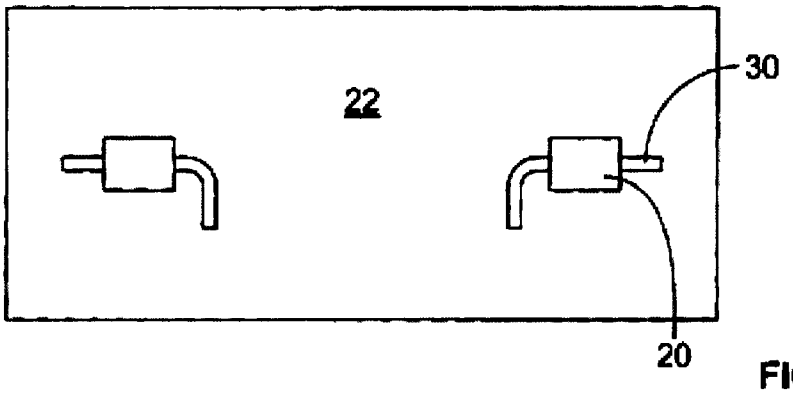

FIG. 5B

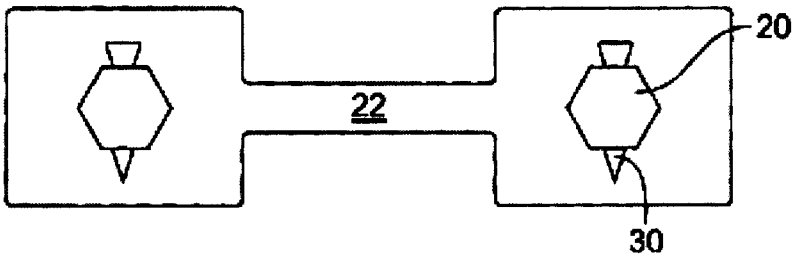

FIG. 5C

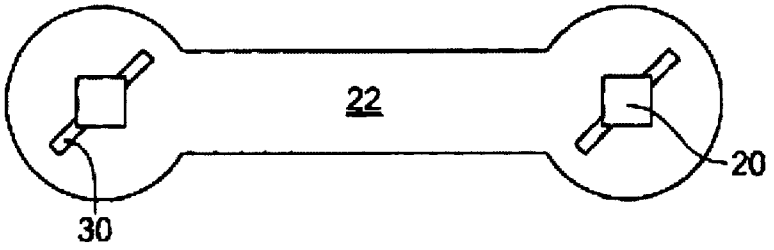

FIG. 5D

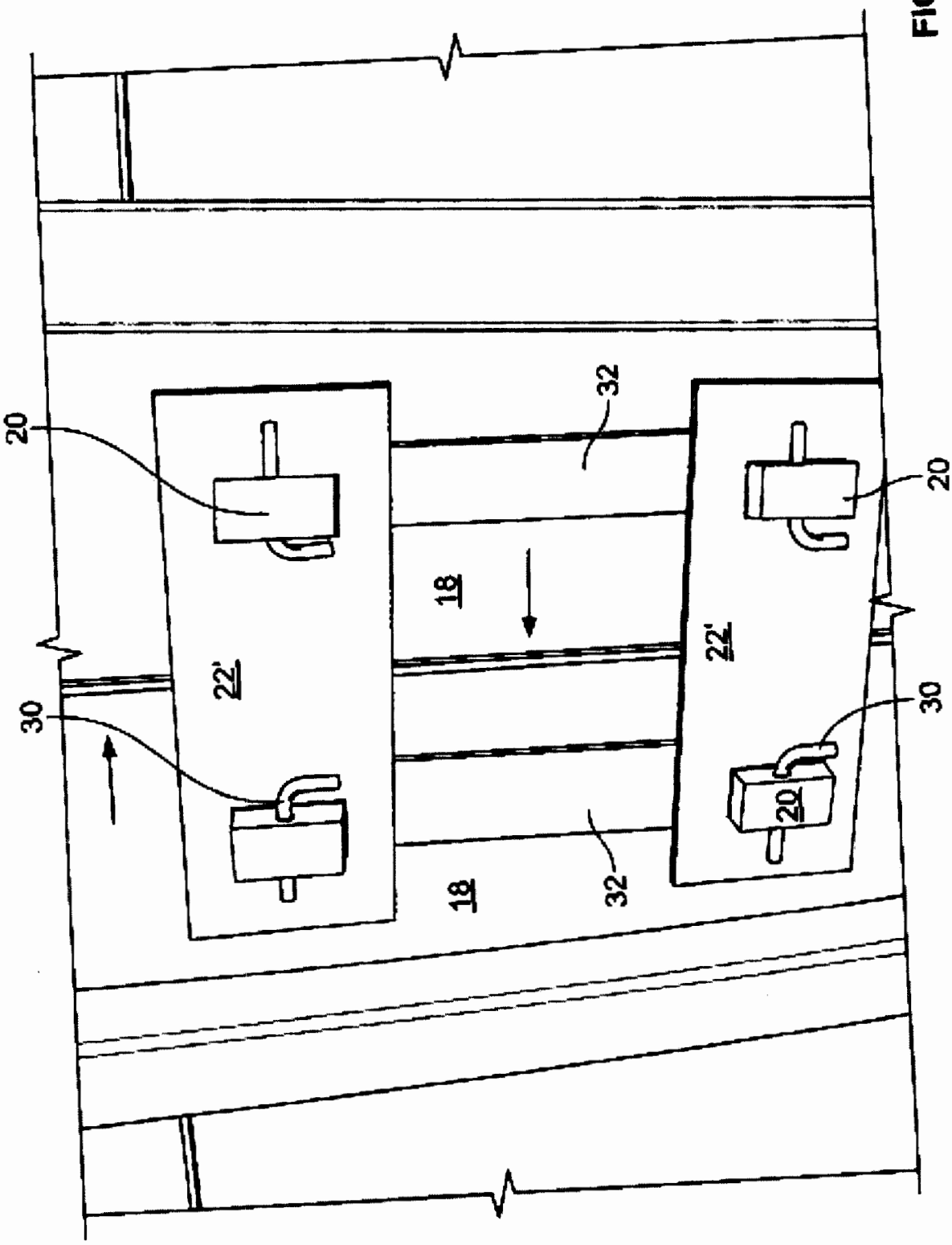

FIG. 6

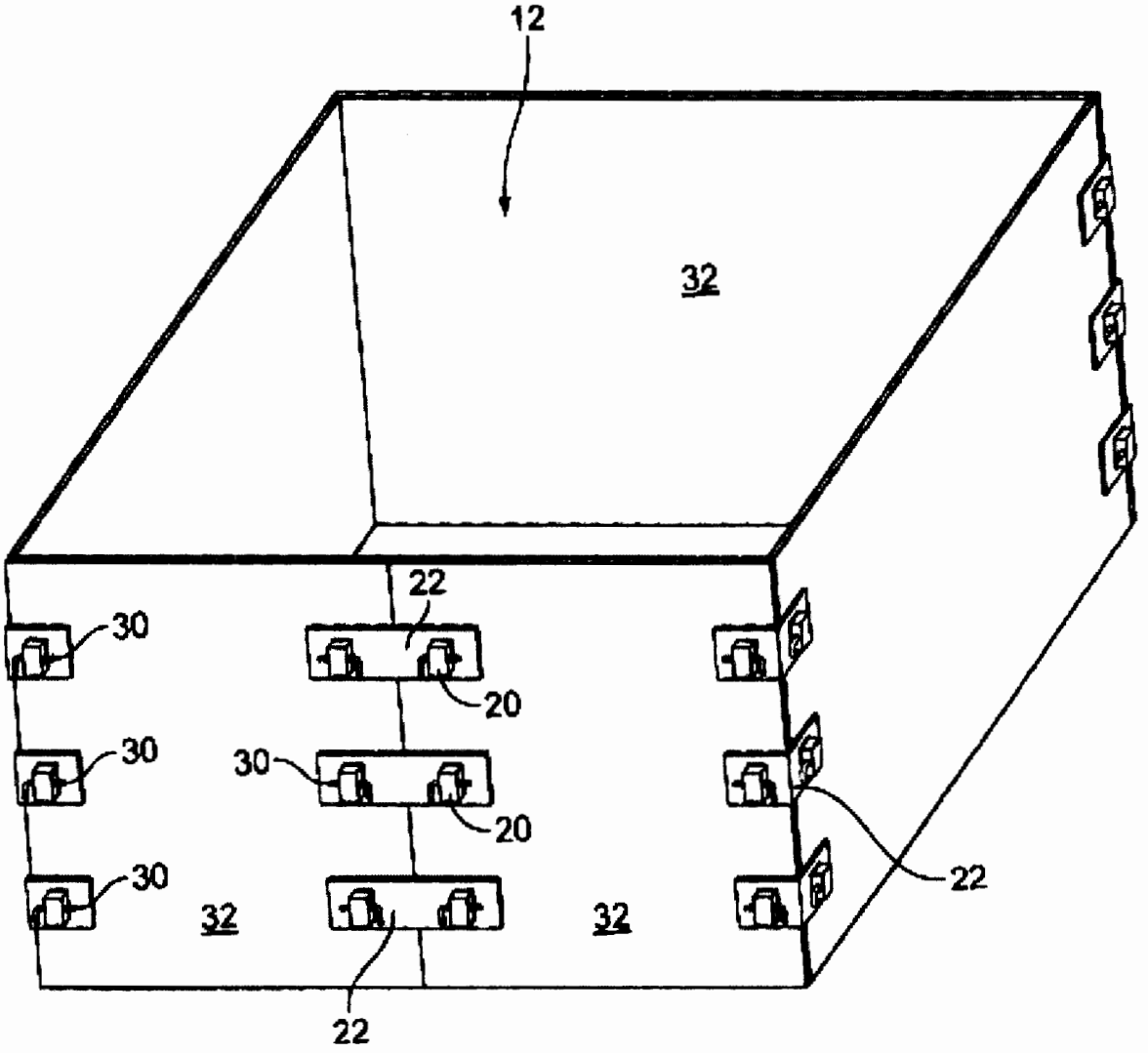

FIG. 7

United States Patent Application **20110194893**
Kind Code **A1**
WIEBE; Cliff **August 11, 2011**

CONTAINER FASTENING ASSEMBLY

Abstract

A connection arrangement for connection of vertically and/or horizontally arranged containers. Each of the containers provides bosses or projections over a collinear pair of which is placed a separate plate. The plate provides matched polygonal apertures to receive the projections. Each of the projections provides an aperture there through to receive a retainer pin or bolt. The pin or bolt abuts the plate when engaged. The arrangement greatly expedites the separation of the containers when desired. The user needs only tap out the retainer pin and pull off the plate. This obviates the use of fasteners which can freeze, rust or become otherwise inoperative or cumbersome.

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Serial No.: **985362**
Series Code: **12**
Filed: **January 6, 2011**
Current U.S. Class: **403/300**; 220/23.83
Class at Publication: **403/300**; 220/23.83
International Class: B65D 21/02 20060101 B65D021/02; F16B 5/07 20060101 F16B005/07

Foreign Application Data

Date	Code	Application Number
Feb 5, 2010	CA	2692016

Claims

1. A connection assembly for connecting similar containers, comprising, in combination: a first container and a second container in contact; boss means integral with and projecting

outwardly from an extension wall of each said container of said containers, said boss means being in horizontal alignment on containers to be connected; a second cooperating engagement member for overlying releasable engagement with at least a pair of said boss means of containers to be connected, said second cooperating engagement member being independent of each said container, said second cooperating member having a configuration matched in shape to said boss means, said boss means extending beyond said second cooperating engagement member when said second cooperating engagement member overlies said boss means, said second cooperating engagement member when engaged with said boss means overlies a contact interface of connected containers; third cooperating engagement means integral with said boss means; and fourth cooperating engagement means adapted for releasable engagement with said third cooperating engagement means and for retaining said second cooperating engagement member when overlying said boss means, whereby when said boss means, connection between containers being effected solely when said boss means receives said second cooperating engagement member and said third cooperating engagement means receives said fourth cooperating engagement means, each said container is connected and secured against substantial vertical and horizontal separation.

2. The combination as set forth in claim 1, wherein said second cooperating engagement member is separate and unconnected to each said container.

