

An aerial photograph of an oil well site in a snowy, mountainous region. In the foreground, a surveying tripod is set up on a snow-covered rock. The well site in the background features a central derrick, several storage tanks, and various pieces of equipment. The surrounding landscape is covered in snow and sparse trees.

WELLSITE SPACING RECOMMENDATIONS

Prepared by:

Wellsite Spacing Committee

Date:

March 23, 2003

Table of Contents:

1. The Challenge.....	1
2. The Committee.....	2
3. Well Spacing Layouts.....	3
4. Regulations Table	4
5. Well Site Sizing Check List.....	5
6. Committee Recommendations	6
A. Industry Recommended Practice (IRP):	6
B. Construction and Reclamation Group:.....	6
C. Industrial Construction and Reclamation Committee (ICRC):.....	6
D. Petroleum Institute Training Services (PITS):.....	6
E. Government AOA/EFR and Public Lands Handbooks:.....	7
F. Workplace Health and Safety:	7
G. BC – Oil and Gas Commission and WCB.....	7
H. Saskatchewan – SEM:.....	7
7. Feed Back Process;	8
8. Do’s and Don’t List;	8
9. Acknowledgments	8

For copies of this document or a CD containing this document and a related presentation, contact:



**Challenger Geomatics Ltd.
300 – 6940 – Fisher Road SE
Calgary AB T2H 0W3**

Phone: (403) 253-8101

FAX: (403) 253-1985

e-mail: calgary@challengergeomatics.com

1. The Challenge

In December of 2000, the Committee got together for the first time to begin discussion on wellsite spacing relating to wellsite size. From the outset, the committee fit together well and began to focus of a common goal, under joint Government and Industry leadership.

Although most of the members will agree, this has been a long out-standing requirement; it was a discussion at the Industry Construction and Reclamation Committee (ICRC) in the fall of 2000 that led to the challenge.

Ralph Woods brought forth the discussion with two primary issues which he wanted to discuss, as follows:

- Many hours of time were being wasted over discussions, with many subsequent re-applications, as a result of O&G companies applying for a multitude of different wellsite sizes. If each wellsite was the result of exploration for a different product or was on different terrain some variation would be expected but when this occurred in the same Forest Area where all the drilling was for shallow gas, differences were not justified or justifiable.
- It was perceived that many wellsites (for oil drilling primarily) were too large.

Dan Duncan as Co-Chair of the ICRC group and former Chair of the Construction and Reclamation Group, supported Ralph's desire to have this reviewed and suggested to the ICRC that a sub-Committee to do just that should be established. Dan Duncan, with his knowledge of numerous eligible persons in the O&G sector, brought the group together.

After much work, many meetings and a lot of travelling, the Committee has put together its recommendations. The initial focus was to define what the issues that were being encountered by both industry and government. The following summarizes the recommendations made by the committee.

2. The Committee

From the Oil and Gas Industry

<u>Name</u>	<u>Workplace</u>
Danny Duncan (Co-Chairman)	Gulf Canada Resources Ltd.
Carl Jensen	EnCana Corporation
Roxanne Kosiorek	Pennwest Petroleum Ltd.
Sheldon Reves	Burlington Resources
Don Thompson	PetroCanada

Note: Gary Webster and subsequently Roger Shaneman of CAPP were recipients of the committee meeting minutes and recommendations.

From the Government

<u>Name</u>	<u>Workplace</u>
Ralph Woods (Co-Chairman)	Alberta Sustainable Resource Development, Public Lands Division
Paul Bothwell	Alberta Energy Utilities Board (AEUB)
Adolf Bruniski	Alberta Sustainable Resource Development, Public Lands Division
Casey Leahey	Alberta Workplace Health/Safety
Bruce Cazes	Oil & Gas Commission – British Columbia
Rod Lowen	Worker's Compensation Board – British Columbia

3. Well Spacing Layouts

The size of the working area of a wellsite is most often determined by the size of the drill rig intended to drill the well. However, other factors that will have an influence include the accessories needed for the drill rig including trailers for various critical crew, specialty equipment, type of drill sump and often, the size of the service rig and its associated equipment after the drill rig operation. The associated service rig equipment often includes multiple truck for frac operations, nitrogen trucks etc.

In addition to the working area, in many cases, additional space is required due to the cut and fill required if a well is placed along the slope of the land. Sandy soils will require a wider slope than higher clay type soils for side slope stability. Additional area may be required for the storage of salvaged soils, snow storage, drainage ditches, berms and other considerations.

In order to determine an optimum size wellsite size, the committee worked through a series of typical operations indicating the appropriate size lease for typical size drill rigs and service rigs. As a result, templates were generated to reflect the appropriate working area size. It is well recognized that because of the variance in drill rig and service rig set-ups, there are many more variations that could have been used. However, our experience suggests that the types provided, would capture the majority of operations.

Consideration was also given to multiple well pads that are often construction for shallow or heavy oil operations. Also considered was the lease requirements for core hole programs usually associated with heavy oil programs. The committee concluded that these situations vary too much depending on the operator and the well layout conditions, and as a result, they would not be part of the Spacing Committee mandate.

The templates generated include a side profile of the lease, a template for drilling operations, service rig or coil tubing operations as well as typical production requirements. To demonstrate key issues regarding lease size determination, pictures are included to help explain the situations encountered.

The templates areas developed are as follows;

- **1) Deep Oil Operation**
- **2) Deep Gas Operation**
- **3) Shallow Gas Operation**
- **4) Prairie Shallow Gas Low Impact Operation**
- **5) Forested Area Shallow Gas Low Impact Operation**
- **6) Shallow Gas Coil Tubing Operation**
- **7) Under Balance Operation**
- **8) Shallow Oil Operation**
- **9) Blank Template**

4. Regulations Table

The size of the well site is heavily influenced by the various regulations that apply to the oil and gas industry. To characterize the various government agencies requirements, a table was generated indicating the minimum spacing requirements as well as the associated regulation code that reflects the specific standard for each Province.

A conflict was identified for the minimum spacing requirement by the Government agencies between Provinces for the same type of operation. It was assumed that this conflict was mostly attributed to the conversion from English units to Metric Units where some provinces rounded up, while other rounded down. Effort by the committee to standardize the distances did not materialize and this issue remains outstanding and should be reviewed and potentially resolved as part of the proposed IRP exercise.

Another area of concern was when, why and how some of the specific rules were determined. After much discussion and limited success in developing the history, the Committee concluded that there must have been some support for the distance and as a result, changing some of the distance was not done. A specific example was the 25 meter no smoking rule as opposed to the 50 meter flare rule. Discussions suggested that the flare has much for potential for out of control burn and potential for radiant heat. The IP process may consider reviewing some of the science behind some of the spacing distances.

The attachment Regulations Tables includes the requirements for;

- Alberta Energy Utility Board (EUB)
- Saskatchewan Energy and Mines
- BC – WCB
- BC – Oil and Gas Commission
- Workplace Health and Safety for Alberta, BC and Saskatchewan.
- Forest and Prairie Protection Act
- Public Lands
- Wildlife
- Alberta Private Sewage Systems Standard of Practice

5. Well Site Sizing Check List

Another issue that often develops when building well sites is that the constructed well site may be too big for the intended operations or too small. The oversized lease obviously doesn't have a big impact on the subsequent operations but it does mean additional construction expense that was not required as well as the disturbance of adjacent land. A lease too small often results in illegal operations which could result in an operation being shut down by a Regulatory Agency. This also poses a potential safety issue for on site personal and equipment damage.

As an aid to optimize the well site requirements, a Check List was developed for utilization during the surveying/planning of the well site. The Check list includes confirmation of key factors including the following;

- 1) LSD Location
- 2) Well Type
- 3) Well Depth
- 4) Future plans/Completions/Production
- 5) Rig Type
- 6) Mud System
- 7) Drilling Waste Disposal
- 8) Flare requirements for Drilling and Production
- 9) Tank Spacing Requirements
- 10) Winter or Summer Drill
- 11) Berm requirements
- 12) Drainage Ditches
- 13) Brush Storage
- 14) Soil Storage
- 15) Construction Method
- 14) Well Site Working Area and Total Area Size

6. Committee Recommendations

As defined in the Challenge section, there were many circumstances that led to the development of the Spacing Committee. As a result, the committee has developed a number of tools to help optimize the lease size to both meet the regulatory requirements but also not over construct which results in disturbance of additional land, additional costs both for construction and reclamation.

With the tools defined, the recommendations by the committee are as follows;

A. Industry Recommended Practice (IRP):

As a result of a joint meeting between the Spacing Committee and CAPP representatives, the key recommendation made was to transfer the tools developed by this committee into an IRP. This process will involve setting up another sub-Committee under the Drilling and Completion Committee (DACC). This new committee will also include involvement from other Industry representatives including PSAC, WH&S, CAPP and CAODC.

As part of the IRP process, it is hoped that the discrepancies in spacing requirements between provinces for the same operation will also be addressed. In addition, any inclusion of spacing requirement for the Territories should also be considered.

B. Construction and Reclamation Group:

The tools should be distributed to the members of the Construction and Reclamation Group members for future distribution to their field construction and reclamation staff. It is hoped that the “Users” of the information will determine if additional modifications need to be added or changed.

C. Industrial Construction and Reclamation Committee (ICRC):

This group is a sub-committee of the Construction and Reclamation Group and also includes a number of Government agencies. Copies of the various tools should also be distributed to these representatives with the intent of them forwarding on to their respective field staff for input and potential modifications.

D. Petroleum Institute Training Services (PITS):

Through the efforts of Construction and Reclamation group members and PITS representatives, a four day course called Lease Development and Reclamation course was developed. This course walks through the life of a well from the “Dirt’s” perspective starting from the initial geology, geophysical, surveying, mineral and surface land acquisition, licensing requirements, well site construction and reclamation techniques.

It is recommended that the efforts developed by the Spacing Committee be added to the course content.

E. Government AOA/EFR and Public Lands Handbooks:

Alberta Sustainable Resource Development (SRD) has developed a number of documents including the Environmental Field report (EFR) and Area Operating Agreement (AOA) that detail requirements Industry must meet in order to obtain Mineral Surface Leases (MSL) and, PLA (Pipeline Approval) and License of Occupation (LOC). The SRD has also developed a Handbook specifying various requirements for industry. Recommendation is that the tools prepared by the committee be considered as part of the various processes.

F. Workplace Health and Safety:

A WH&S table was developed reflecting various spacing requirements by Workplace Health and Safety and also included the same requirements for Alberta, BC and Saskatchewan. In review, it was determined that with a few exceptions, the majority of WH&S requirements were less stringent than that of the AEUB. As a result, the Regulations Table was modified to reflect only the exceptions.

G. BC – Oil and Gas Commission and WCB

The Committee Recommendations will be circulated through various Application and Approval groups to solicit feedback. Suggested that the IRP process will provide more response from various affected groups within BC.

H. Saskatchewan – SEM:

Saskatchewan Energy and Mines recently updated their document of Saskatchewan Upstream Petroleum Industry Storage Standards which includes a matrix of various spacing requirements. This table information was included in the Regulation Table.

7. Feed Back Process;

In parallel to the development of an IRP, the intent is to circulate the various developed tools to Industry and Government to use in the interim. Any suggestions for modification or corrections should be directed back to the Co-Chairs of the Industrial Construction and Reclamation Group for initial capture until the new IRP Spacing Committee is established.

The Key Feedback contacts are:

John Begg of Public Lands: john.begg@gov.ab.ca
Darren Fantin of Burlington Resources; dfantin@br-inc.ca

8. Do's and Don't List;

During the various meetings held, a number of issues became apparent as those that continued to create issues by either Industry and or Governments members. As a result, we collectively wrote down what the key issue were to hopefully minimize the issues and the resulting implication. The Do's and Don't list was intended to aid others and could be used at each individuals discretion.

9. Acknowledgments

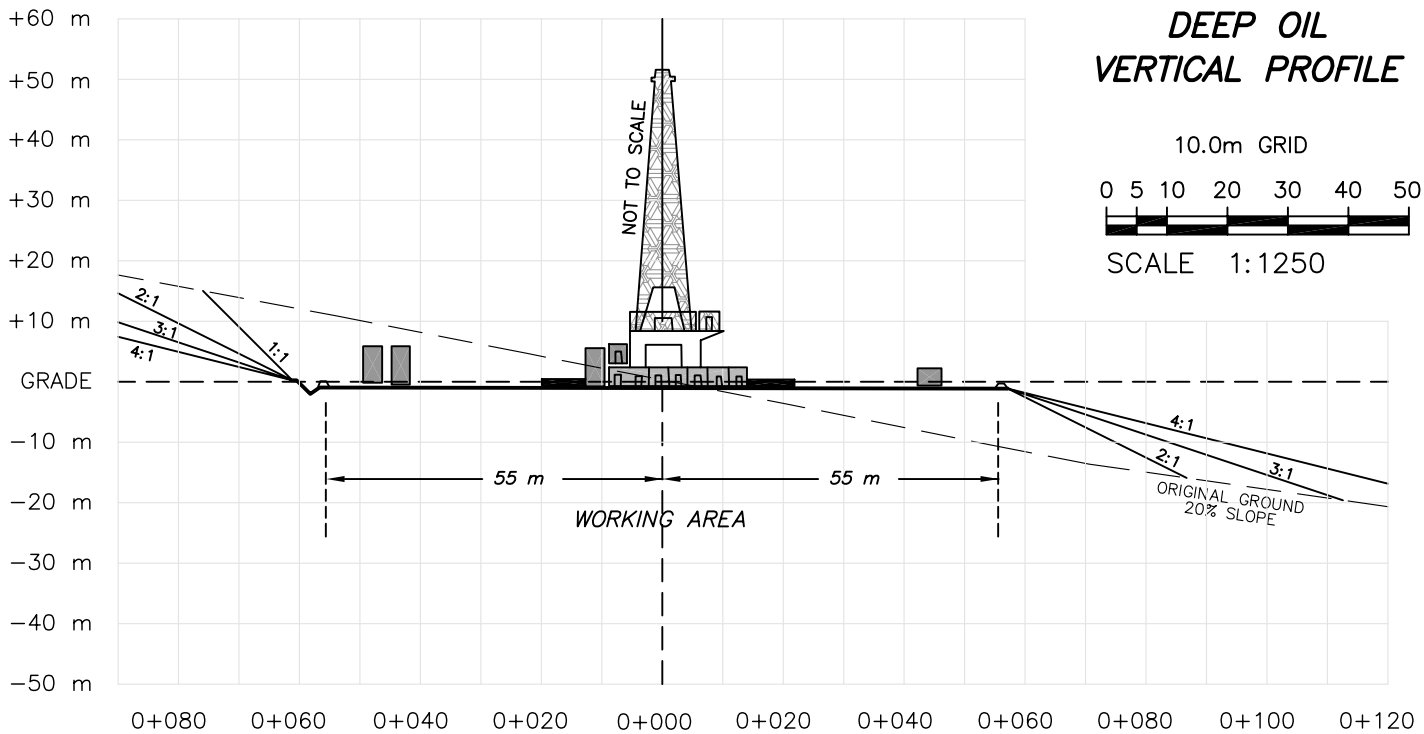
The Spacing Committee was initiated in December of 2002 as a result of continuous conflicts observed by the Land Managers with Industry demanding bigger leases than their counterparts were using or bigger that what SRD thought was necessary. As part of the discussions held at a ICRC meeting, Ralph Woods suggested that this item be addressed as a joint Government and Industry committee. The relationship between Government and Industry had worked very positively with the initiatives of the ICRC group. As a result, Dan Duncan, as co-chair of the ICRC group and previous Chair of the Construction and reclamation group organized the Spacing Committee

In addition to the current committee members, a number of other people participated at various stages of the committee activity but due to other commitments, could not continue with the process. The following individuals were involved and we thank them for their significant contributions;

Ron Elle, AEUB
John Beggs, Alberta Public Lands
Bill Bayrak, BC Oil and Gas Commission
Gordon Graham, Alberta Sustainable Resource Development
Rod Thomas, Bonus Well Servicing
Eugene Sarrasin, Bonus Well Services
Dustin Brodner, Petro-Canada, (Completions)
Brian Mathieson, Saskatchewan Energy and Mines

The Committee would also like to thank the Industry Committee and Alberta Government representatives for hosting the meetings and providing nourishment during the long gruelling discussions. The majority of the meetings were alternated between Edmonton Government office and the various committee members' offices in Calgary and one lone meeting in Peace River as follows:

<u>Date:</u>	<u>Location</u>	<u>Facilities</u>
1) December 21, 2000	Calgary	Gulf Canada
2) February 8, 2001	Edmonton	Alberta Government/Forestry
3) April 12, 2001	Calgary	Gulf Canada
4) June 7, 2001	Edmonton	Alberta Government/Forestry
5) January 9, 2002	Peace River	Alberta Government/Forestry
6) May 22, 2002	Calgary	Conoco (Gulf)
7) July 24, 2002	Edmonton	Alberta Government/Forestry
8) September 25, 2002	Calgary	Pennwest
9) November 6 th , 2002	Edmonton	Alberta Government/Forestry
10) December 4, 2002	Calgary	Burlington
11) January 23, 2003	Calgary	EnCana
12) February 20, 2003	Edmonton	Alberta Government/Forestry
13) March 20, 2003	Calgary	Pennwest (Sheraton Hotel)



DEEP OIL VERTICAL PROFILE

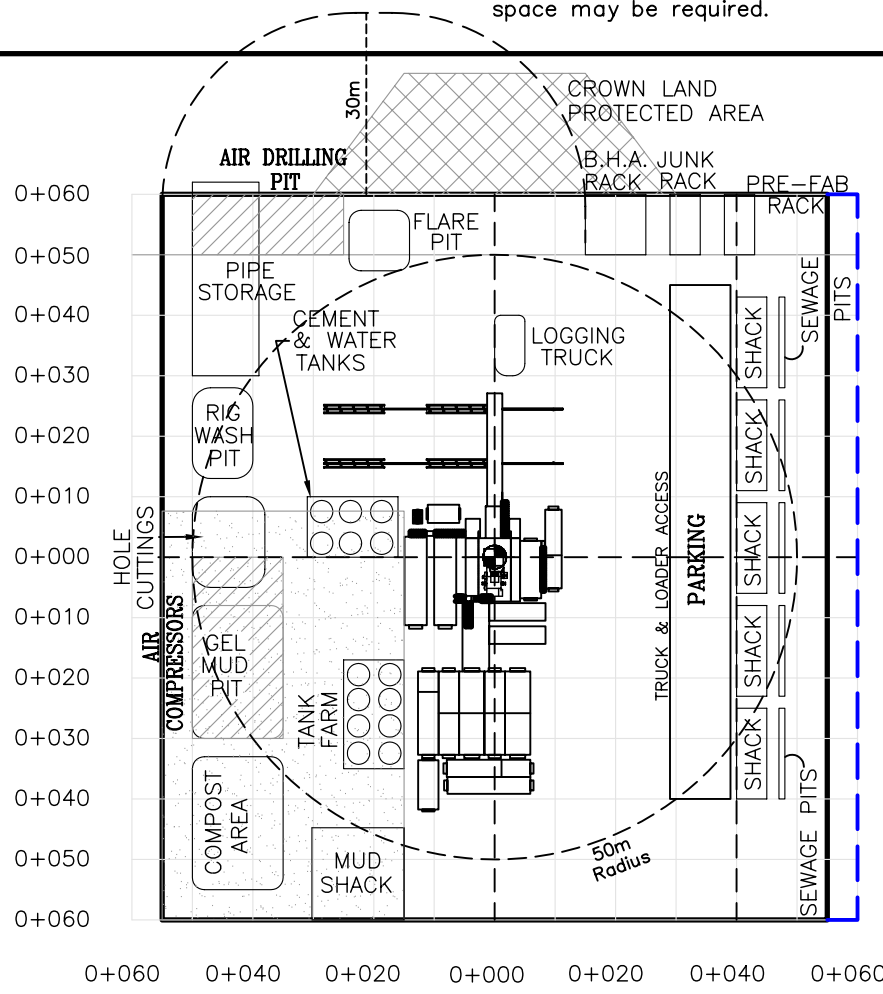
10.0m GRID
0 5 10 20 30 40 50
SCALE 1:1250

NOTES:

- 1.) Drawings do not account for soil storage.
- 2.) Sloped lands will vary lease perimeter.
- 3.) Space requirements vary with equipment type.
- 4.) During equipment set up and tear down additional working space may be required.