3. The combination as set forth in claim 1, wherein each container has a plurality of projecting boss means in vertical spaced relation.

4. The combination as set forth in claim 3, wherein said projecting boss means are in collinear arrangement.

5. The combination as set forth in claim 1, wherein said boss means of said first container and said second container are in a collinear arrangement.

6. The combination as set forth in claim 2, wherein said second cooperating engagement member comprises a removable plate.

7. The combination as set forth in claim 1, wherein a horizontal distance between said boss means between contacted containers is identical to a vertical distance between said boss means of an individual container of said first container and said second container.

8. The combination as set forth in claim 1, wherein at least a boss means between adjacent containers is connected.

9. The combination as set forth in claim 1, wherein said third cooperating engagement means comprises an aperture extending through said boss means.

10. The combination as set forth in claim 1, wherein said fourth cooperating engagement means comprises a separate member unconnected to said container.

11. The combination as set forth in claim 10, wherein said fourth cooperating engagement means comprises an L-shaped pin releasably connectable within said third cooperating engagement means.

12. The combination as set forth in claim 1, wherein said fourth cooperating engagement means, when engaged with said third cooperating engagement means, abuts said second cooperating engagement member.

13. The combination as set forth in claim 1, wherein said first container and said second container are arranged in horizontal disposition.

14. The combination as set forth in claim 1, wherein said first container and said second container are arranged in vertical disposition.

15. The combination as set forth in claim 1, wherein said boss means and said second cooperating engagement member have matched polygonal shapes.

16. A connection assembly for connecting similar containers, comprising, in combination: a first container and a second container in contact; a plurality of projections projecting from each wall of each container of said containers arranged in alignment on containers in contact; a separate plate member for overlying releasable engagement with said projections projecting from each container, said separate plate member being independent of each said container, said plate having apertures matched in shape to said projections, said projections extending beyond said plate when in overlying relation with said projections, aperture means extending through said projections; and retainer means adapted for releasable engagement with said aperture means, connection between containers being effected solely when said projections receive said separate plate and said aperture means receives said retainer means, each said container is connected and secured against substantial vertical and horizontal separation.

17. A modular container, comprising: a plurality of separate container wall segments adapted for releasable connection with each other to form a container or enclosure: boss means projecting from each said container wall segment of said containers, said boss means being in alignment on each container wall segment; a second cooperating engagement plate for overlying releasable engagement with at least a pair of said boss means of each juxtaposed wall, said second cooperating engagement member being independent of said container wall segments, said second cooperating plate having a configuration matched in shape to said boss means, said boss means extending beyond said second cooperating engagement means when said second cooperating engagement plate overlies said boss means of juxtaposed walls; third cooperating engagement means integral with said boss means; and fourth cooperating engagement means adapted for releasable engagement with said third cooperating engagement means and for retaining said second cooperating engagement member when overlying said first cooperating engagement means, formation of said container being effected solely by said boss means being received in said second cooperating engagement member and when said

third cooperating engagement means is received in said fourth cooperating engagement means, whereby said container or enclosure is secured against substantial vertical and horizontal separation.

18. The container as set forth in claim 17, wherein said plate is planar.

19. The container as set forth in claim 17, wherein said plate is angular.

Description

TECHNICAL FIELD

[0001] The present invention relates to fasteners for modular containers/enclosures and more particularly, the present invention relate to a fastening assembly which is expeditiously removed and assembled to allow separation and assembly of the containers by the user without the need to unfasten bolts etc.

BACKGROUND OF THE INVENTION

[0002] Fastening assemblies of a broad variety have been used for some time in connecting modular containers and panels or segments making up the enclosures or containers. Contributory to the problem with the fastening arrangements known is that they are not designed for simplicity of use and with the least number of parts. It is well known that the nut and bolt or other mechanical arrangements are very often overly complex for the purpose of securing containers together. In the bolt system, the user is often faced with rusted connectors which are difficult if not impossible sometimes to disconnect. This often leads to complete destruction of the fastener and potential damage to the container which elevates costs for wasted time, materials and repairs.

[0003] As a further problem, the possibility of attempting to remove nuts from bolts etc. in inclement weather such as freezing weather becomes exceedingly difficult considering the clothing the user must wear to stay warm. The result is that the user often must at least remove hand protection to operate a wrench etc., thus introducing the possibility of frostbite or other exposure.

[0004] Tattarn, in British Patent 1,517,312, teaches an improved container. Unfortunately, it is the container that is formed with individual panels. In this manner, some panels have apertures for receiving bosses with additional connection means. Clearly, the container construction itself relies on the fasteners as opposed to the fastening system being used to connect existing adjacently positioned containers.

[0005] The prior art is replete with as many variations of fastening systems, all of which are

not designed for user ease.

SUMMARY OF THE INVENTION

[0006] One object of the invention is to provide an improved fastening assembly for fastening adjacent pre-existing containers.

[0007] A further object of one embodiment is to provide a connection assembly for connecting pre-existing similar containers, comprising, in combination:

[0008] a first container and a second container in contact;

[0009] first cooperating engagement means projecting from each container of the containers, the first cooperating engagement means being in alignment on containers in contact;

[0010] second cooperating engagement means adapted for overlying releasable engagement with the first cooperating engagement means, the second cooperating means having a configuration matched in shape to the first cooperating engagement means, the first cooperating engagement means extending beyond the second cooperating engagement means when the second cooperating engagement means overlies the first cooperating engagement means;

[0011] third cooperating engagement means integral with the first cooperating engagement means; and

[0012] fourth cooperating engagement means adapted for releasable engagement with the third cooperating engagement means and for retaining the second cooperating engagement means when overlying the first cooperating engagement means, whereby when the first cooperating engagement means receives the second cooperating engagement means and the third cooperating engagement means receives the fourth cooperating engagement means, each container is connected and secured against substantial vertical and horizontal separation.

[0013] The arrangement has been found to be particularly simple to use in any weather conditions. The first cooperating engagement means in one embodiment comprises a polygonal boss or projection extending outwardly from each adjacently positioned container and may be on a wall thereof.

[0014] The second cooperating engagement means comprises, in one embodiment, a plate adapted to overly the bosses between a pair of adjacent containers. The plate is provided with apertures matched in configuration to the bosses. It is preferred that the shape of the bosses and the plate apertures be selected from a polygonal repertoire; circular arrangements do not provide any protection for horizontal and/or vertical movement between adjacent containers. The polygonal shape is advantageous to avoid such potentially hazardous and damaging movement, since matched configuration between the bosses and plate apertures will preclude

such movement.

[0015] The bosses are horizontally and vertically collinear to allow any plate to be used over any projections.

[0016] With respect to the fourth cooperating engagement means, the same may comprise in one possible embodiment, a pin or L bolt which is simply inserted in to the aperture extending through each boss or any other suitable catch which prevents disengagement of the plate from the boss. It is also important that the fourth cooperating engagement means be very easily removed.

[0017] The arrangement is particularly convenient, since a user wishing to disconnect connected containers, simply pushes out the pin from each boss and pulls the plate free of the bosses.

[0018] A further object of one embodiment of the present invention is to provide a connection assembly for connecting similar containers, comprising, in combination:

[0019] a first container and a second container in contact;

[0020] a plurality of projections projecting from each container of the containers arranged in alignment on containers in contact;

[0021] a separate plate member adapted for overlying releasable engagement with the projections projecting from each container, the plate having apertures matched in shape to the projections, the projections extending beyond the plate when in overlying relation with the projections;

[0022] aperture means extending through the projections; and

[0023] retainer means adapted for releasable engagement with the aperture means, whereby when the projections receive the separate plate and the aperture means receives the retainer means, each container is connected and secured against substantial vertical and horizontal separation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] FIG. 1 is a perspective view of the container arrangement and fastening assembly according to one embodiment;

[0025] FIG. 2 is an enlarged view of the assembly illustrated in FIG. 1;

[0026] FIG. 3 is an enlarged view of FIG. 2;

[0027] FIG. 4 is a section along line 4-4 of FIG. 3;

[0028] FIGS. 5A through 5D illustrate alternate embodiments of FIG. 3;

[0029] FIG. 6 is an illustration of an alternate embodiment of the present invention; and

[0030] FIG. 7 is an illustration of yet another alternate embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0031] Referring now to FIG. 1, shown is a perspective view of a first embodiment of the present invention. Numeral 10 generally refers to the arrangement. Large containers 12 for storage of, for example, water are desirably connected together for modulation at a site.

[0032] The overall fastening assembly is referenced by numeral 14 and is more detailed in FIG. 2.

[0033] Each container 12 is positioned for contact with an adjacent container 12 at an interface 16. A wall or extension 18 is provided on each container 12 for abutment with a similar component from the adjacent container 12. Each wall 18 includes a plurality of projecting bosses 20 extending outwardly in parallel planar relation from wall 18. The bosses 20 function as a first cooperating engagement. The bosses 20 may be welded to the walls 18. The bosses 20 on an individual container 12 are arranged in collinear equidistant relation and are horizontally aligned when walls 18 are abutted between containers 12. The horizontal distance between bosses 20 of adjacent containers, in this embodiment is the same and this is true of the spacing of bosses on an individual container 12.

[0034] With reference to FIG. 3, shown is an enlarged view of the arrangement. The bosses 20, shown in the example as having a rectangular shape, receive, in overlying relation, a second releasable cooperating engagement member 22. The member 22 is shown in the example as a plate. The plate 22 has spaced apart apertures 24 which receive the bosses 20. The boss 20 shape and aperture 24 are configured for cooperation.