TYPICAL 1A VERTICAL PROFILE

Rev. # 11 Date: Feb. 25, 2003.
File # 13699-deep oil-Rev 11



DEEP OIL RIG LAYOUT WORKING AREA (110 Wide x 120 Long)

10.0m GRID
0 5 10 20 30 40 50
SCALE 1:1250

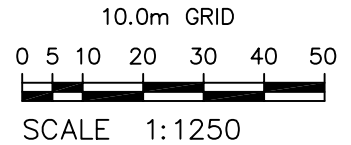
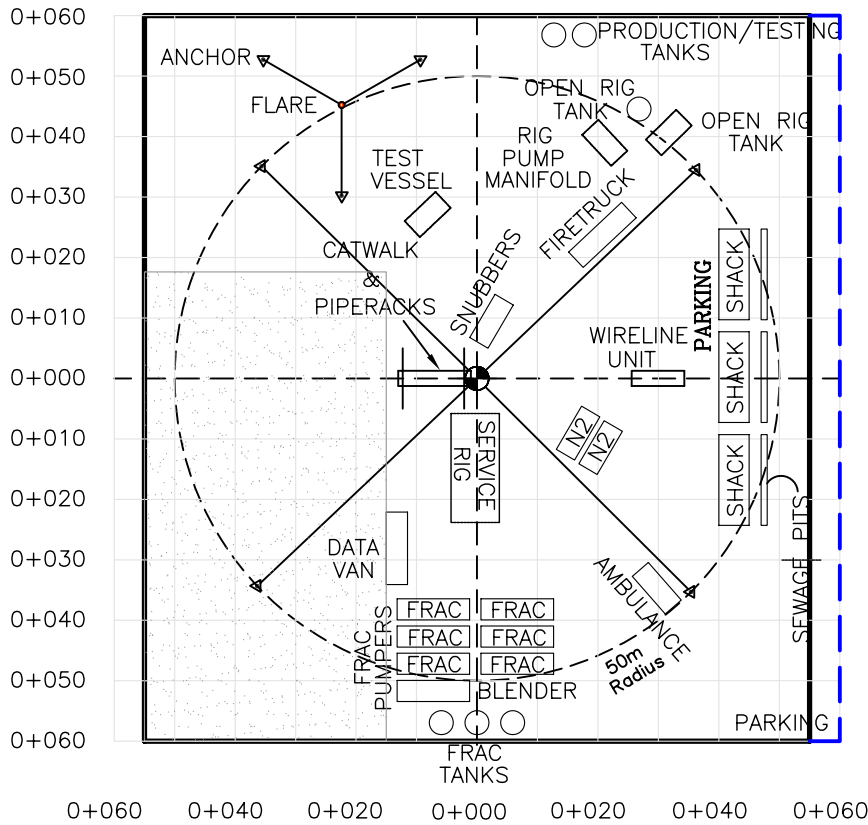
NOTE:

- Shape may vary but acreage will remain the same.
- EXTRA AREA REQUIRED FOR WELLS IN BRITISH COLUMBIA
- ▨ EXTRA AREA MAY BE REQUIRED FOR RIGGING UP
- ▨ AIR DRILLING PIT & AIR COMPRESSORS
- ▨ SUMP & SPOIL PILE AREA (IF REQUIRED)
NOTE: SIZE VARIES BY DEPTH

TYPICAL 1B RIG LAYOUT

Rev. # 11 Date: Feb. 25, 2003.
File # 13699-deep oil-Rev 11

DEEP OIL COMPLETION OPERATION (110 Wide x 120 Long)



NOTES:

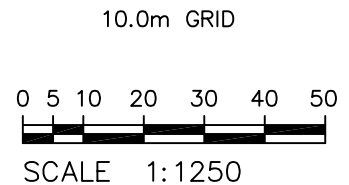
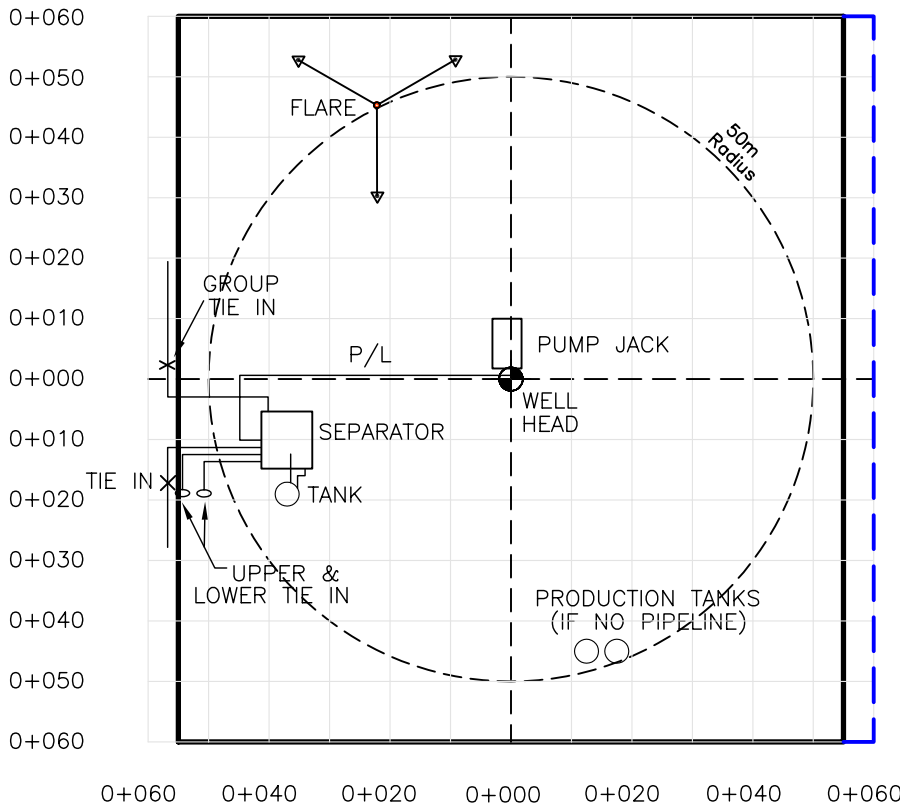
- 1.) Drawings do not account for soil storage.
- 2.) Sloped lands will vary lease perimeter.
- 3.) Space requirements vary with equipment type.
- 4.) During equipment set up and tear down additional working space may be required.
- 5.) Shape may vary but acreage will remain the same.

- EXTRA AREA REQUIRED FOR WELLS IN BRITISH COLUMBIA
- SUMP & SPOIL PILE AREA (IF REQUIRED)
NOTE: SIZE VARIES BY DEPTH

TYPICAL 1C SERVICE WELL

Rev. # 11 Date: Feb. 25, 2003.
File # 13699-deep oil-Rev 11

DEEP OIL PRODUCTION FACILITY (110 Wide x 120 Long)

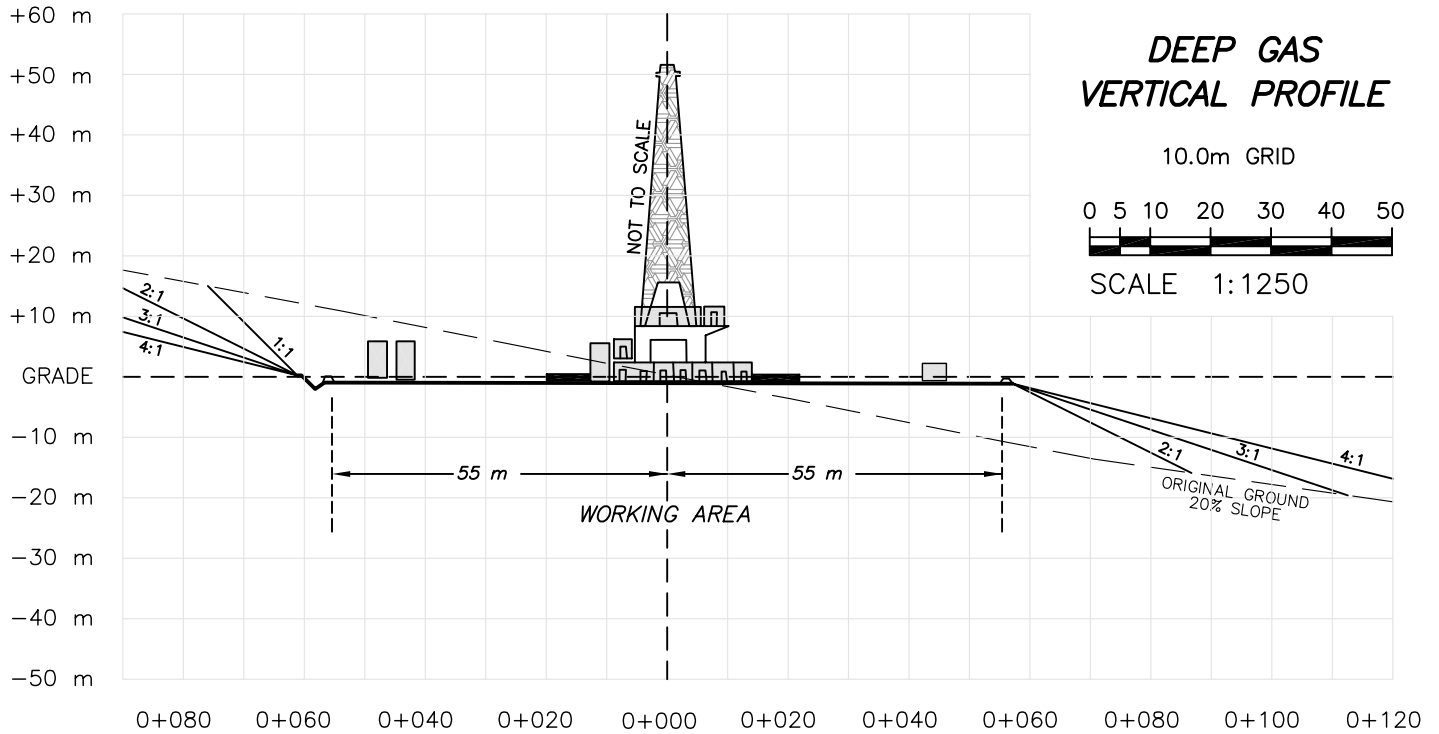


- EXTRA AREA REQUIRED FOR WELLS IN BRITISH COLUMBIA

TYPICAL 1D PRODUCTION FACILITY

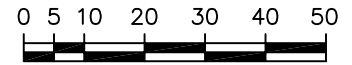
Rev. # 11 Date: Feb. 25, 2003.
File # 13699-deep oil-Rev 11





DEEP GAS VERTICAL PROFILE

10.0m GRID



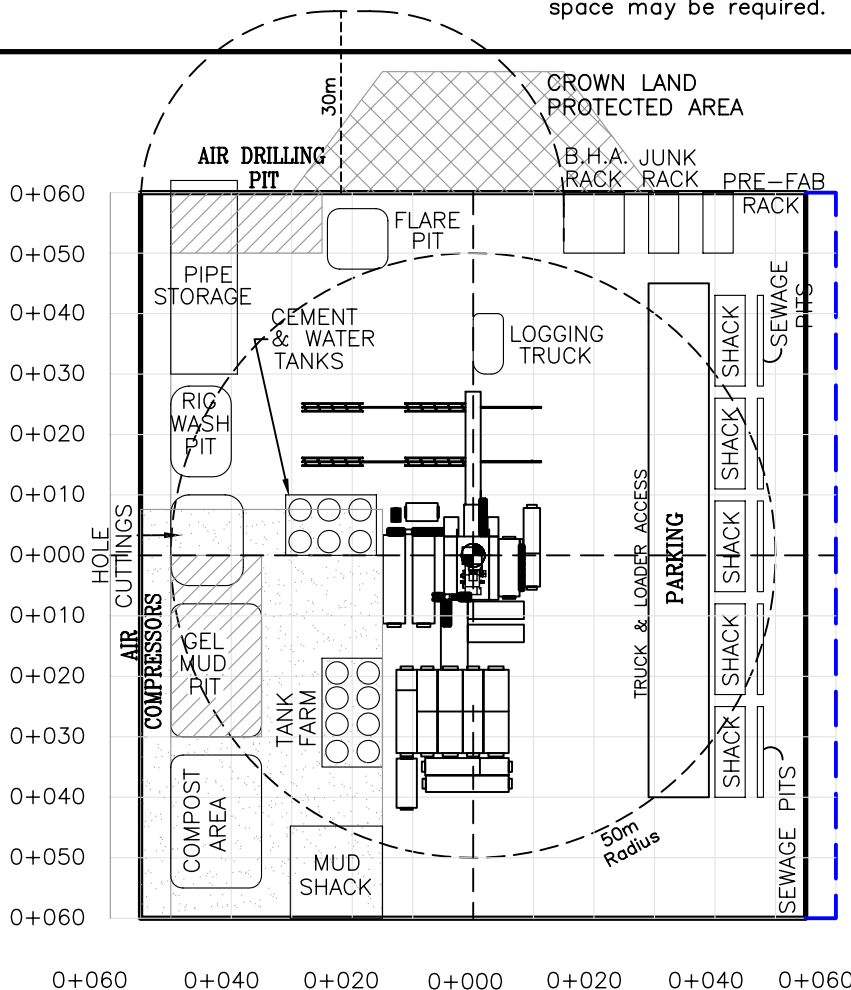
SCALE 1:1250

NOTES:

- 1.) Drawings do not account for soil storage.
- 2.) Sloped lands will vary lease perimeter.
- 3.) Space requirements vary with equipment type.
- 4.) During equipment set up and tear down additional working space may be required.

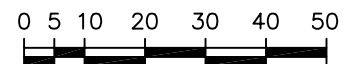
TYPICAL 2A VERTICAL PROFILE

Rev. # 12 Date: Feb. 25, 2003.
File # 13699-deep gas-sample Rev 12



DEEP GAS RIG LAYOUT WORKING AREA (110 Wide x 120 Long)

10.0m GRID



SCALE 1:1250

NOTE:

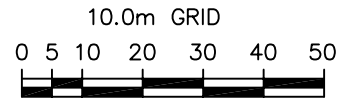
Shape may vary but acreage will remain the same.