[0035] Plate 22 may comprise a similar material of which the containers 12 are made, such as steel. The plate 22 is dimensioned to overlie the interface of abutment, referenced by numeral 16, of the adjacent containers 12. The plate is also dimensioned to be of a lesser thickness than the height of the bosses 20. In this manner, the plate 22 can be loosely retained on the bosses 20 in a parallel plane to the walls 18.

[0036] In order to further assist in retaining the plate 22 on the bosses 20, a third releasably engageable cooperating means in the form of an aperture 28 (chain line) cooperates with a fourth releasably engageable cooperating means in the form of, for example, a pin or L-bolt 30. As is illustrated in the example, the pin 30 is received within the aperture 28. The reception is such that the pin 30 abuts the surface of the plate 22. This relationship ensures

that the plate 22 remains snugly against the walls 18. The former relationship is depicted in FIG. 4.

[0037] The Figures illustrate the boss 20 shape as a rectangle. This is useful when combined with a keyed or matched configuration in the plate 22 to reduce, if not eliminate, any vertical or horizontal movement of connected containers. Any suitable polygonal shape is envisioned as a possibility. FIGS. 5A through 5D illustrate a number of variations for the plate 22 in terms of the apertures 24 being diamond, square, hexagonal and generally square in shape. The bosses 20 would obviously have a keyed shape for cooperation. In addition, FIGS. 5A through 5D show variations on the shape and disposition of the pins or L bolts 30. The pins or bolts may be inserted into the aperture 28 of the bosses 20 vertically, horizontally or angularly. Further, the pins may be of a varying dimension, i.e. conical, straight, or bent. As a further variation, the plate 22 may comprise any suitable shape variations of which are shown in FIGS. 5C and 5D with a generally dumbbell configuration. Other variations will be appreciated by those skilled.

[0038] Referring now to FIG. 6, shown is another alternate embodiment of the present invention.

[0039] In this embodiment, two bosses 20, a pair from each container 12, are connected by a modified plate 22'. In this embodiment, two plates are joined by joining members 32, shown in the example to be vertical arms. Any suitable configuration to achieve this end is possible and will be appreciated by those skilled. Further, any number of bosses 20 may be connected.

[0040] Referring now to FIG. 7, shown is a further variation of the present invention. In this embodiment, the container 12 is formed of a plurality of individual wall segments 32. Each segment includes the bosses 20 which cooperate with an adjacent segment 32 in a manner similar to that discussed with respect to the previous embodiments. Plate 22 joins the adjacent segments. Conveniently, the intersection of two segments at a corner can be easily accommodated by modifying plate 22 by a right angle bend as shown in the illustration. In situations where the angle required is acute or obtuse, the plate will be modified accordingly.

[0041] Of particular benefit is the fact that the bosses are attached to a wall of the containers, with no apertures required in the walls. The bosses are positioned to be in a parallel plane with a respective wall to which they are connected with the plate also being in a parallel relationship with the boss over which it lies.

[0042] Although embodiments of the invention have been described above, it is not limited thereto and it will be apparent to those skilled in the art that numerous modifications form part of the present invention insofar as they do not depart from the spirit, nature and scope of the claimed and described invention.

Appendix D: Geotextile Specifications

Western Industries Inc.
PO Box 428
Yellowstone Hill
Miles City, Montana 59301
(406) 234-1680
(406) 234-7774 Fax
(800) 488-3592

8, 10 & 12 oz.
Nonwoven Geotextile

Property				**ASTM**
Weight	8 oz/yd²	10 oz/yd²	12 oz/yd²	
Grab Tensile	205 lbs	250 lbs	300 lbs	D-4632
Grab Elongation	50%	50%	50%	D-4632
Trapezoidal Tear	80 lbs	100 lbs	115 lbs	D4533
Puncture Resistance	525 lbs	625 lbs	825 lbs	D-6241
UV Resistance After 500 hrs.	70% Strength Retained	70% Strength Retained	70% Strength Retained	D-4355
Hydraulic				
Apparent Opening Size (AOS)[3]	80 US Std. Sieve	100 US Std. Sieve	100 US Std. Sieve	D-4751
Permittivity	1.5 sec^{-1}	1.2 sec^{-1}	1.0 sec^{-1}	D-4491
Water Flow Rate	110 gpm/ft²	85 gpm/ft²	75 gpm/ft²	D-4491

These values are typical data and are not intended as limiting specifications.

Appendix E: Liner Specifications

Material Safety Data Sheet
May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910 1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY *(as Used on Label and List)*
GSE Low Density Polyethylene Geomembrane (LLDPE)

Note: Blank spaces are not permitted. If any item is not applicable or no information is available, the space must be marked to indicate that.

Section 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Manufacturer's name GSE Lining Technology	Emergency Telephone Number 1-800-435-2008 CHEMTREC (800) 424-9300
Address (Number, Street, City, State and ZIP Code)	Telephone Number for Information 1-800-435-2008
19103 Gundle Rd	Date Prepared 1/1/1999
Houston, Texas 77073	Signature of Preparer (optional)

Section2 Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity, Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
PRODUCT NAME: LLDPE (ALL GRADES)	**None**	**None**	**None**	

CHEMICAL NAME:
Polyethylene or Ethylene-Olefin Copolymer

CHEMICAL FAMILY:
Ethylene-Based Polymer

PRODUCT DESCRIPTION:
Odorless opaque white pellets or granules.

This product is not hazardous as defined in 29 CFR1910.1200

Section 3 COMPOSITION/INFORMATION ON INGREDIENTS

POTENTIAL HEALTH EFFECTS EYE CONTACT: Particulates may scratch eye surfaces/cause mechanical irritation.

SKIN CONTACT:
Negligible hazard at ambient temperatures (-18 to +38 degrees C; 0 to 100 degrees F).
Exposure to hot material may cause thermal burns.

INHALATION:
Negligible hazard at ambient temperature (-18 to 38 Deg C; 0 to 100 Deg F)
Vapors and/or aerosols which may be formed at elevated temperatures may be irritating to eyes and respiratory tract.

INGESTION:
Minimal toxicity.

Section 4 FIRST AID MEASURES

EYE CONTACT:
This product is an inert solid. If in eye, remove as one would any foreign object.

SKIN CONTACT:
For hot product, immediately immerse in or flush the affected area with large amounts of cold water to dissipate heat. Cover with clean cotton sheeting or gauze and get prompt medical attention. No attempt should be made to remove material from skin or to remove contaminated clothing, as the damaged flesh can be easily torn.

INHALATION:
In case of adverse exposure to vapors and/or aerosols formed at elevated temperatures, immediately remove the affected victim from exposure. Administer artificial respiration if breathing is stopped. Keep at rest. Call for prompt medical attention.

INGESTION:
First aid is normally not required.

Liner

Product Description
The Liner geomembranes are economical lining materials made from blended/reprocessed resins selected for optimum performance at the lowest cost. Products are intended for use in gomembrane applications such as oil and gas reserve pits, temporary containment of frac water, backflow water high in salt concentration, seepage control, water containment and short-term protective covers. Prefabricated liners are also ideal for installation by contractors, owners, or agricultural operators.

Technical Data
Materials information is below.

Installation
Liner is flexible enough to be prefabricated at our facility into large panels (Up to 27,000 square feet at 30 mil). The prefabricated panel is accordion folded, rolled on a core, and delivered to the job site secured to a pallet. Prefabricated panels can often cover a small project with a single panel. Local labor forces are used to unroll and unfold the panels. Our entire primary field welding of liner is based on hot wedge welding technology. Field wedge welding Liner provides strong seams, and fast installations on large projects. Small welds and repairs can be completed with the Layfield Enviro Liner® welding kit.