- EXTRA AREA REQUIRED FOR WELLS IN BRITISH COLUMBIA
- EXTRA AREA MAY BE REQUIRED FOR RIGGING UP
- AIR DRILLING PIT & AIR COMPRESSORS
- SUMP & SPOIL PILE AREA (IF REQUIRED)
NOTE: SIZE VARIES BY DEPTH

TYPICAL 2B RIG LAYOUT

Rev. # 12 Date: Feb. 25, 2003.
File # 13699-deep gas-sample Rev 12

DEEP GAS COMPLETION OPERATION (110 Wide x 120 Long)



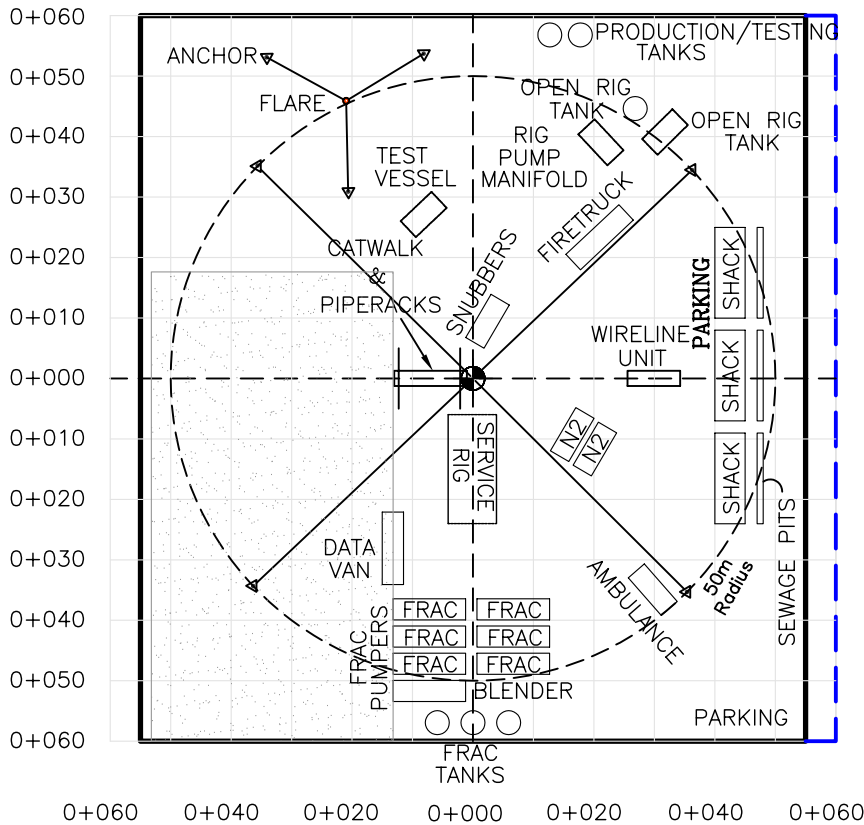
SCALE 1:1250

NOTES:

- 1.) Drawings do not account for soil storage.
- 2.) Sloped lands will vary lease perimeter.
- 3.) Space requirements vary with equipment type.
- 4.) During equipment set up and tear down additional working space may be required.
- 5.) Shape may vary but acreage will remain the same.

— — — — — EXTRA AREA REQUIRED FOR WELLS IN BRITISH COLUMBIA

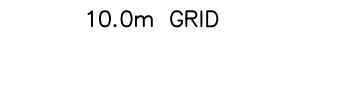
▨ SUMP & SPOIL PILE AREA (IF REQUIRED)
NOTE: SIZE VARIES BY DEPTH



TYPICAL 2C SERVICE WELL

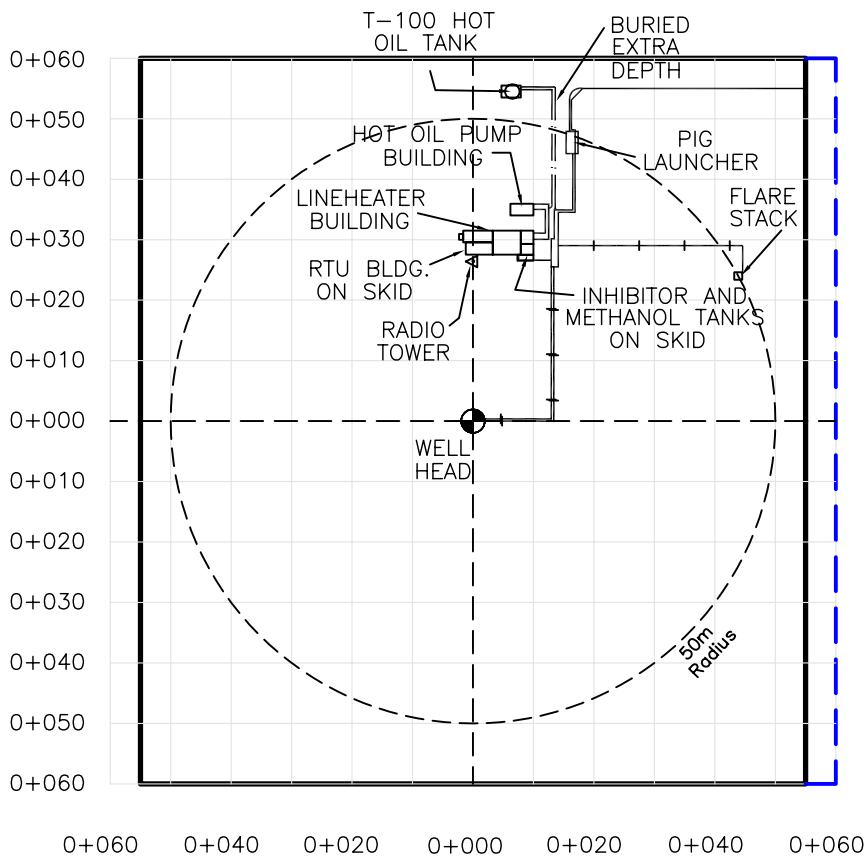
Rev. # 12 Date: Feb. 25, 2003.
File # 13699—deep gas—sample Rev 12

DEEP GAS PRODUCTION FACILITY (110 Wide x 120 Long)



SCALE 1:1250

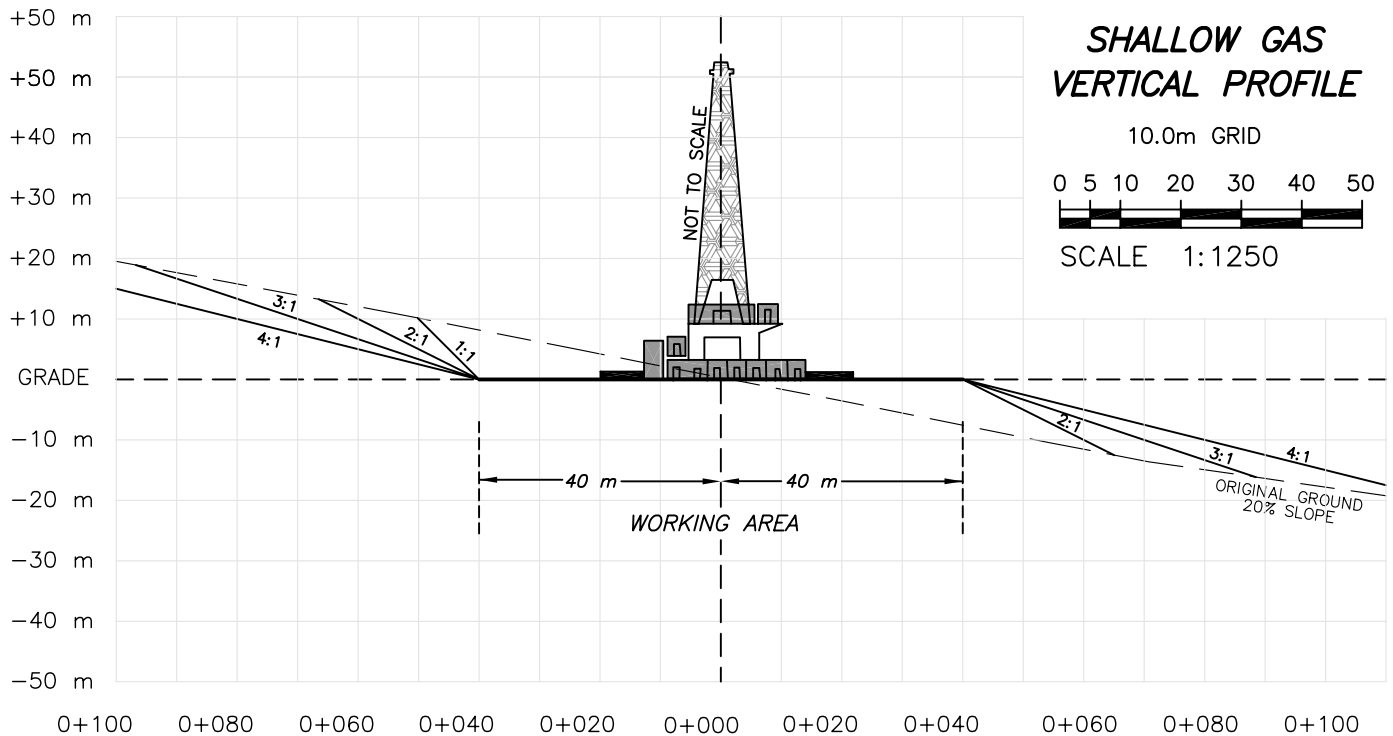
— — — — — EXTRA AREA REQUIRED FOR WELLS IN BRITISH COLUMBIA



TYPICAL 2D PRODUCTION FACILITY

Rev. # 12 Date: Feb. 25, 2003.
File # 13699—deep gas—sample Rev 12





SHALLOW GAS VERTICAL PROFILE

10.0m GRID



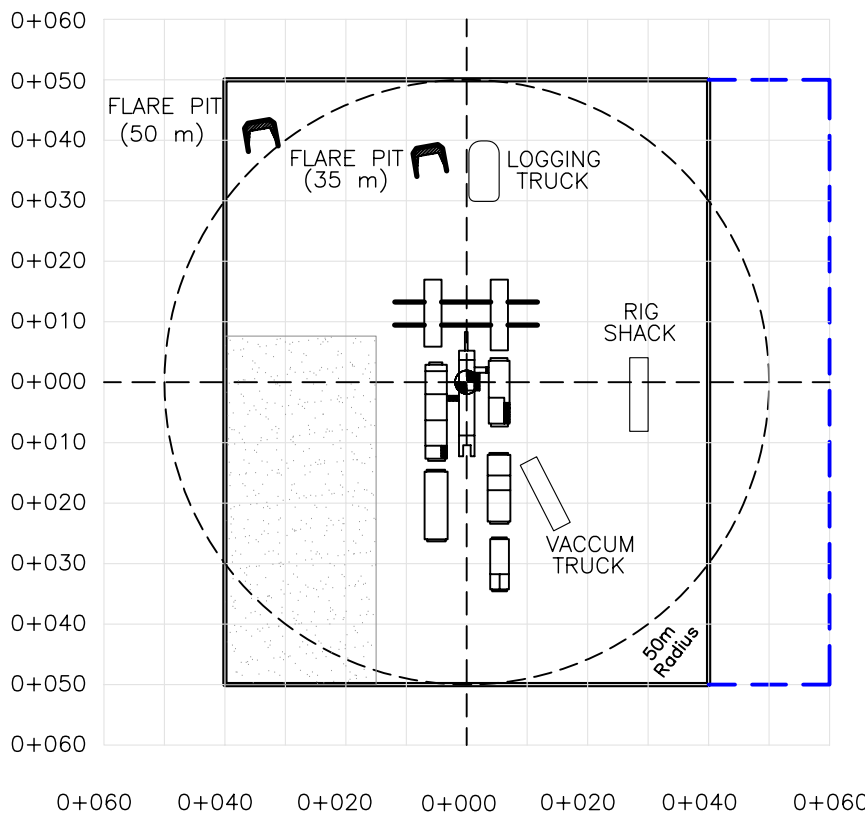
SCALE 1:1250

NOTES:

- 1.) Drawings do not account for soil storage.
- 2.) Sloped lands will vary lease perimeter.
- 3.) Space requirements vary with equipment type.
- 4.) During equipment set up and tear down additional working space may be required.

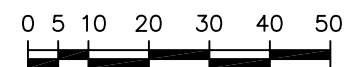
TYPICAL VERTICAL PROFILE 3A

Rev. # 11 Date: Feb. 25, 2003.
File # 13699-shallow gas-Rev 11



SHALLOW GAS RIG LAYOUT WORKING AREA (80 Wide x 100 Long)

10.0m GRID



SCALE 1:1250

NOTE:

Shape may vary but acreage will remain the same.

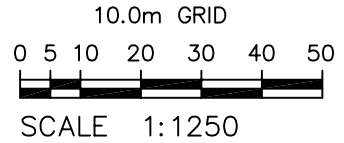
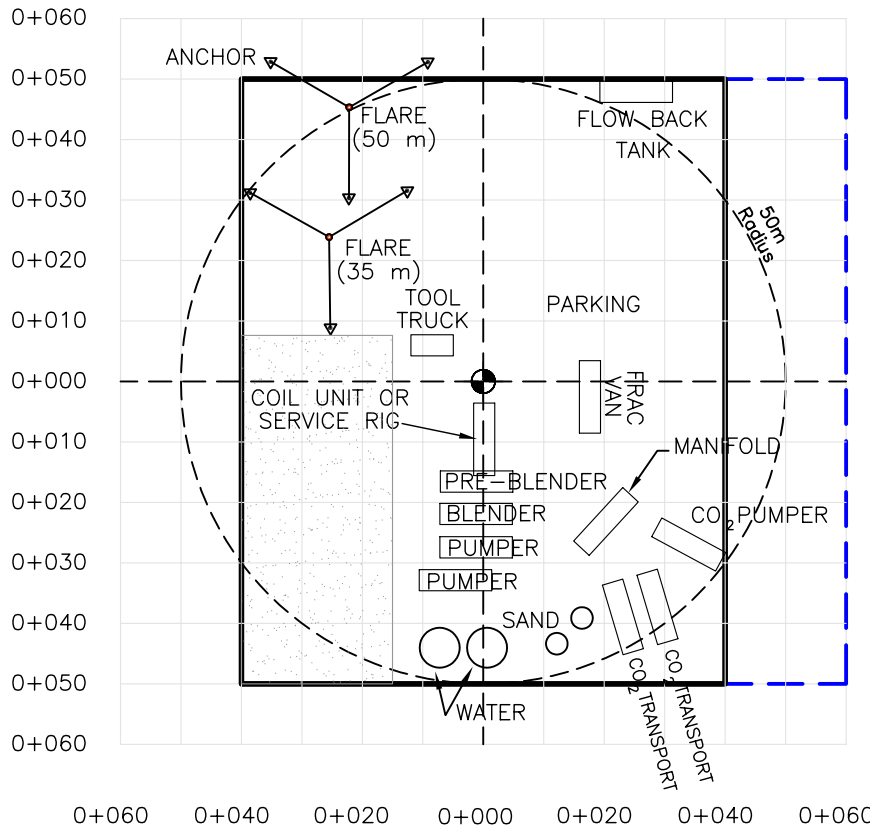
--- EXTRA AREA REQUIRED FOR WELLS IN BRITISH COLUMBIA

▨ SUMP & SPOIL PILE AREA (IF REQUIRED)
NOTE: SIZE VARIES BY DEPTH

TYPICAL RIG LAYOUT 3B

Rev. # 11 Date: Feb. 25, 2003.
File # 13699-shallow gas-Rev 11

SHALLOW GAS COMPLETION OPERATION (80 Wide x 100 Long)



NOTES:

- 1.) Drawings do not account for soil storage.
- 2.) Sloped lands will vary lease perimeter.
- 3.) Space requirements vary with equipment type.
- 4.) During equipment set up and tear down additional working space may be required.
- 5.) Shape may vary but acreage will remain the same.

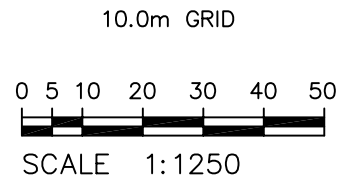
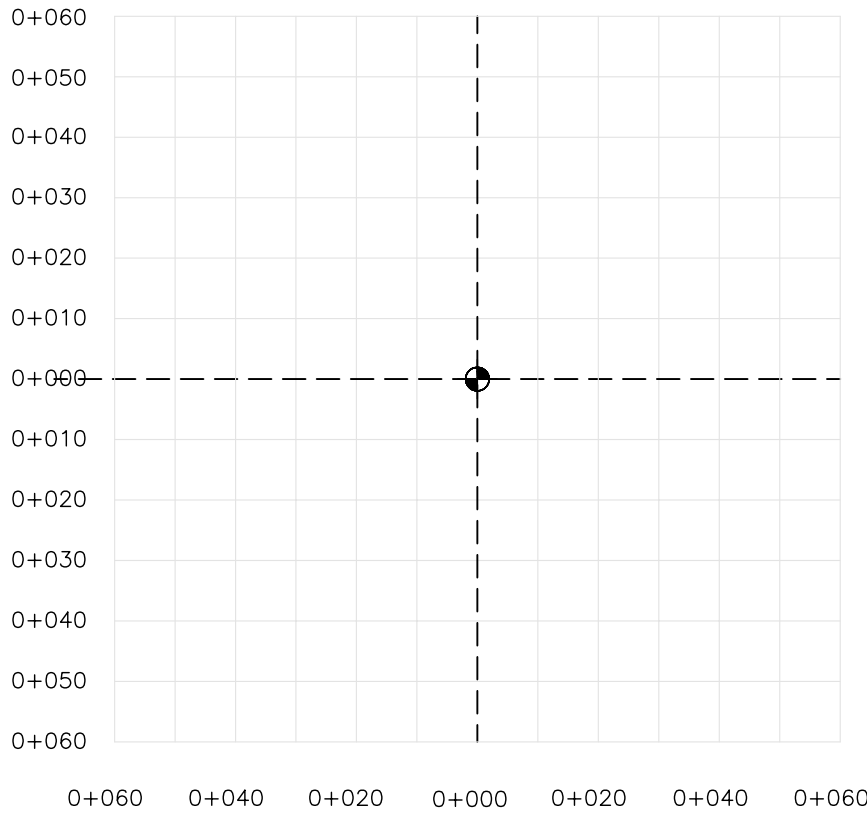
— EXTRA AREA REQUIRED FOR WELLS IN BRITISH COLUMBIA

▨ SUMP & SPOIL PILE AREA (IF REQUIRED)
NOTE: SIZE VARIES BY DEPTH

TYPICAL SERVICE WELL 3C

Rev. # 11 Date: Feb. 25, 2003.
File # 13699—shallow gas—Rev 11

SHALLOW GAS PRODUCTION FACILITY



TYPICAL PRODUCTION FACILITY 3D

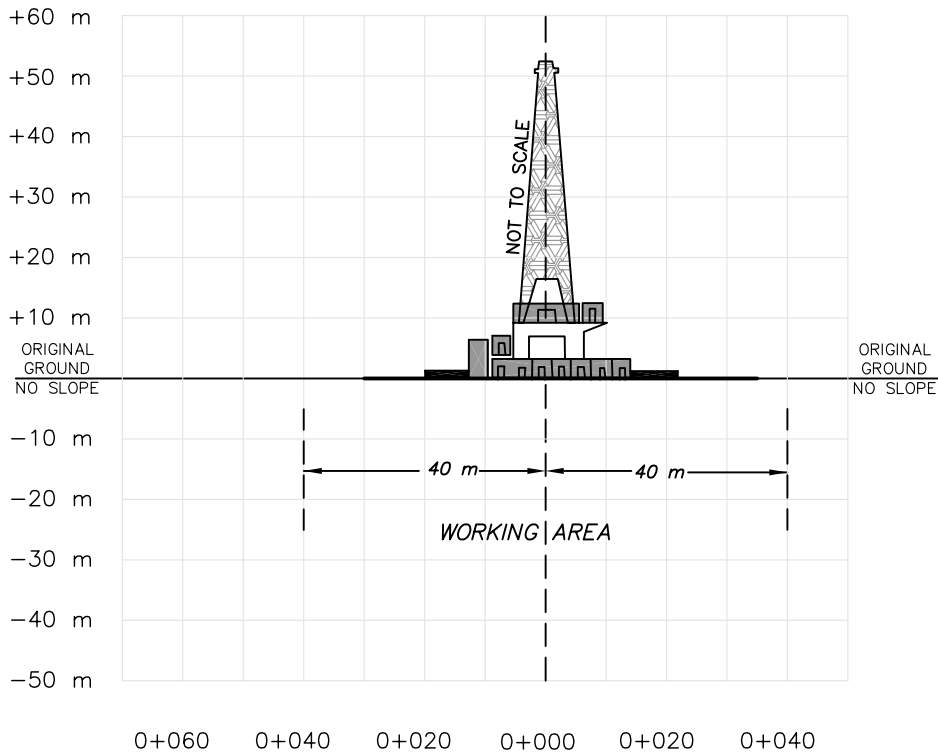
Rev. # 11 Date: Feb. 25, 2003.
File # 13699—shallow gas—Rev 11



2003 4 11

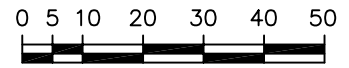


2003 4 11



**PRAIRIE SHALLOW GAS
LOW IMPACT
VERTICAL PROFILE**

10.0m GRID



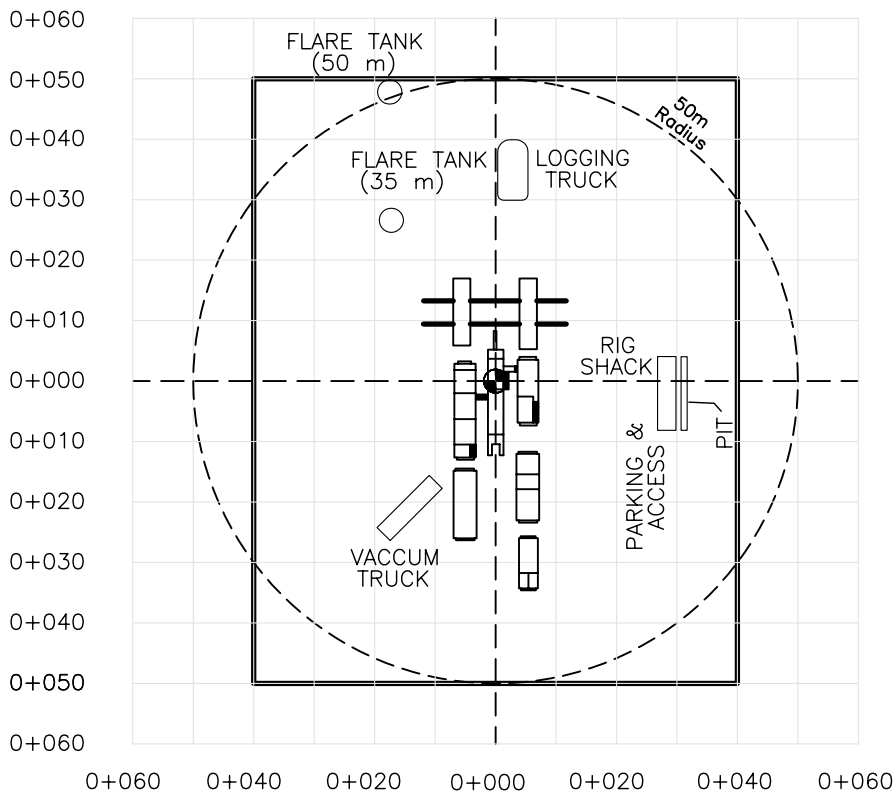
SCALE 1:1250

NOTES:

- 1.) Sloped lands will vary lease perimeter.
- 2.) Space requirements vary with equipment type.
- 3.) During equipment set up and tear down additional working space may be required.

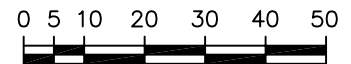
**TYPICAL 4A
VERTICAL PROFILE**

Rev. # 12 Date: Feb. 25, 2003.
File # 13699-Prairie shallow gas low impact-Rev 12



**PRAIRIE SHALLOW GAS
LOW IMPACT
RIG LAYOUT
WORKING AREA
(80 Wide x 100 Long)**

10.0m GRID



SCALE 1:1250

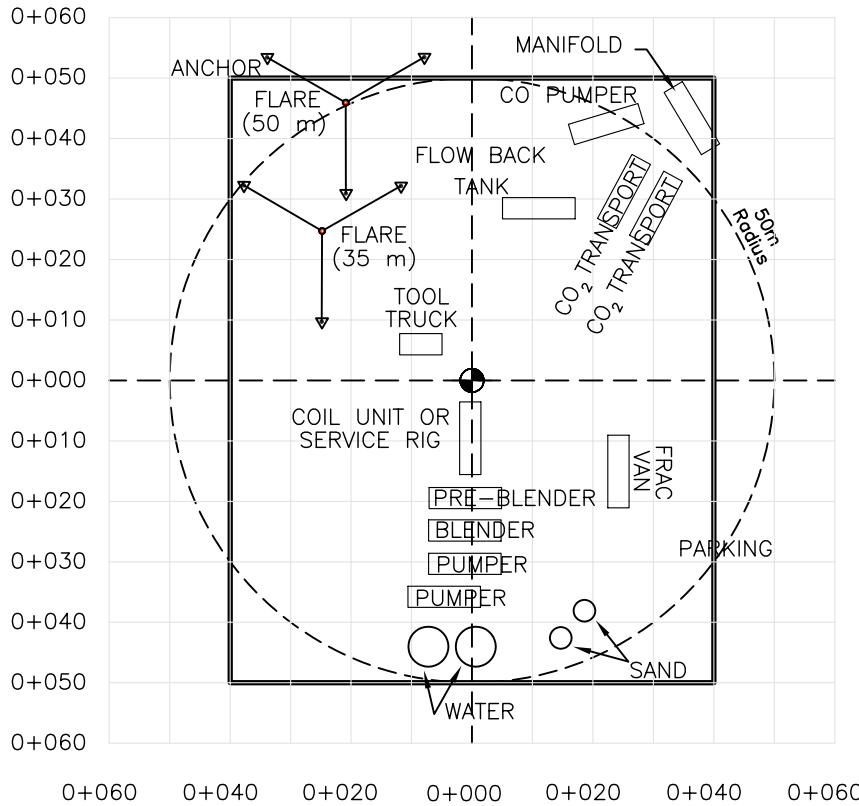
NOTE:

Shape may vary but acreage will remain the same.

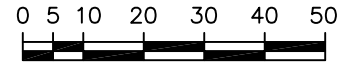
**TYPICAL 4B
RIG LAYOUT**

Rev. # 12 Date: Feb. 25, 2003.
File # 13699-Prairie shallow gas low impact-Rev 12

**PRAIRIE SHALLOW GAS
LOW IMPACT
COMPLETION OPERATION
(80 Wide x 100 Long)**



10.0m GRID



SCALE 1:1250

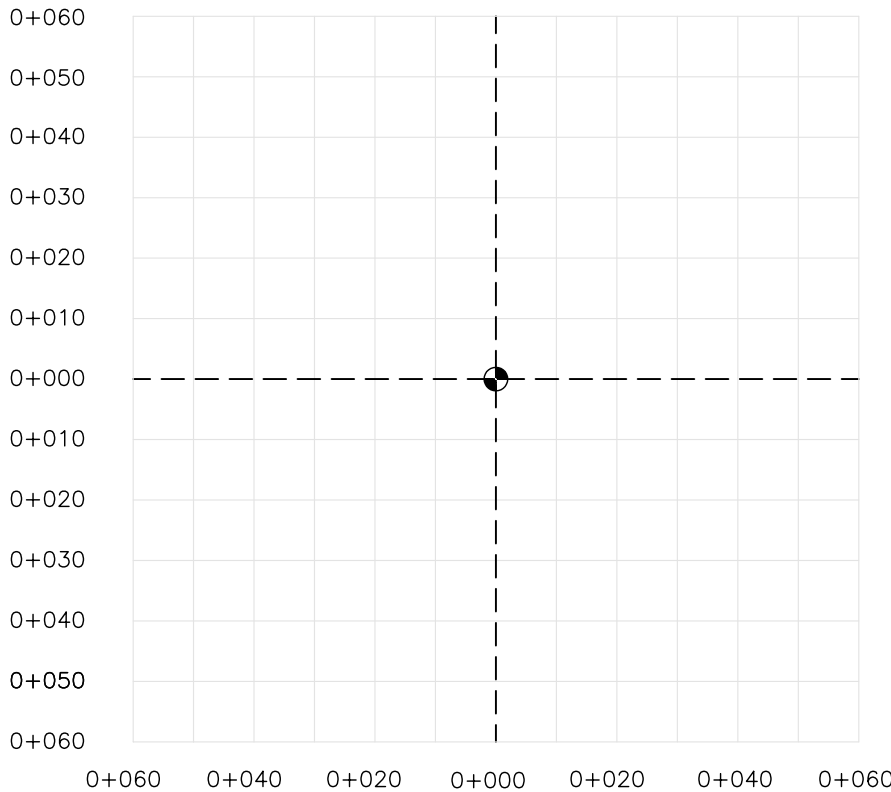
NOTES:

- 1.) Sloped lands will vary lease perimeter.
- 2.) Space requirements vary with equipment type.
- 3.) During equipment set up and tear down additional working space may be required.
- 4.) Shape may vary but acreage will remain the same.

TYPICAL SERVICE WELL 4C

Rev. # 12 Date: Feb. 25, 2003.
File # 13699-Prairie shallow gas low impact-Rev 12

**PRAIRIE SHALLOW GAS
LOW IMPACT
PRODUCTION FACILITY**



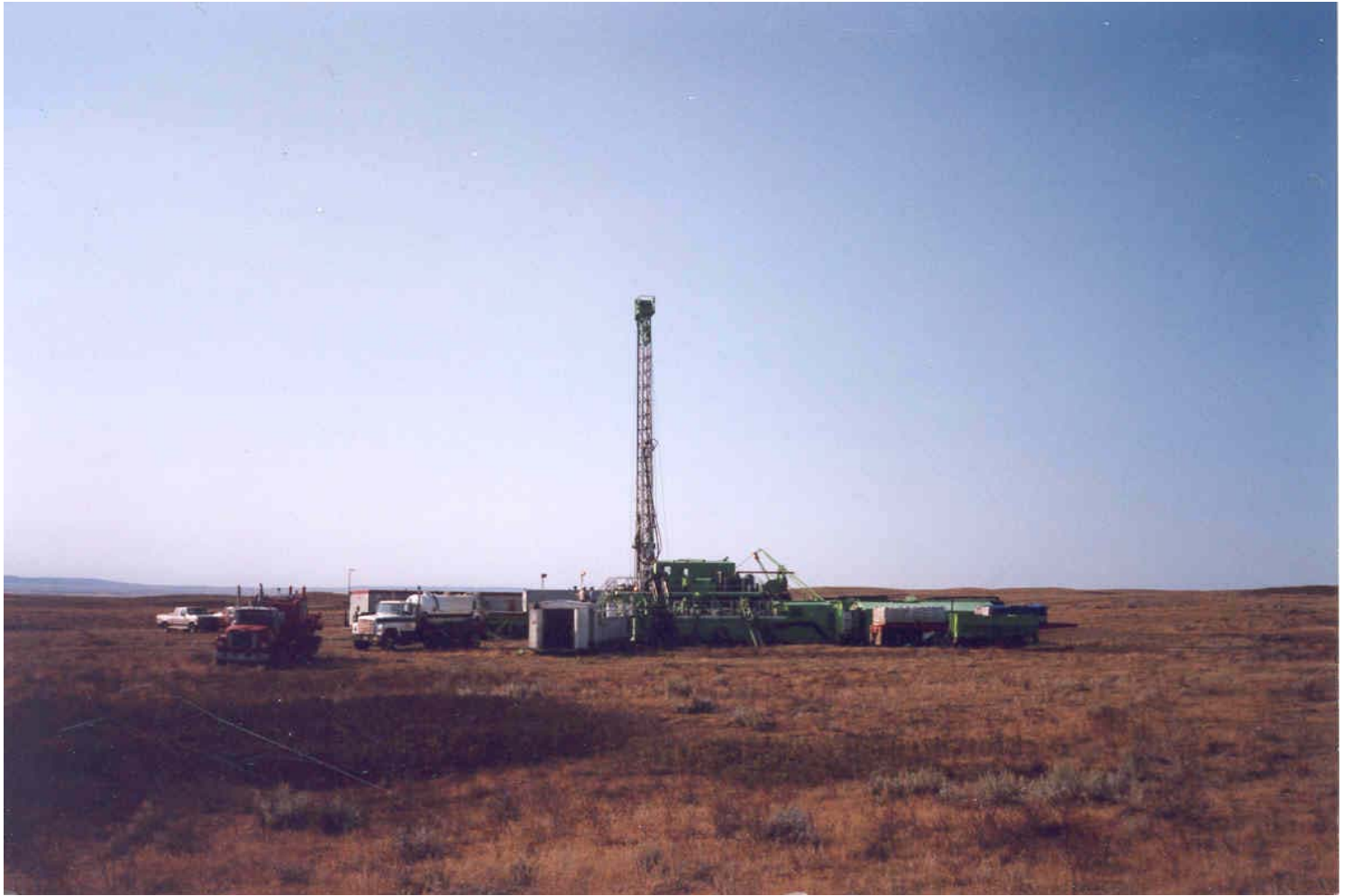
10.0m GRID



SCALE 1:1250

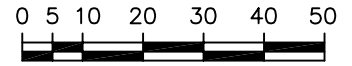
TYPICAL PRODUCTION FACILITY 4D

Rev. # 12 Date: Feb. 25, 2003.
File # 13699-Prairie shallow gas low impact-Rev 12

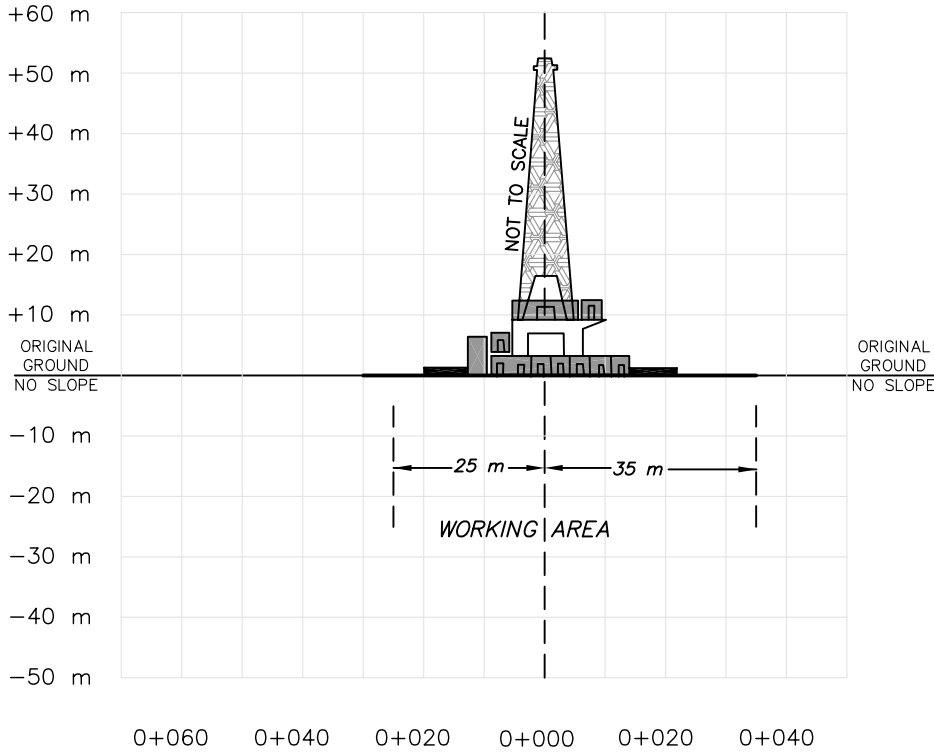


**FORRESTED AREA
SHALLOW GAS
LOW IMPACT
VERTICAL PROFILE**

10.0m GRID



SCALE 1:1250



NOTES:

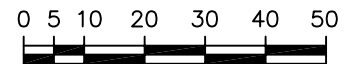
- 1.) Sloped lands will vary lease perimeter.
- 2.) Space requirements vary with equipment type.
- 3.) During equipment set up and tear down additional working space may be required.