9. Material Properties

19 Nov 2011	Series Typical Properties			
Style	ASTM	20 mil	30 mil	40 mil
Thickness (Nominal)	D5199	20 mil 0.50 mm	30 mil 0.75 mm	40 mil 1.0 mm
Tensile Strength at Break	D638	75 ppi 13.8 N/mm	114 ppi 21 N/mm	154 ppi 28.5 N/mm
Elongation	D638	800%	800%	800%
Tear Resistance	D1004	11 lbs 49 N	16 lbs 71 N	22 lbs 98 N
Puncture Resistance	D4833	30 lbs 130 N	45 lbs 200 N	60 lbs 270
Low Temperature Impact Resistance	D1790	-40°F -40°C	-40°F -40°C	-40°F -40°C
Dimensional Stability	D1204 Max Chng	<2.0%	<2.0%	<2.0%

10. Shop Seam Strengths

19 Nov 2011	Shop Seam Strengths			
Style	ASTM	20 mil	30 mil	40 mil
Heat Bonded Seam Strength	D6392 25.4 mm (1") Strip	25 ppi 4.4 N/mm	36 ppi 6.3 N/mm	48 ppi 8.4 N/mm
Heat Bonded Peel Adhesion Strength	D6392 25.4 mm (1") Strip	FTB 18 ppi 3.2 N/mm	FTB 29 ppi 5.1 N/mm	FTB 39 ppi 6.8 N/mm

GSE

The Pioneer of Geosynthetics

Product Data Sheet - OT

GSE 30 mil UltraFlex Smooth Geomembrane (Nominal)

GSE 30 mil UltraFlex is a smooth linear low density polyethylene (LLDPE) geomembrane manufactured with the highest quality resin specifically formulated for flexible geomembranes. This product is used in applications that require increased flexibility and elongation properties where differential or localized subgrade settlements may occur such as in a landfill closure application.

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	NOMINAL VALUE 30 mil
Thickness, (Nominal) mil (mm) with a tolerance +/- 10%	ASTM D 5199	every roll	27 (0.68)
Density, g/cm^3	ASTM D 1505	200,000 lb	0.92
Tensile Properties (each direction) Strength at Break, lb/in-width (N/mm) Elongation at Break, %	ASTM D 6693, Type IV Dumbell, 2 ipm G.L. 2.0 in (51 mm)	20,000 lb	 114 (20) 800
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	16 (70)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	42 (190)
Carbon Black Content[1], % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note[1]
Oxidative Induction Time, min	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>140
TYPICAL ROLL DIMENSIONS			
Roll Length[2], ft (m)			1,120 (341)
Roll Width[2], ft (m)			22.5 (6.9)
Roll Area, ft^2 (m^2)			25,200 (2,341)

NOTES:

- [1] Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- [2] Roll lengths and widths have a tolerance of ±1%.
- GSE UltraFlex is available in rolls weighing approximately 3,900 lb (1,769 kg).
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77° C when tested according to ASTM D 746.
- *Modified

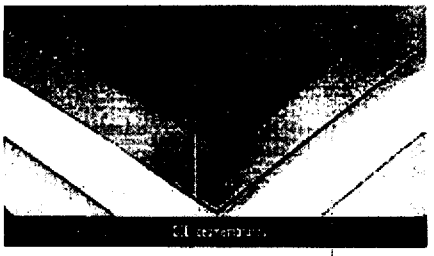
OTDSUT R02/15/12

GSE

The Pioneer Of Geosynthetics

Technical Note

Chemical Resistance for Geomembrane Products



GSE geomembranes are made of high quality, virgin polyethylene which demonstrates excellent chemical resistance. GSE polyethylene geomembranes are resistant to a great number and combinations of chemicals. It is this property of (HDPE) high density polyethylene geomembranes that makes it the lining material of choice.

In order to gauge the durability of a material in contact with a chemical mixture, testing is required in which the material is exposed to the chemical environment in question. Chemical resistance testing is a very large and complex topic because of two factors. First, the number of specific media is virtually endless and second, there are many criteria such as tensile strength, hardness, etc. that may be used to assess a material's resistance to degradation.

The chemical resistance of polyethylene has been investigated by many people over the past few decades. We are able to draw from that work when making statements about the chemical resistance of today's polyethylene geomembranes. In addition to that, many tests have been performed that specifically use geomembranes and certain chemical mixtures. Naturally, however, every mixture of chemicals cannot be tested for. As a result of these factors, GSE published a chemical resistance chart, demonstrating general guidelines.

Polyethylene is, for practical purposes, considered impermeable. Be aware, however, that all materials are permeable to some extent. Permeability varies with concentration, temperature, pressure and type of permeant. The rates of permeation are usually so low, however, that they are insignificant. As a point of reference, polyethylene is commonly used for packaging of several types of materials. These include gasoline, motor oil, household cleaners (i.e. bleach), muratic acid, pesticides, insecticides, fungicides, and other highly concentrated chemicals. Also, you should be aware that there are some chemicals which may be absorbed by the material but only when present at very high concentrations. These include halogenated and/or aromatic hydrocarbons at greater than 50%; their absorption results in swelling and slight changes in physical properties such as increased tensile elongations. This includes many types of fuels and oils. Recognize that this action, however, does not affect the liner's ability to act as a barrier for the material it is containing.

Since polyethylene is a petroleum product, it can absorb other petroleum products. Like a sponge, the material becomes slightly thicker and more flexible but does not produce a hole or void. However, unlike a sponge, this absorption is not immediate. It takes a much longer time for a polyethylene liner to swell than it does for a sponge. The exact time it takes for swelling to occur depends on the particular constituents and concentrations of the contained media. However, a hole would not be produced. Also, this absorption is reversible and the material will essentially return to it's original state when the chemical is no longer in contact with the liner.

With regard to typical municipal landfills in the United States, legally allowable levels of chemicals have been demonstrated to have no adverse affect on polyethylene geomembrane performance. The very low levels of salts, metals and organic compounds do not damage polyethylene. A double-lined containment with a leachate (leak detection) removal system effectively prevents any significant, continuous exposure of the secondary membrane to these materials and for practical purposes makes the total liner system even more impermeable.

GSE

The Pioneer Of Geosynthetics

Chemical Resistance Chart

GSE is the world's leading supplier of high quality, polyethylene geomembranes. GSE polyethylene geomembranes are resistant to a great number and combinations of chemicals. Note that the effect of chemicals on any material is influenced by a number of variable factors such as temperature, concentration, exposed area and duration. Many tests have been performed that use geomembranes and certain specific chemical mixtures. Naturally, however, every mixture of chemicals cannot be tested for, and various criteria may be used to judge performance. Reported performance ratings may not apply to all applications of a given material in the same chemical. Therefore, these ratings are offered as a guide only.

Medium	Concentration	Resistance at: 20° C (68° F)	60° C (140° F)
A			
Acetic acid	100%	S	L
Acetic acid	10%	S	S
Acetic acid anhydride	100%	S	L
Acetone	100%	L	L
Adipic acid	sat. sol.	S	S
Allyl alcohol	96%	S	S
Aluminum chloride	sat. sol.	S	S
Aluminum Fluoride	sat. sol.	S	S
Aluminum sulfate	sat. sol.	S	S
Alum	sol	S	S
Ammonia, aqueous	dil. sol	S	S
Ammonia, gaseous dry	100%	S	S
Ammonia, liquid	100%	S	S
Ammonium chloride	sat. sol.	S	S
Ammonium fluoride	sol	S	S
Ammonium nitrate	sat. sol.	S	S
Ammonium sulfate	sat. sol.	S	S
Ammonium sulfide	sat.	S	S
Amyl acetate	100%	S	L
Amyl alcohol	100%	S	L
Aniline	100%	S	L
Antimony trichloride	90%	S	S
Arsenic acid	sat. sol.	S	S
Aqua regia	HCl-HNO3	U	U
B			
Barium carbonate	sat. sol.	S	S
Barium chloride	sat. sol.	S	S
Barium hydroxide	sat. sol.	S	S
Barium sulfate	sat. sol	S	S
Barium sulfide	sol	S	S
Benzaldehyde	100%	S	L
Benzene		L	L
Benzoic acid	sat. sol.	S	S
Beer	—	S	S
Borax (sodium tetraborate)	sat. sol.	S	S
Boric acid	sat. sol.	S	S
Bromine, gaseous dry	100%	U	U
Bromine, liquid	100%	U	U
Butane, gaseous	100%	S	S
1-Butanol	100%	S	S
Butyric acid	100%	S	L
C			
Calcium carbonate	sat. sol.	S	S
Calcium chlorate	sat. sol	S	S
Calcium chloride	sat. sol	S	S
Calcium nitrate	sat. sol	S	S
Calcium sulfate	sat. sol	S	S
Calcium sulfide	dil. sol.	L	L
Carbon dioxide, gaseous dry	100%	S	S
Carbon disulfide	100%	L	U
Carbon monoxide	100%	S	S
Chloroacetic acid	sol.	S	S
Carbon tetrachloride	100%	L	U
Chlorine, aqueous solution	sat. sol	L	U
Chlorine, gaseous dry	100%	L	U
Chloroform	100%	U	U
Chromic acid	20%	S	L
Chromic acid	50%	S	L
Citric acid	sat. sol.	S	S

Medium	Concentration	Resistance at: 20° C (68° F)	60° C (140° F)
Copper chloride	sat. sol.	S	S
Copper nitrate	sat. sol.	S	S
Copper sulfate	sat. sol.	S	S
Cresylic acid	sat. sol.	L	—
Cyclohexanol	100%	S	S
Cyclohexanone	100%	S	L
D			
Decahydronaphthalene	100%	S	L
Dextrine	sol	S	S
Diethyl ether	150%	L	—
Dioctylphthalate	100%	S	L
Dioxane	150%	S	S
E			
Ethanediol	130%	S	S
Ethanol	40%	S	L
Ethyl acetate	150%	S	U
Ethylene trichloride	100%	U	U
F			
Ferric chloride	sat. sol	S	S
Ferric nitrate	sol.	S	S
Ferric sulfate	sat. sol.	S	S
Ferrous chloride	sat. sol	S	S
Ferrous sulfate	sat. sol	S	S
Fluorine, gaseous	100%	U	U
Fluorosilicic acid	40%	S	S
Formaldehyde	40%	S	S
Formic acid	50%	S	S
Formic acid	98-100%	S	S
Furfuryl alcohol	100%	S	L
G			
Gasoline		S	L
Glacial acetic acid	96%	S	L
Glucose	sat. sol	S	S
Glycerine	100%	S	S
Glycol	sol	S	S
H			
Heptane	100%	S	U
Hydrobromic acid	50%	S	S
Hydrobromic acid	100%	S	S
Hydrochloric acid	10%	S	S
Hydrochloric acid	35%	S	S
Hydrocyanic acid	10%	S	S
Hydrofluoric acid	4%	S	S
Hydrofluoric acid	60%	S	L
Hydrogen	100%	S	S
Hydrogen peroxide	30%	S	L
Hydrogen peroxide	90%	S	U
Hydrogen sulfide, gaseous	100%	S	S
Lactic acid	100%	S	S
Lead acetate	sat. sol.	S	—
M			
Magnesium carbonate	sat. sol	S	S
Magnesium chloride	sat. sol	S	S
Magnesium hydroxide	sat. sol	S	S
Magnesium nitrate	sat. sol	S	S
Maleic acid	sat. sol	S	S
Mercuric chloride	sat. sol	S	S
Mercuric cyanide	sat. sol	S	S
Mercuric nitrate	sat.	S	S

Continued

Technical Note

Medium	Concentration	Resistance at: 20° C (68° F)	60° C (140° F)
Mercury	100%	S	S
Methanol	100%	S	S
Methylene chloride	100%	L	—
Milk	—	S	S
Molasses	—	S	S
N			
Nickel chloride	sat. sol.	S	S
Nickel nitrate	sat. sol.	S	S
Nickel sulfate	sat. sol.	S	S
Nicotinic acid	dil. sol.	S	—
Nitric acid	25%	S	S
Nitric acid	50%	S	U
Nitric acid	75%	U	U
Nitric acid	100%	U	U
O			
Oils and Grease	—	S	L
Oleic acid	100%	S	L
Orthophosphoric acid	50%	S	S
Orthophosphoric acid	95%	S	L
Oxalic acid	sat. sol.	S	S
Oxygen	100%	S	L
Ozone	100%	L	U
P			
Petroleum (kerosene)	—	S	L
Phenol	sol.	S	S
Phosphorus trichloride	100%	S	L
Photographic developer	cust. conc.	S	S
Picric acid	sat. sol.	S	—
Potassium bicarbonate	sat. sol.	S	S
Potassium bisulfide	sol.	S	S
Potassium bromate	sat. sol.	S	S
Potassium bromide	sat. sol.	S	S
Potassium carbonate	sat. sol.	S	S
Potassium chlorate	sat. sol.	S	S
Potassium chloride	sat. sol.	S	S
Potassium chromate	sat. sol.	S	S
Potassium cyanide	sol.	S	S
Potassium dichromate	sat. sol.	S	S
Potassium ferricyanide	sat. sol.	S	S
Potassium ferrocyanide	sat. sol.	S	S
Potassium fluoride	sat. sol.	S	S
Potassium hydroxide	10%	S	S
Potassium hydroxide	sol.	S	S
Potassium hypochlorite	sol.	S	L
Potassium nitrate	sat. sol.	S	S
Potassium orthophosphate	sat. sol.	S	S
Potassium perchlorate	sat. sol.	S	S
Potassium permanganate	20%	S	S
Potassium persulfate	sat. sol.	S	S
Potassium sulfate	sat. sol.	S	S
Potassium sulfite	sol.	S	S
Propionic acid	50%	S	S
Propionic acid	100%	S	L
Pyridine	100%	S	L
Q			
Quinol (Hydroquinone)	sat. sol.	S	S
S			
Salicylic acid	sat. sol.	S	S