**TYPICAL 5A
VERTICAL PROFILE**

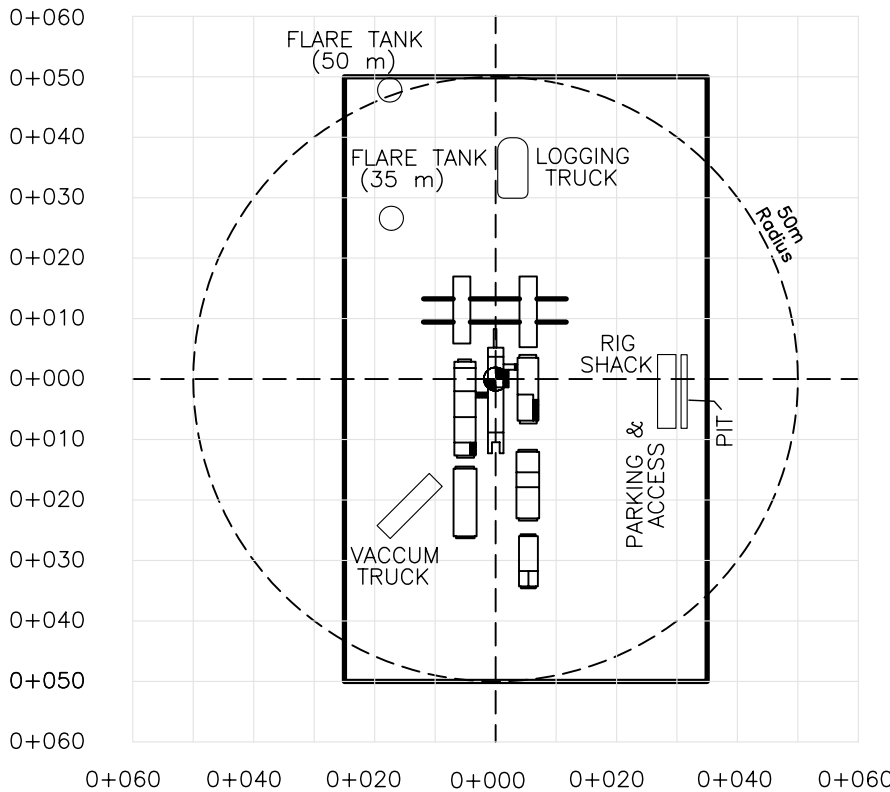
Rev. # 11 Date: Feb. 25, 2003.
File # 13699-Forrested shallow gas
low impact-Rev 11

**FORRESTED AREA
SHALLOW GAS
LOW IMPACT
RIG LAYOUT
WORKING AREA
(60 Wide x 100 Long)**

10.0m GRID



SCALE 1:1250



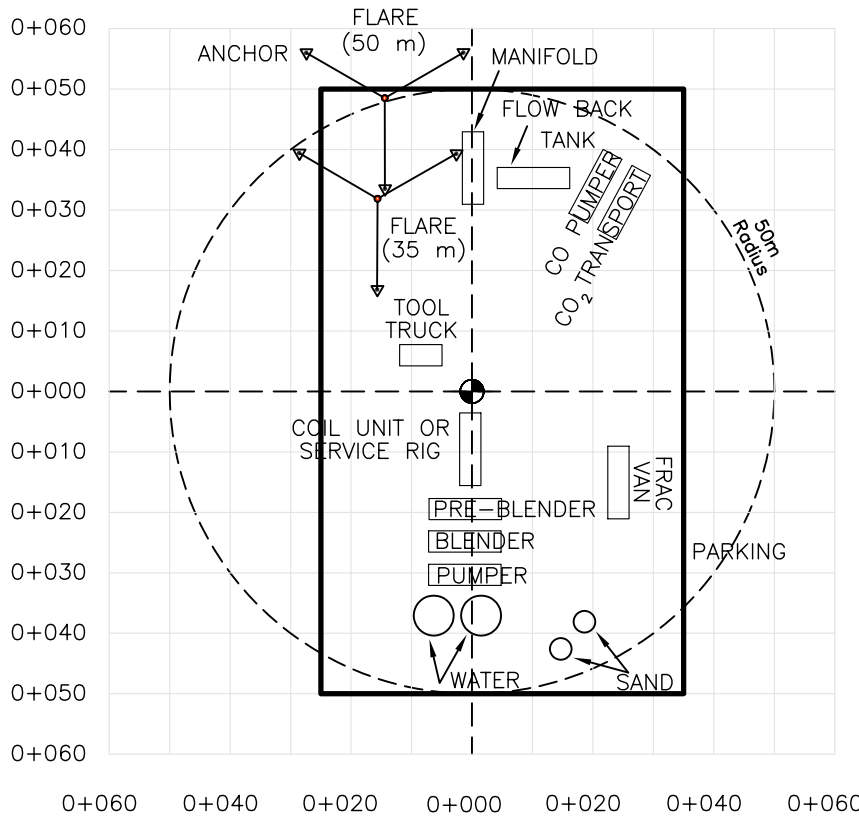
NOTE:

Shape may vary but acreage will remain the same.

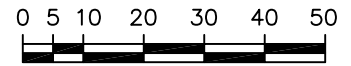
**TYPICAL 5B
RIG LAYOUT**

Rev. # 11 Date: Feb. 25, 2003.
File # 13699-Forrested shallow gas
low impact-Rev 11

**FORRESTED AREA
SHALLOW GAS
LOW IMPACT
COMPLETION OPERATION
(60 Wide x 100 Long)**



10.0m GRID



SCALE 1:1250

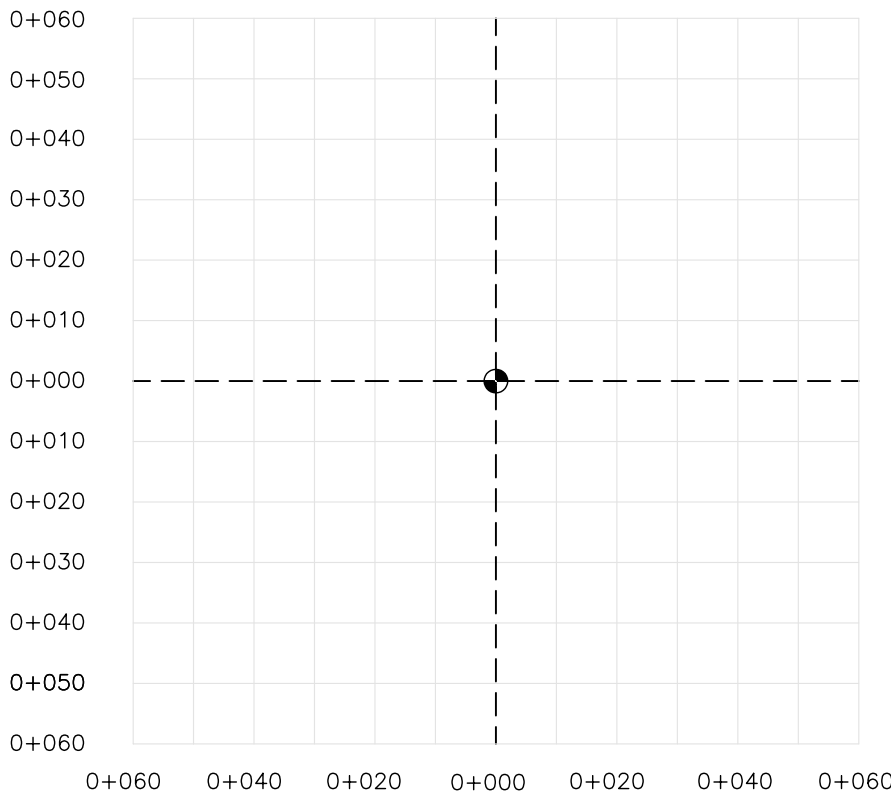
NOTES:

- 1.) Sloped lands will vary lease perimeter.
- 2.) Space requirements vary with equipment type.
- 3.) During equipment set up and tear down additional working space may be required.
- 4.) Shape may vary but acreage will remain the same.

**TYPICAL 5C
SERVICE WELL**

Rev. # 11 Date: Feb. 25, 2003.
File # 13699-Forrested shallow gas
low impact-Rev 11

**FORRESTED AREA
SHALLOW GAS
LOW IMPACT
PRODUCTION FACILITY**



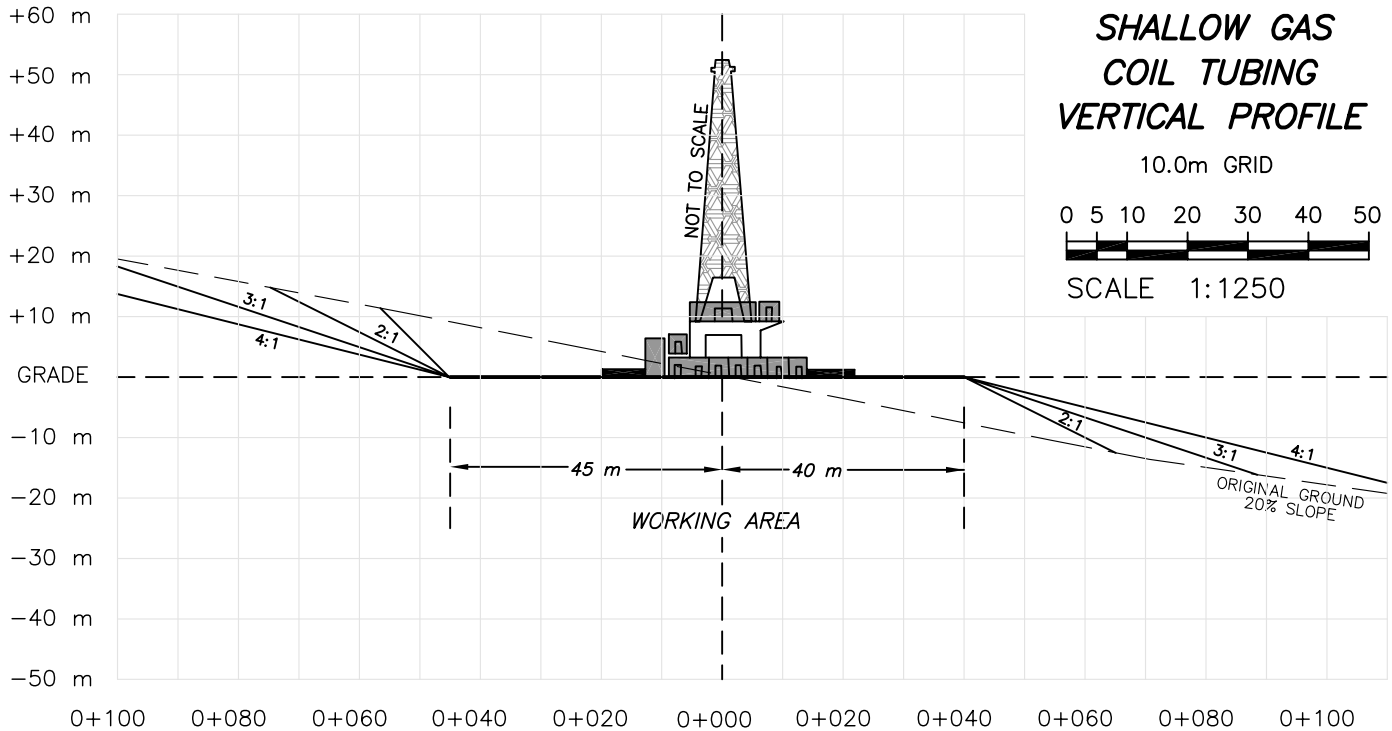
10.0m GRID



SCALE 1:1250

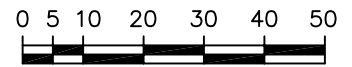
**TYPICAL 5D
PRODUCTION FACILITY**

Rev. # 11 Date: Feb. 25, 2003.
File # 13699-Forrested shallow gas
low impact-Rev 11



**SHALLOW GAS
COIL TUBING
VERTICAL PROFILE**

10.0m GRID



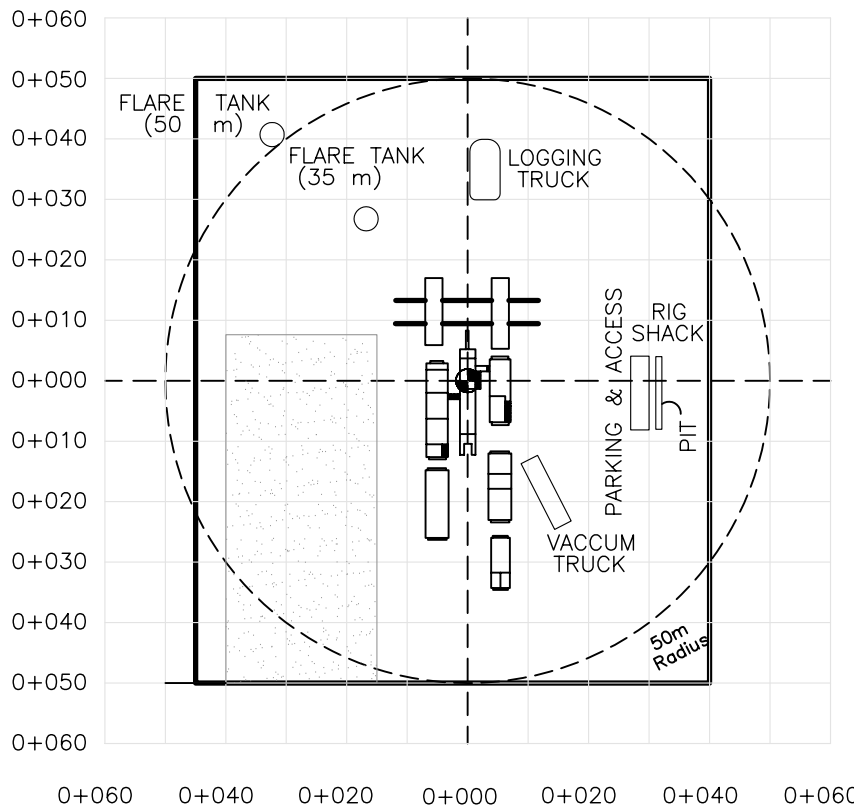
SCALE 1:1250

NOTES:

- 1.) Drawings do not account for soil storage.
- 2.) Sloped lands will vary lease perimeter.
- 3.) Space requirements vary with equipment type.
- 4.) During equipment set up and tear down additional working space may be required.

TYPICAL VERTICAL PROFILE 6A

Rev. # 11 Date: Feb. 25, 2003.
File # 13699-coil tubing-Rev 11



**SHALLOW GAS
COIL TUBING
RIG LAYOUT
WORKING AREA
(85 Wide x 100 Long)**

10.0m GRID



SCALE 1:1250

NOTE:

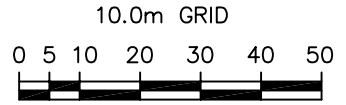
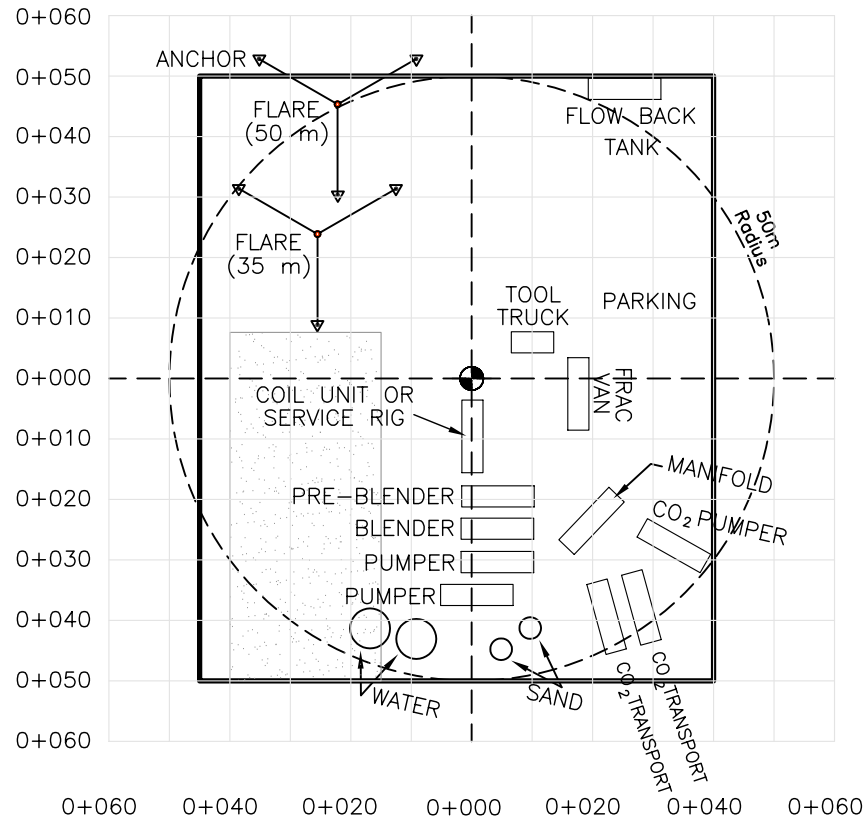
Shape may vary but acreage will remain the same.

SUMP & SPOIL PILE AREA (IF REQUIRED)
NOTE: SIZE VARIES BY DEPTH

TYPICAL RIG LAYOUT 6B

Rev. # 11 Date: Feb. 25, 2003.
File # 13699-coil tubing-Rev 11

SHALLOW GAS COIL TUBING COMPLETION OPERATION (85 Wide x 100 Long)



SCALE 1:1250

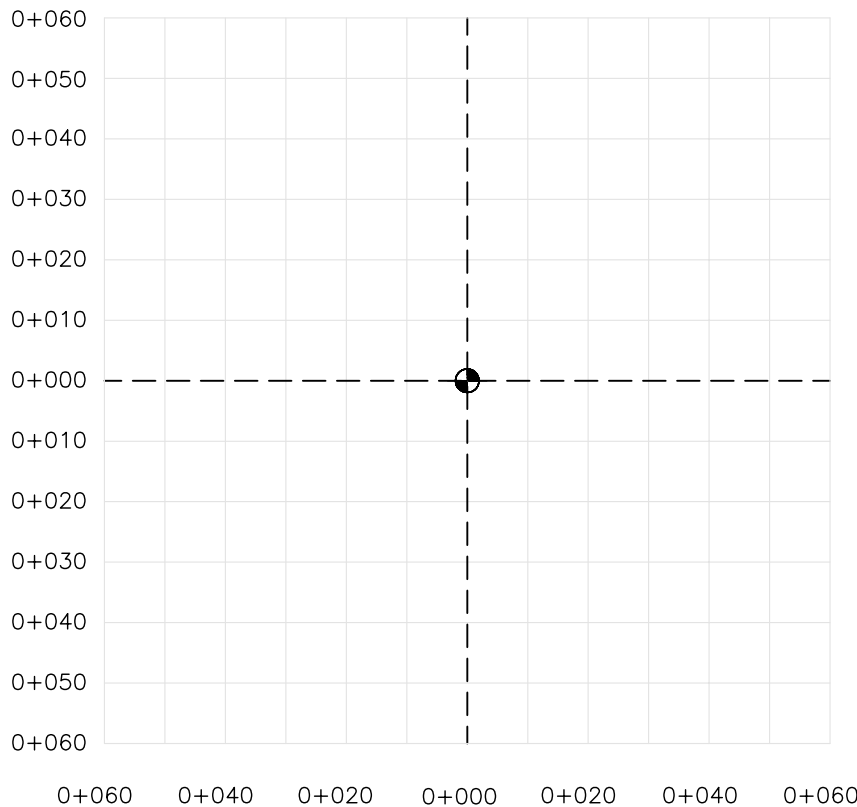
NOTES:

- 1.) Drawings do not account for soil storage.
- 2.) Sloped lands will vary lease perimeter.
- 3.) Space requirements vary with equipment type.
- 4.) During equipment set up and tear down additional working space may be required.
- 5.) Shape may vary but acreage will remain the same.