Medium	Concentration	Resistance at: 20° C (68° F)	60° C (140° F)
Silver acetate	sat. sol.	S	S
Silver cyanide	sat. sol.	S	S
Silver nitrate	sat. sol.	S	S
Sodium benzoate	sat. sol.	S	S
Sodium bicarbonate	sat. sol.	S	S
Sodium biphosphate	sat. sol.	S	S
Sodium bisulfite	sol.	S	S
Sodium bromide	sat. sol.	S	S
Sodium carbonate	sat. sol.	S	S
Sodium chlorate	sat. sol.	S	S
Sodium chloride	sat. sol.	S	S
Sodium cyanide	sat. sol.	S	S
Sodium ferricyanide	sat. sol.	S	S
Sodium ferrocyanide	sat. sol.	S	S
Sodium fluoride	sat. sol.	S	S
Sodium hydroxide	40%	S	S
Sodium hydroxide	sat. sol.	S	S
Sodium hypochlorite	15% active chlorine	S	S
Sodium nitrate	sat. sol.	S	S
Sodium nitrite	sat. sol.	S	S
Sodium orthophosphate	sat. sol.	S	S
Sodium sulfate	sat. sol.	S	S
Sodium sulfide	sat. sol.	S	S
Sulfur dioxide, dry	100%	S	S
Sulfur trioxide	100%	U	U
Sulfuric acid	10%	S	S
Sulfuric acid	50%	S	S
Sulfuric acid	98%	S	U
Sulfuric acid	fuming	U	U
Sulfurous acid	30%	S	S
T			
Tannic acid	sol.	S	S
Tartaric acid	sol.	S	S
Thionyl chloride	100%	L	L
Toluene	100%	L	L
Triethylamine	sol.	S	L
U			
Urea	sol.	S	S
Urine	—	S	S
W			
Water	—	S	S
Wine vinegar	—	S	S
Wines and liquors	—	S	S
X			
Xylenes	100%	L	U
Y			
Yeast	sol.	S	S
Z			
Zinc carbonate	sat. sol.	S	S
Zinc chloride	sat. sol.	S	S
Zinc (II) chloride	sat. sol.	S	S
Zinc (IV) chloride	sat. sol.	S	S
Zinc oxide	sat. sol.	S	S
Zinc sulfate	sat. sol.	S	S

Specific immersion testing should be undertaken to ascertain the suitability of chemicals not listed above with reference to special requirements.

NOTES:

(S) **Satisfactory**: Liner material is resistant to the given reagent at the given concentration and temperature. No mechanical or chemical degradation is observed.

(L) **Limited Application Possible**: Liner material may reflect some attack. Factors such as concentration, pressure and temperature directly affect liner performance against the given media. Application, however, is possible under less severe conditions, e.g. lower concentration, secondary containment, additional liner protections, etc.

(U) **Unsatisfactory**: Liner material is not resistant to the given reagent at the given concentration and temperature. Mechanical and/or chemical degradation is observed.

(—) **Not tested**

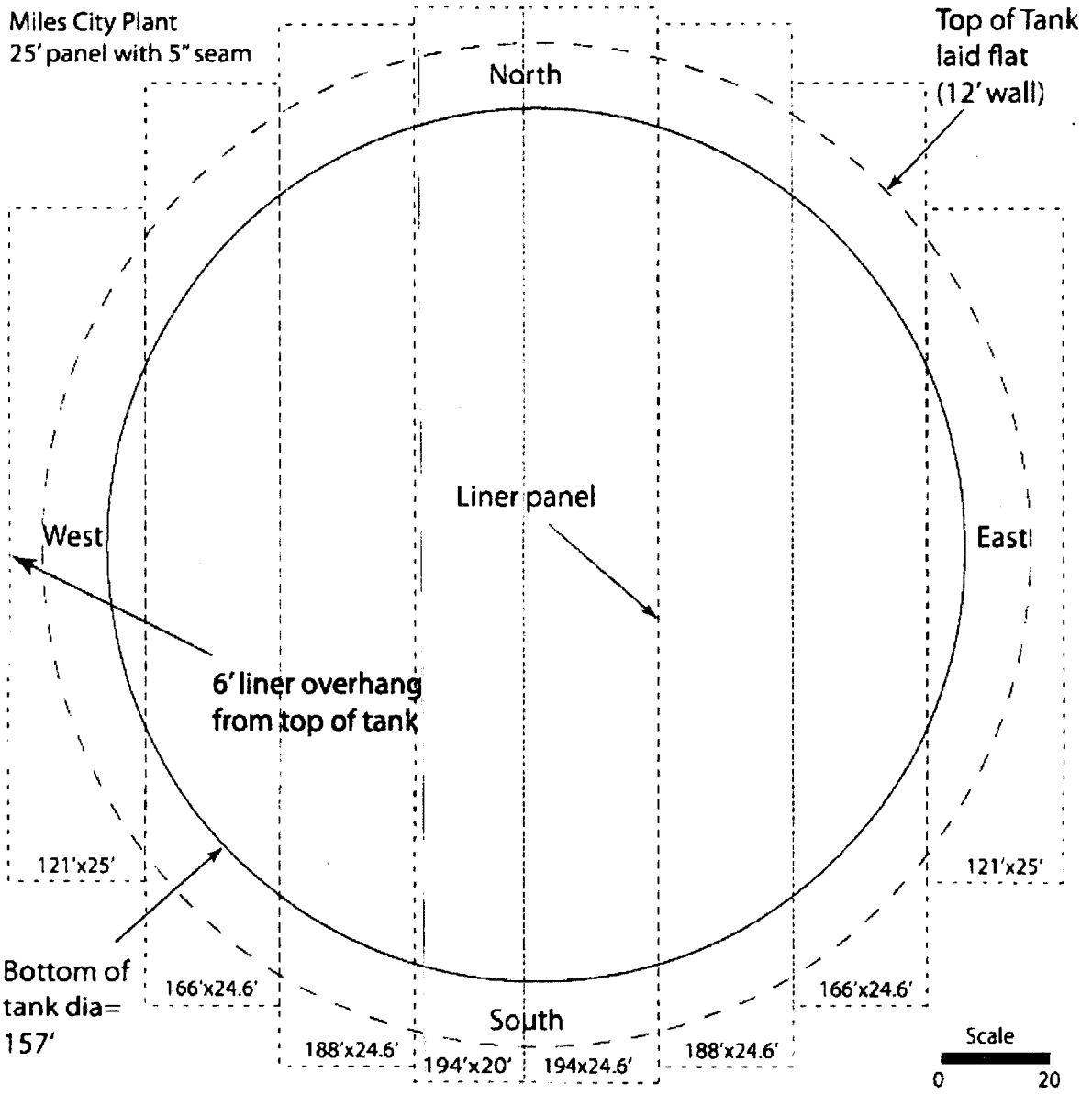
sat. sol. = Saturated aqueous solution, prepared at 20°C (68°F)

sol. = aqueous solution with concentration above 10% but below saturation level

dil. sol. = diluted aqueous solution with concentration below 10%

cust. conc. = customary service concentration

Appendix F: Design Diagram for Liner Seam Orientation


Miles City Plant
25' panel with 5" seam
North
Top of Tank
laid flat
(12' wall)
Liner panel
West
East
6' liner overhang
from top of tank
121'x25'
121'x25'
Bottom of
tank dia=
157'
166'x24.6'
166'x24.6'
South
188'x24.6'
194'x20'
194x24.6'
188'x24.6'
Scale
0
20

Appendix G: Atlantis Systems Set-Up Procedures

Steps for Setting the Atlantis Modular Impoundment

Pre Job Checklist

- Get site info
- Get company rep name
- Check site for topography and ground material make-up
- Confirm shipping location of impoundment and company providing shipment

Inventory Needed On-site for System Install

- Geotextile
- Liner
- Impoundment walls
- Piping and all necessary hardware
- Ladders and fall protection
- Plate stands with plates, pins, and safety pins
- Clamps

Tools and Equipment Needed On-site for System Install

- Trackhoe with an operator
- Boom truck or crane capable of reach 7000 lbs at least 50 feet with an operator
- Genie boom with a minimum 30' reach
- Laser level for checking ground work prior impoundment to set-up
- Wrenches, pry-bars, crow-bars
- Marking paint
- 300' tape measure
- Tools necessary for pulling out liner

Poseidon Concepts

Tank setting Procedures

Use proper safety procedures for all steps. Hoisted loads must have tag lines, genie operators will be harnessed properly and anchored, and all required PPE will be worn at all times.