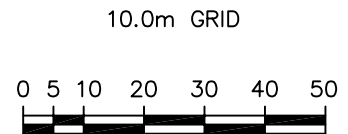
SUMP & SPOIL PILE AREA (IF REQUIRED)
NOTE: SIZE VARIES BY DEPTH

TYPICAL 6C SERVICE WELL

Rev. # 11 Date: Feb. 25, 2003.
File # 13699-coil tubing-Rev 11



SHALLOW GAS COIL TUBING PRODUCTION FACILITY

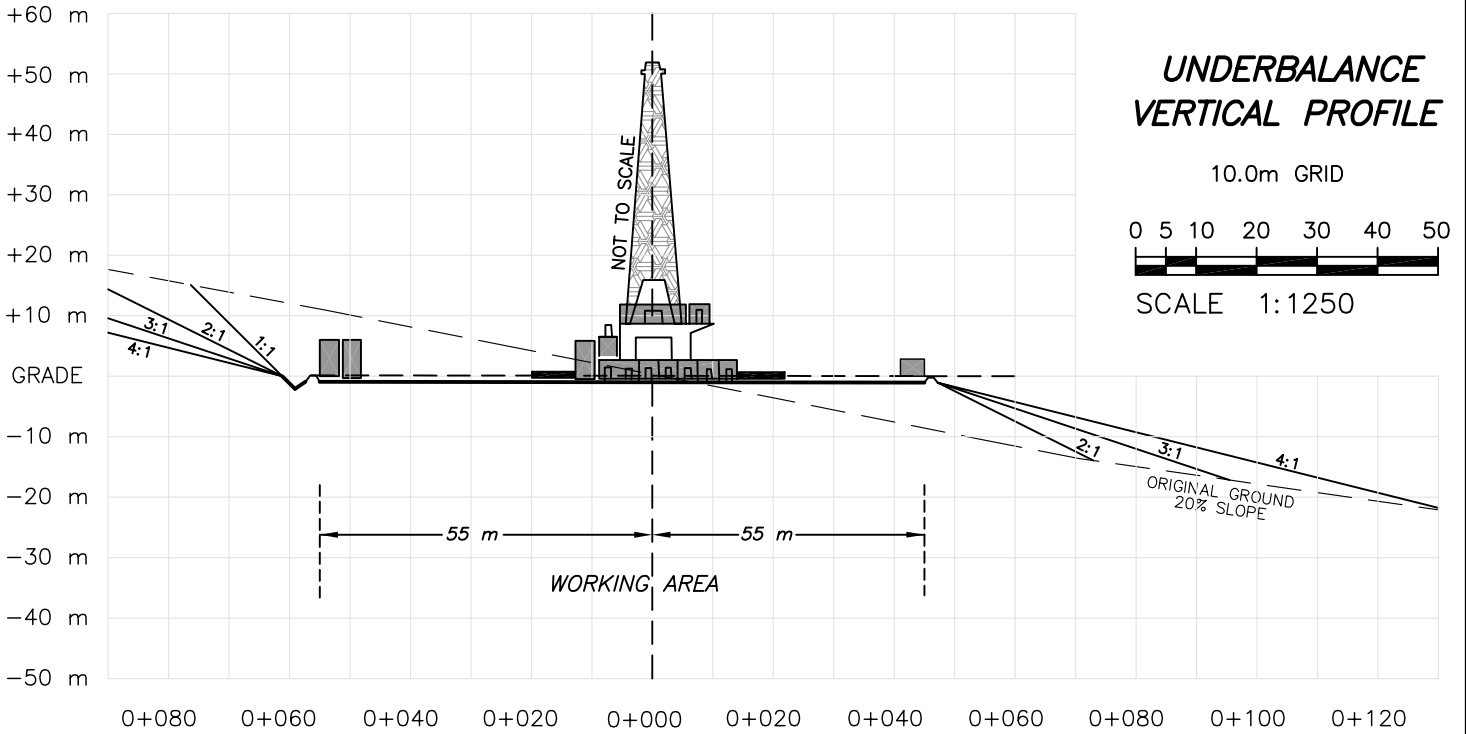


SCALE 1:1250

TYPICAL 6D PRODUCTION FACILITY

Rev. # 11 Date: Feb. 25, 2003.
File # 13699-coil tubing-Rev 11





**UNDERBALANCE
VERTICAL PROFILE**

10.0m GRID



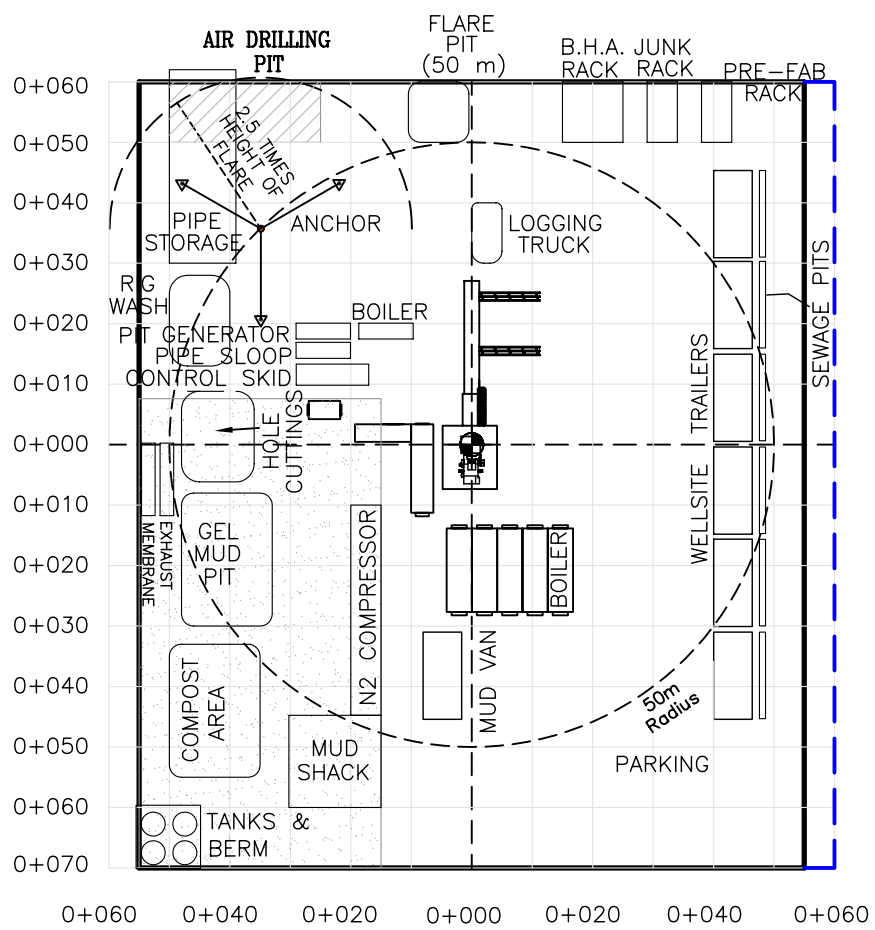
SCALE 1:1250

NOTES:

- 1.) Drawings do not account for soil storage.
- 2.) Sloped lands will vary lease perimeter.
- 3.) Space requirements vary with equipment type.
- 4.) During equipment set up and tear down additional working space may be required.

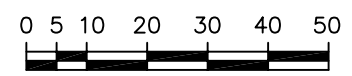
**TYPICAL 7A
VERTICAL PROFILE**

Rev. # 13 Date: Feb. 25, 2003.
File # 13699-underbalance-Rev 13



**UNDERBALANCE
RIG LAYOUT
WORKING AREA
(110 Wide x 130 Long)**

10.0m GRID



SCALE 1:1250

NOTE:

Shape may vary but acreage will remain the same.

- EXTRA AREA REQUIRED FOR WELLS IN BRITISH COLUMBIA
- AIR DRILLING PIT & AIR COMPRESSORS
- SUMP & SPOIL PILE AREA (IF REQUIRED)
NOTE: SIZE VARIES BY DEPTH

**TYPICAL 7B
RIG LAYOUT**

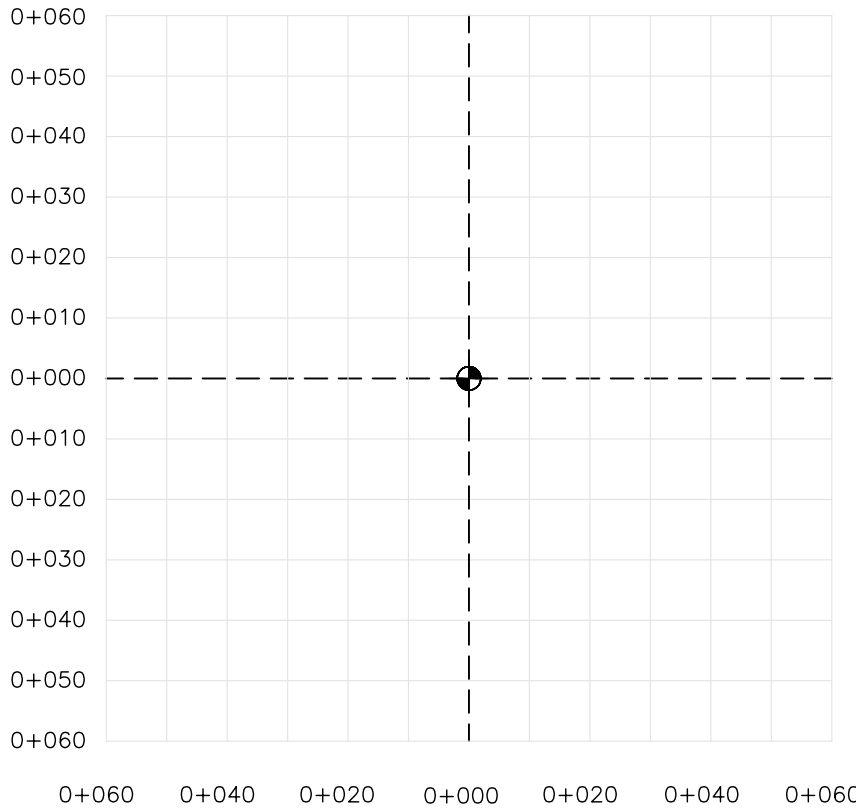
Rev. # 13 Date: Feb. 25, 2003.
File # 13699-underbalance-Rev 13

UNDERBALANCE COMPLETION OPERATION

10.0m GRID



SCALE 1:1250



NOTES:

- 1.) Drawings do not account for soil storage.
- 2.) Sloped lands will vary lease perimeter.
- 3.) Space requirements vary with equipment type.
- 4.) During equipment set up and tear down additional working space may be required.
- 5.) Shape may vary but acreage will remain the same.

**TYPICAL 7C
SERVICE WELL**

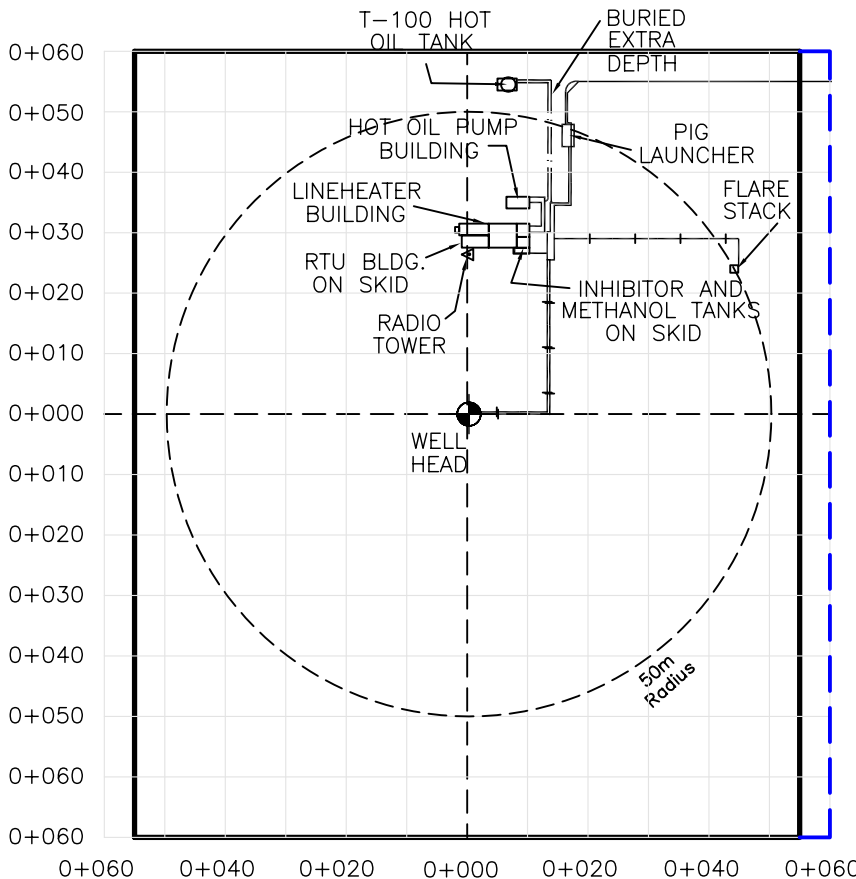
Rev. # 13 Date: Feb. 25, 2003.
File # 13699-underbalance-Rev 13

UNDERBALANCE PRODUCTION FACILITY (110 Wide x 130 Long)

10.0m GRID



SCALE 1:1250

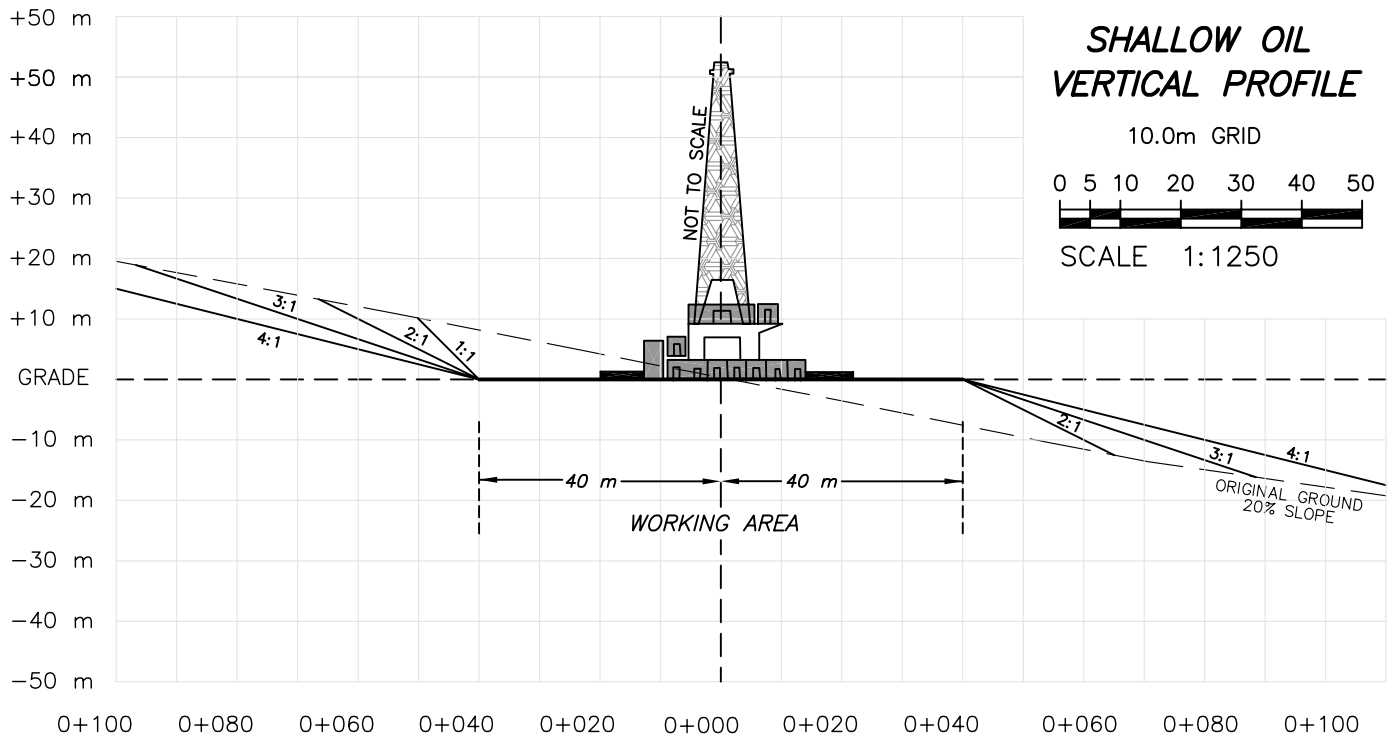


— — — — EXTRA AREA REQUIRED FOR
WELLS IN BRITISH COLUMBIA

**TYPICAL 7D
PRODUCTION FACILITY**

Rev. # 13 Date: Feb. 25, 2003.
File # 13699-underbalance-Rev 13



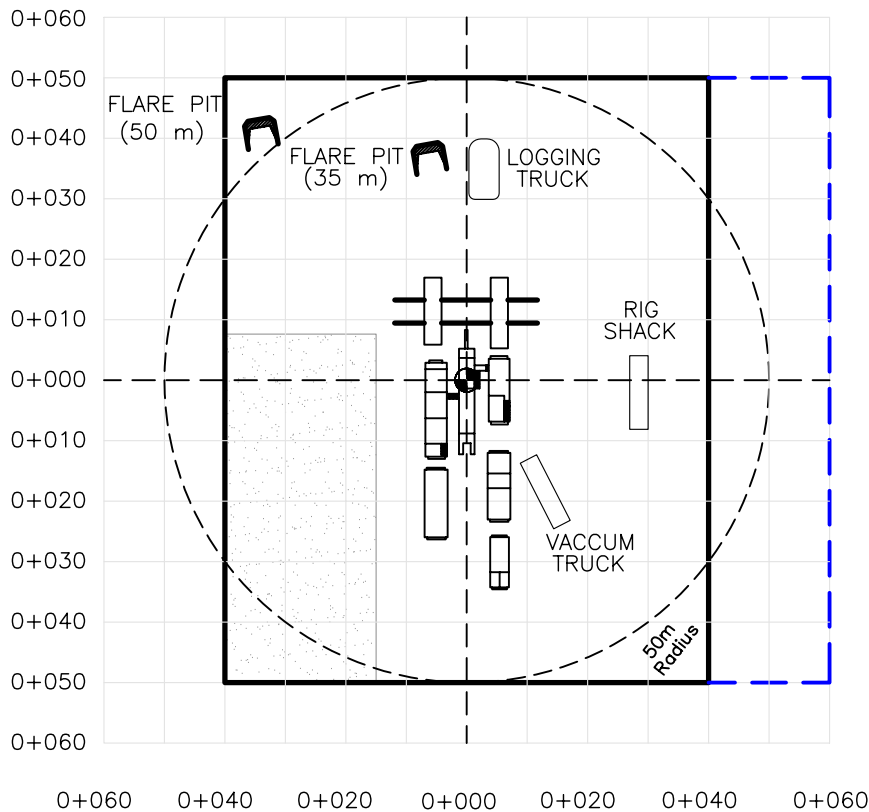


NOTES:

- 1.) Drawings do not account for soil storage.
- 2.) Sloped lands will vary lease perimeter.
- 3.) Space requirements vary with equipment type.
- 4.) During equipment set up and tear down additional working space may be required.

TYPICAL VERTICAL PROFILE 8A

Rev. # 1 Date: Mar. 14, 2003.
File # 13699-shallow oil-Rev 1



SHALLOW OIL RIG LAYOUT WORKING AREA (80 Wide x 100 Long)

10.0m GRID
0 5 10 20 30 40 50
SCALE 1:1250

NOTE:

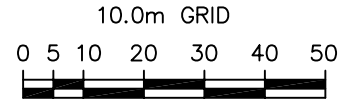
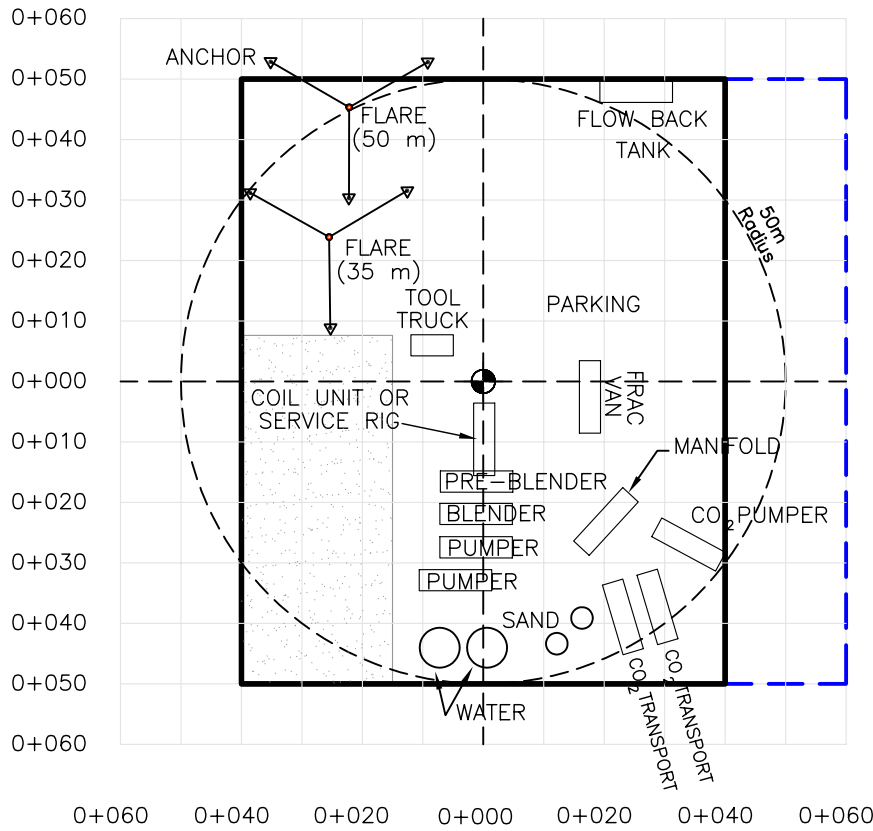
Shape may vary but acreage will remain the same.

- EXTRA AREA REQUIRED FOR WELLS IN BRITISH COLUMBIA
- SUMP & SPOIL PILE AREA (IF REQUIRED)
NOTE: SIZE VARIES BY DEPTH

TYPICAL RIG LAYOUT 8B

Rev. # 1 Date: Mar. 14, 2003.
File # 13699-shallow oil-Rev 1

SHALLOW OIL COMPLETION OPERATION (80 Wide x 100 Long)



SCALE 1:1250

NOTES:

- 1.) Drawings do not account for soil storage.
- 2.) Sloped lands will vary lease perimeter.
- 3.) Space requirements vary with equipment type.
- 4.) During equipment set up and tear down additional working space may be required.
- 5.) Shape may vary but acreage will remain the same.

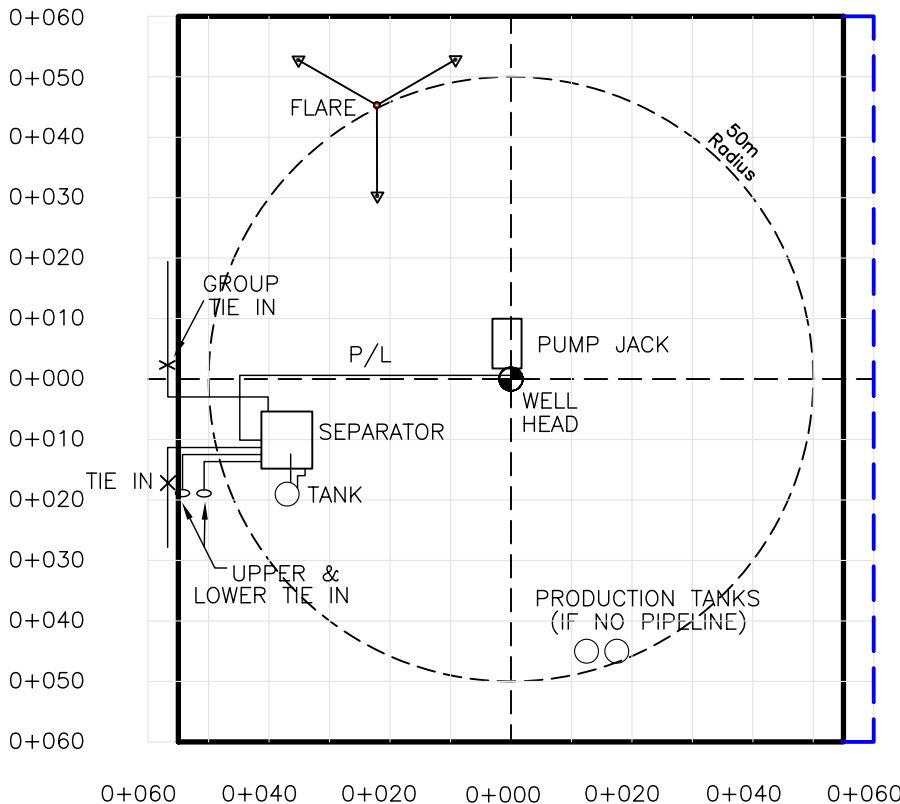
— — — EXTRA AREA REQUIRED FOR WELLS IN BRITISH COLUMBIA

▨ SUMP & SPOIL PILE AREA (IF REQUIRED)
NOTE: SIZE VARIES BY DEPTH

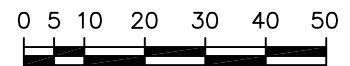
**TYPICAL 8C
SERVICE WELL**

Rev. # 1 Date: Mar. 14, 2003.
File # 13699—shallow oil—Rev 1

SHALLOW OIL PRODUCTION FACILITY (110 Wide x 120 Long)



10.0m GRID

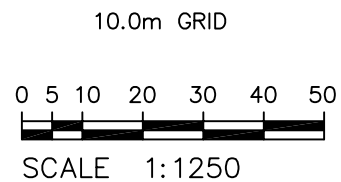
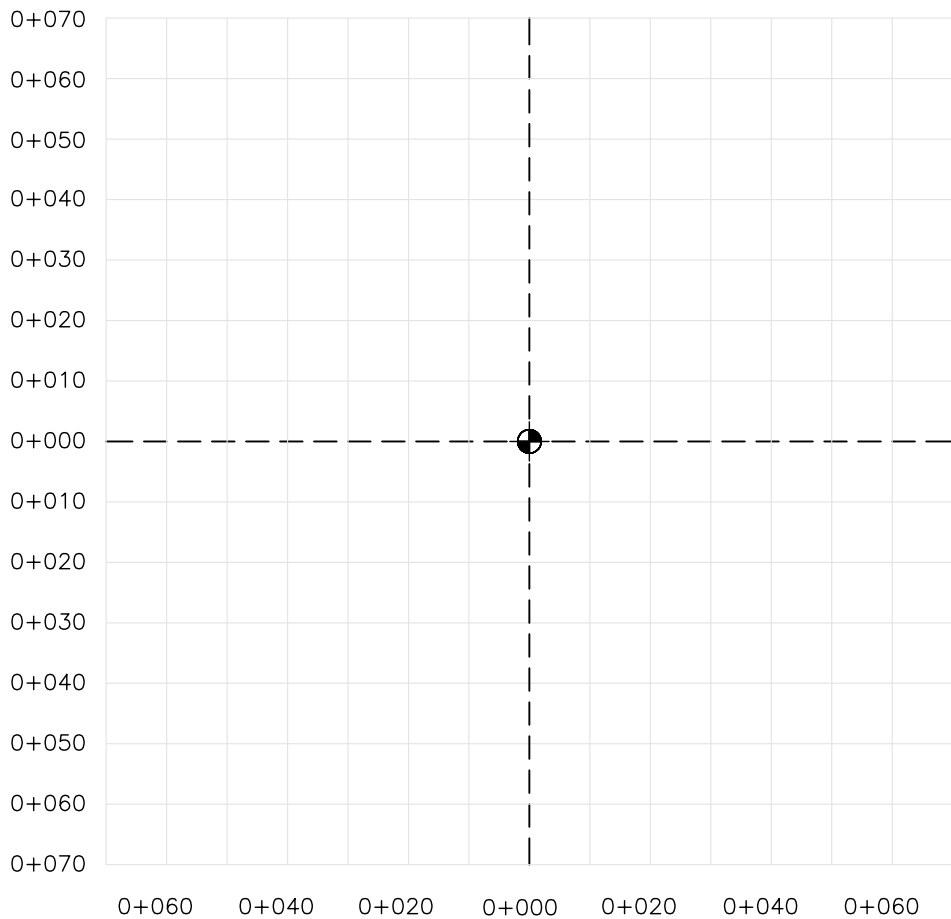


SCALE 1:1250

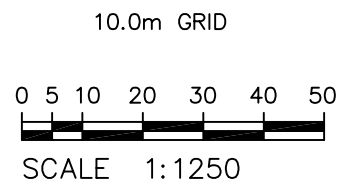
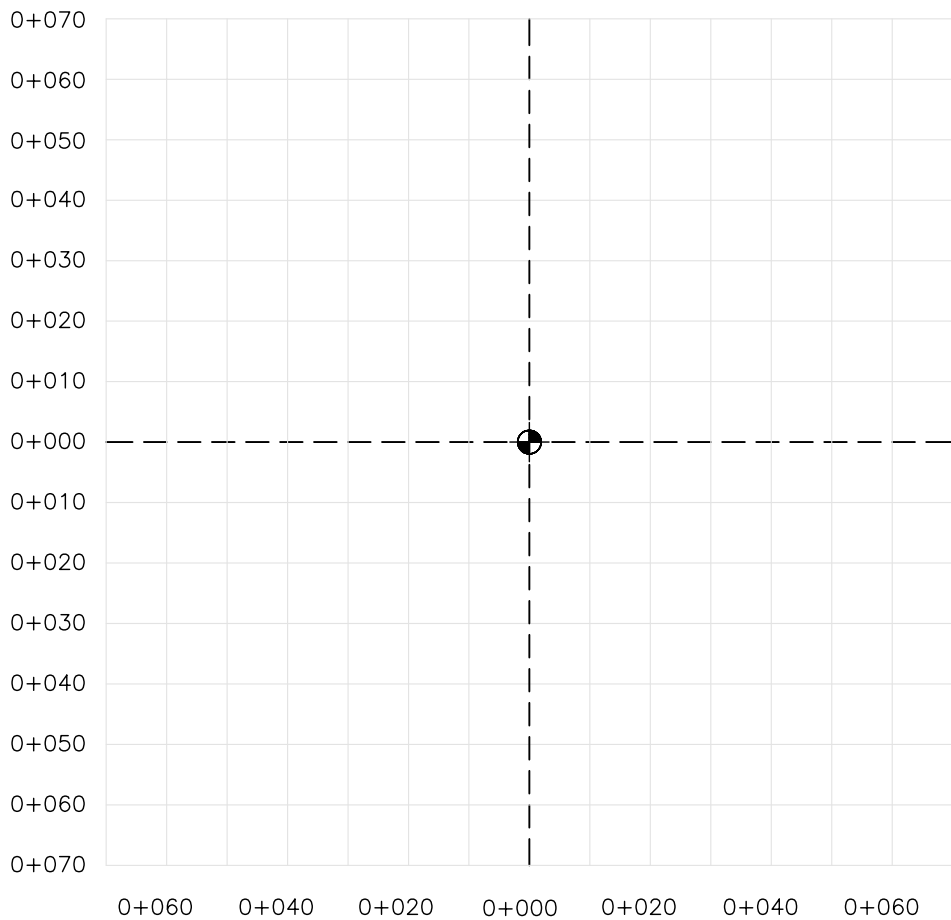
— — — EXTRA AREA REQUIRED FOR WELLS IN BRITISH COLUMBIA

**TYPICAL 8D
PRODUCTION FACILITY**

Rev. # 1 Date: Mar. 14, 2003.
File # 13699—shallow oil—Rev 1



9A



9B

Coreholes



Corehole Mining Rig



Corehole Single Drilling Rig

Multiwell Pad



Adding wells to existing pads



Many wells on a pad requiring downhole avoidance

Multiwell Pad

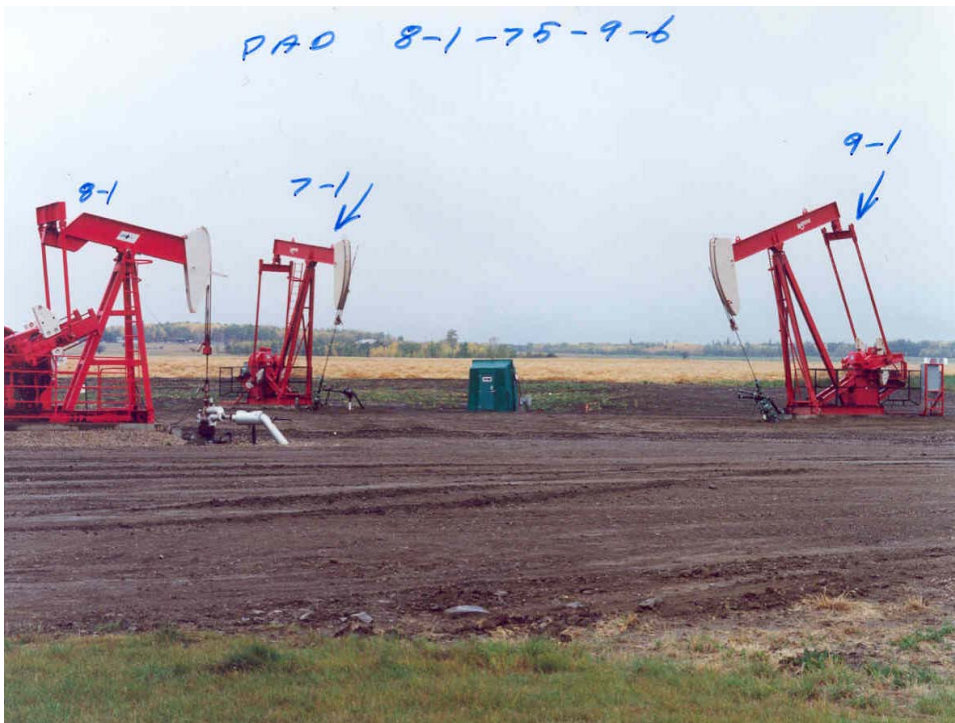


Screwjacks instead of pumpjacks

Slant Wells



Vertical oil well with slant water wells with production facilities



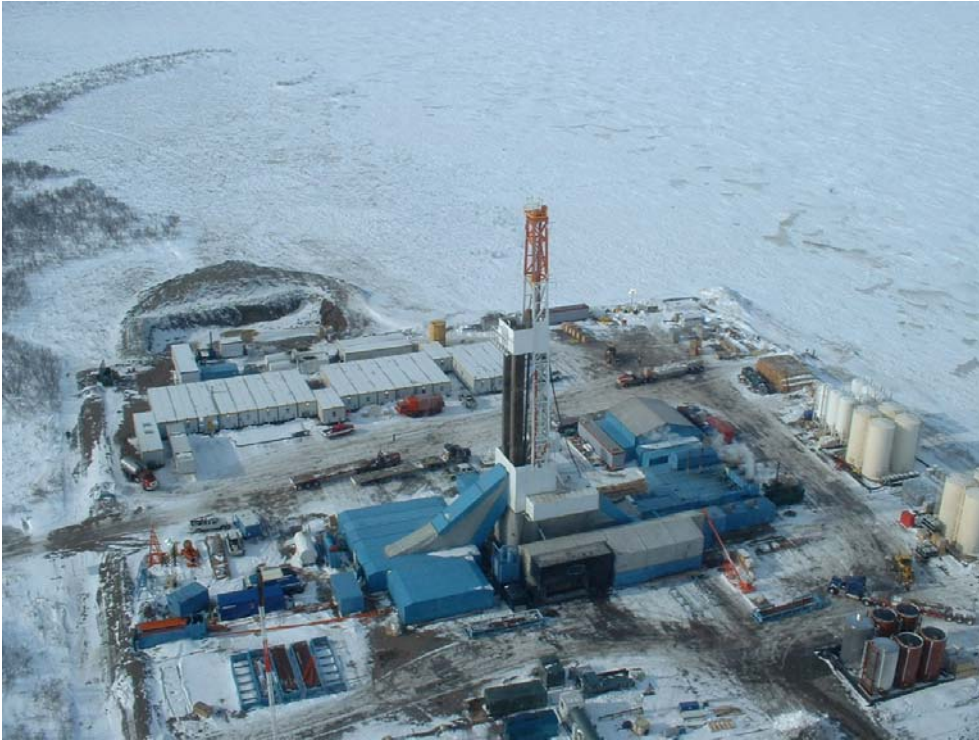
Vertical oil well with slant oil and water wells