- Check pad for rocks, sharp objects, irregularities, proper suction pits.
  - Suction pits should be deeper in the center than toward the edge of the tank. This will prevent air from being trapped and the suction box floating.
  - Y-trenches should be no less than 8" and nor more than 18" deep.
- Unroll geo-fabric (rough/rocky pad may require two layers of geo)
  - Overlap at least 1 foot unless using a one-piece fabricated geo
    Start on the downwind side when using single rolls
  - Paint circle for tank walls on top of the geo
- Setting liner
  - Paint stop lines to indicate how far to pull liner.
  - Set picker to boom out so you can unroll the liner with the trackhoe
  - Use laborers to unfold liner to the stop lines.
  - Square the liner up, if needed.
  - Repeat procedure, if double lined.
  - Fold liner back to center to allow room to place tank walls
  - Paint a circle as a top-of-wall guide for pulling liner, trim outside that line so it will hang at least two feet outside of the tank.
  - At this point it is very helpful to fill your y-trenches to weight down the liner.
- Placing tank walls (with crane)
  - If using a crane or boom truck, position to start placing tank panels
  - Back truck with panels within reach of the crane or pack with the trackhoe.
  - With a 4-point hook, lift panel, swing into place.
  - Picker will set panel on ground and reposition hooks to a four-point lift using the slide arms on the panels to stand upright and position it on the circle painted on the geo.
  - If using a telehandler, hook up to the four inside angled pick points. Then pick and carry to desired starting point. You will need to measure and paint a center reference to make setting panels easier for the telehandler operator.
  - Trackhoe will need to use thumb to "hold" panel in place until the next panel is attached.
  - Repeat steps with next panel, connect with plates, pins and safety pins. Trackhoe may release panel at this point unless high wind conditions exist, then should hold for at least three panels.
  - After connecting each panel, a 3 foot wide length of geo will be placed and secured to protect the liner from the seams of the tank.
  - Continue these steps until tank walls are all in place. Do not connect the last panel until liner-pulling crew has entered the tank, do not make the connections on the last seam until ladders are in place and liner pull is nearing completion.
  - Connect final panel.
- Pulling liner
  - Worker inside the tank straps liner, and hands to genie workers. Genie workers pull the liner so that the pull line is at the top of the wall. Worker inside tank will make sure the liner is to the wall of the tank

along the floor. Clamp the liner in place. (It is helpful in windy situations to be filling the tank as you are pulling liner to add weight and keep the wind from blowing it out.)

- Continue procedure until the entire liner has been pulled over the wall and secured in place.
- Clamps should be spaced and an adequate number put on the wall to minimize wind inside the tank behind the liner.
- After liner is pulled and clamped, trim excess liner 2-3 feet outside of the tank. Trackhoe should clean up and prevent dispersion by covering with dirt, snow, etc.

- Assemble suction, piping and ladders and place over wall
  - Make sure all bolts, connections and clamps are securely fastened. Flexible suction needs to have TWO clamps on each end.
  - Place filler tubes and circulating pipes around tank as needed.
  - Leave all valves open to allow air to escape.
  - Make sure sure fall arrestors are in place and functional.
- Walk outside of tank, make sure all plates are in place, pins properly secured with safety pins in place.
- Check area for garbage, debris, tools, etc..

Appendix H: State Land Office Written Agreement for Modular Impoundment Placement and Site Closure

Purpose

Pursuant to 19.15.17.13.G.2 of the New Mexico Administrative Code, we submit this written agreement on behalf of Devon Energy to serve as documentation of the State Land Office's approval of Devon's proposed alternative to re-vegetation of the production pad at the Turquoise 27-5 well during closure of the above ground modular impoundment.

Project Background

Devon Energy will use produced water to supply hydraulic fracturing operations at Devon's Turquoise 27-5 well. The project will consist of the produced water being trucked to the Turquoise 27-5 well site where it will be treated and stored onsite in a 41,000 bbl above ground modular impoundment.

All components of the mobile treatment system and modular storage impoundment will be located on the production pad for the Turquoise 27-5 well. No additional site development will be required in order to accommodate the treatment system and supporting equipment. **Figure 1** illustrates the planned layout of the treatment and storage equipment on the Turquoise 27-5 well site. All site development must be within the Parkway West Unit.

Alternative to Re-vegetation

19.15.17.13.I of the NMAC provides the conditions for site re-vegetation after pit closure. Devon Energy requests permission from the State Land Office to reclaim the location as an active production pad for the Turquoise 27-5 well as an alternative to re-vegetation. As part of the alternative to re-vegetation, Devon will demonstrate in the following paragraphs that the proposed alternative to re-vegetation will prevent erosion and protect freshwater, human health, and the environment (NMAC 19.15.17.13.G.2).

The production pad, as originally constructed, will consist of 10-12 inches of compacted caliche overlying a dense clay base. As such, the production pad will prevent the erosion of any native underlying soils. Any portion of the pad which was excavated during produced water treatment and storage will be backfilled with approximately 16 inches of compacted caliche and graded to match the surrounding pad. Additionally, the materials used and method of construction for the production pad will be chosen such that the pad will be resistant to wind erosion. Silt fencing will be constructed to capture any fines eroded from the pad by stormwater runoff; the fencing will be constructed along all edges of the pad where stormwater will flow off the pad.

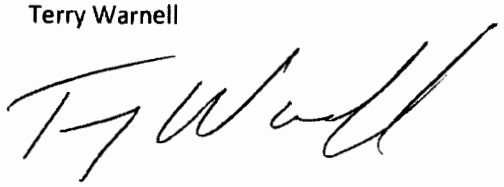
If it is determined that a release of produced water or treated produced water occurred during operations, then Devon will comply with the rules regarding release notification and remediation under NMAC 19.15.29 and 19.15.30, respectively. Additionally, Devon will comply with the production operating practices outlined under NMAC 19.15.18. Devon's strict compliance to these rules will protect freshwater, human health, and the environment during site restoration as well as over the course of the production lifetime for the well.

Devon will re-vegetate the site pursuant to the provisions under NMAC 19.15.17.13.I during closure of the Turquoise 27-5 well.

Approval from the State Land Office

As the land owner, The State Land Office has reviewed and approves Devon Energy's proposed alternative to re-vegetation during closure of the above ground modular impoundment at the Turquoise 27-5 production pad. This approval is contingent upon Devon Energy implementing the proposed alternative to re-vegetation within a period not to exceed 180 days from the signing of this agreement.

Terry Warnell



New Mexico State Land Office

FIGURE 1

Project Layout Relative to the Turquoise 27-5 Production Pad