Slant Wells



Underground facilities may impact well positioning

Stockpiling



Stockpiling to drill through the summer at a remote site

Sag D



SKETCH PLAN

SHOWING
 TYPICAL ALBERTA FLARE PIT
 SCALE: 1:500



**CALTECH
 SURVEYS LTD**

Ph: 263-8055 Fax: 263-8058

FOREST PROTECTION REGULATIONS

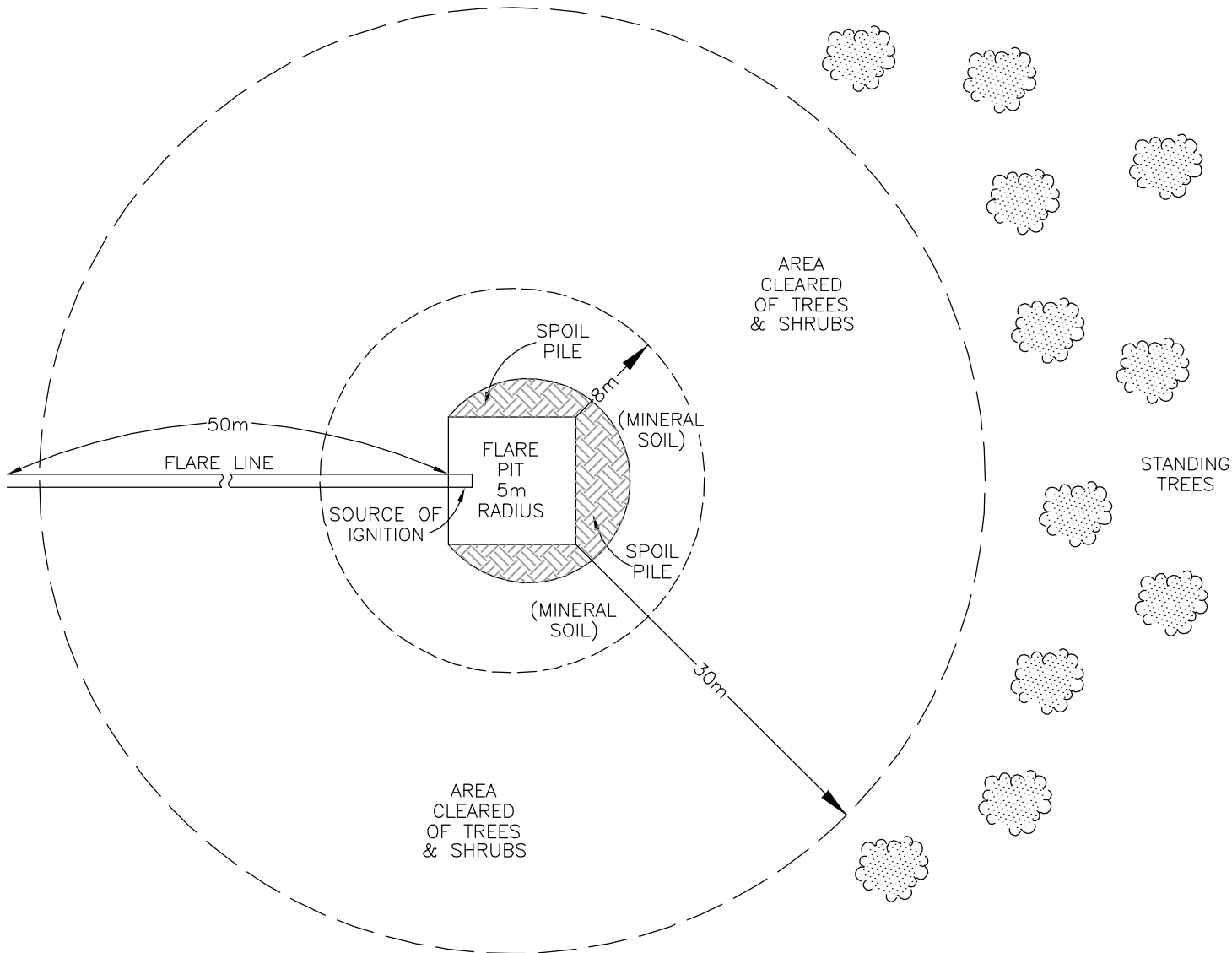
- a) THE AREA AROUND THE FLARE PIT HAS BEEN CLEARED OF ALL COMBUSTIBLE DEBRIS WITHIN 30 METRES.
- b) A CLEAR BARE MINERAL SOIL SURFACE EXTENDING AT LEAST 8 METRES AROUND THE FLARE PIT IS MAINTAINED.
- c) THE FLARE PIT IS SO CONSTRUCTED THAT BURNING DEBRIS CANNOT ESCAPE FROM THE FLARE PIT AT ANY TIME.

EUB REGULATIONS

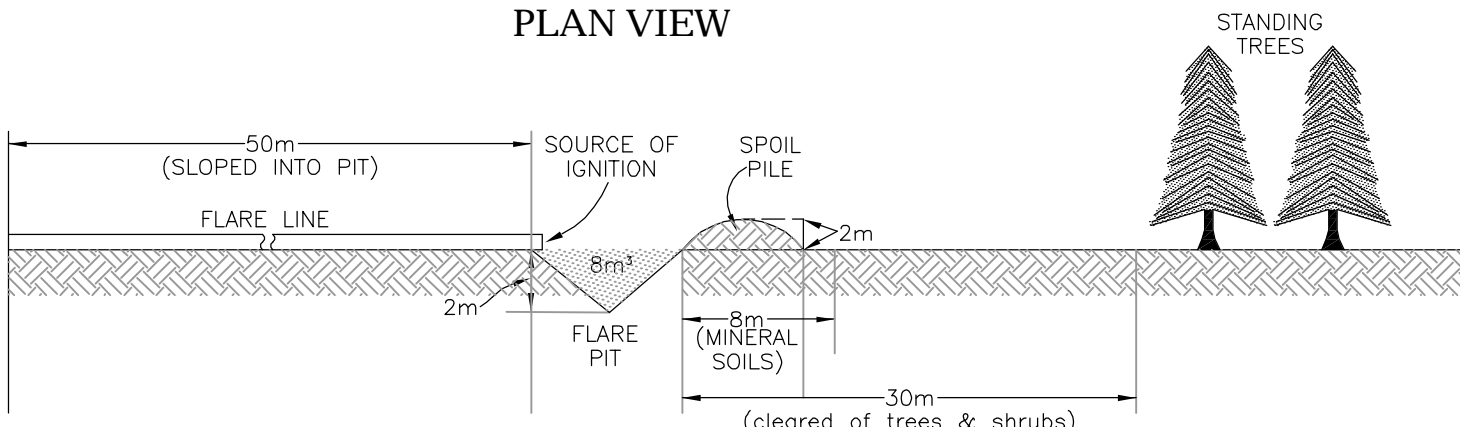
IF A FLARE PIT IS USED, THE FOLLOWING REQUIREMENTS APPLY:

- a) BE CONSTRUCTED TO CONTAIN A MINIMUM OF 8m³ OF FLUID
- b) HAVE SIDE AND BACK WALLS RISING NOT LESS THAN 2m ABOVE GROUND LEVEL
- c) BE CONSTRUCTED TO RESIST THE EROSION OF A HIGH PRESSURE FLOW OF GAS OR LIQUID
- d) BE LOCATED A MINIMUM DISTANCE OF 50m FROM THE WELL

JOB NO: 02-0550		DRAWN: KM/CG
Rev. No.	Date	Description
0	2002.06.10	ISSUED
1	2002.07.08	REVISED FLARE PIT
2	2002.10.11	GENERAL REVISION
3	2003.01.31	GENERAL REVISION
4	2003.02.21	GENERAL REVISION



PLAN VIEW



**CROSS-SECTION VIEW
 NOT TO SCALE**

SKETCH PLAN

SHOWING
 TYPICAL BRITISH COLUMBIA FLARE PIT
 SCALE: 1:500



**CALTECH
 SURVEYS LTD**

Ph: 263-8055 Fax: 263-8058

JOB NO: 02-0550		DRAWN: CG
Rev. No.	Date	Description
0	2002.10.11	ISSUED
1	2003.02.21	GENERAL REVISION

SPECIFICATIONS

THE EARTHEN PIT REFERRED TO IN SUBSECTION (1) (e) MUST

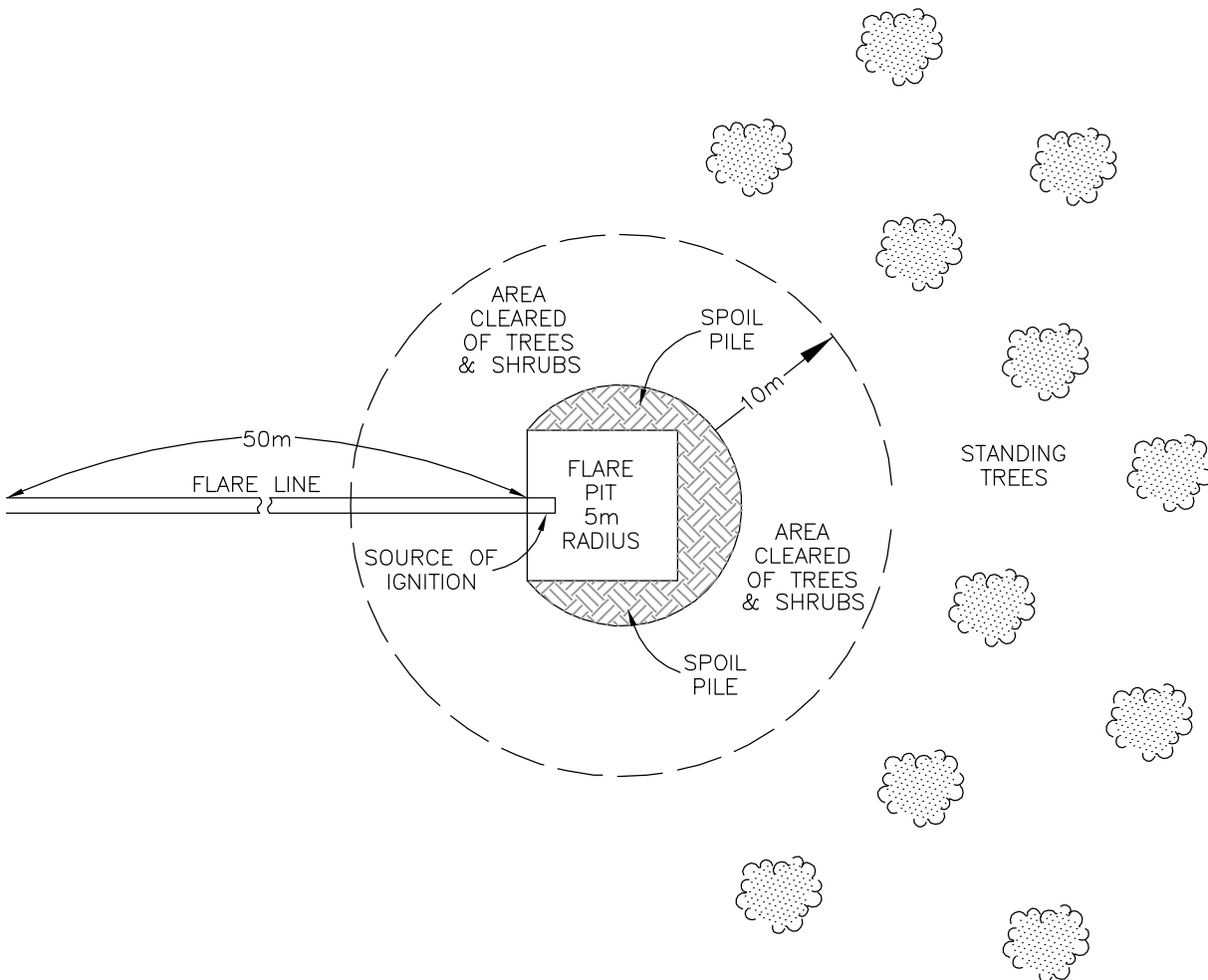
a) BE EXCAVATED TO A DEPTH OF NO LESS THEN 2 METRES.

b) HAVE SIDE AND BACK WALLS RISING NO LESS THAT 2 METRES ABOVE GROUND LEVEL.

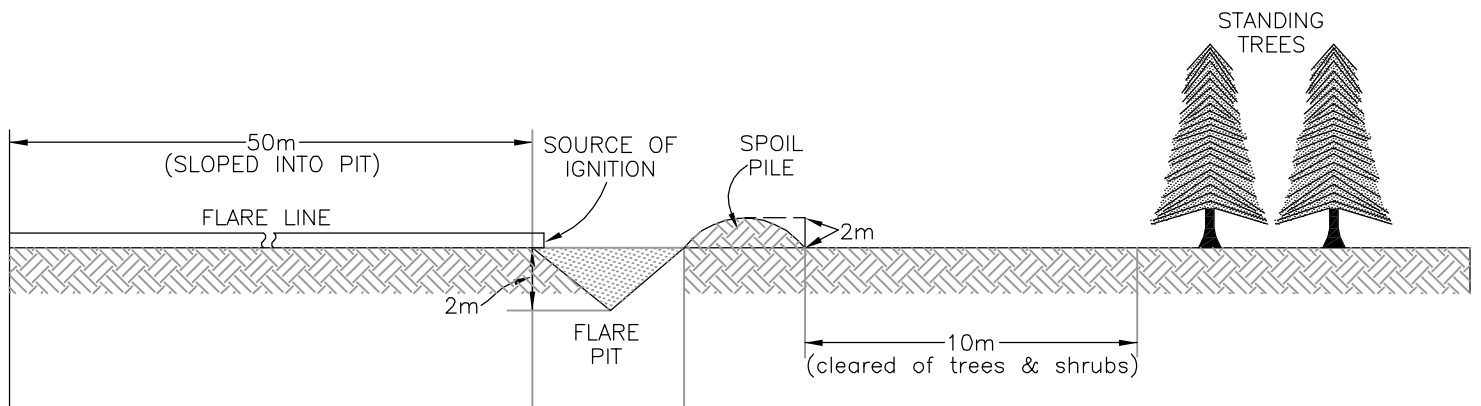
c) BE CONSTRUCTED TO RESIST THE EROSION OF A HIGH PRESSURE FLOW OF GAS OR LIQUID.

d) BE SHAPED TO CONTAIN ANY LIQUIDS.

e) OUTLET LINE MUST TERMINATE IN AN EARTHEN PIT, OR FLARE PIT, 50 METRES FROM WELL.



PLAN VIEW



**CROSS-SECTION VIEW
 NOT TO SCALE**

**Interprovincial Spacing Requirements
6-Mar-03**

Required distance from well head to:	Alberta (EUB)		B.C.		Saskatchewan	
1. Lighted Areodrome	5 km	2.090	*	5 (2)	*	~
2. Unlighted Areodrome	1.6 km	2.090	*	5 (2)	*	~
3.Roads (Surveyed or road allowances)	40 m	2.110	80 m	5(1)	75 m	
4.Surface Improvement	100 m	2.110	80 m	5(1)	75 m	
5.Coal Mine (Active)	3 km	6.140	3 km	6	All mines are restricted, a special application is required	
6.Coal Mine (Abandoned)	400 m	6.140	50 m	65(1)		
7. Flare to production/rig tank	50 m	8.080(3)	50 m	65(1)		
8.Flare	50 m	8.135 (9)	50 m	65(1)(N)	45 m	72(3)
9.Flare Tank - Surface Casing Waiver	35	Guide 8				
10.Flare Tank	50 m/25 m	ID 91-3	50 m	62(a)		
11.Flare to Surface Improvement	100 m	8.080(2)	80 m	62(c)	*	
12.Flare to process equipment	25 m	8.080(3)				
13.Boiler	25m	8.090(1)	25m	65(1)(f)	23m	53(2)
14.Well Site Trailer	25m	8.090(5)	50m	65(1)(a)	23m	53(2)
15.Permanent Building	100m	2.110(1)	80m	5(1)(b)	75m	19(1)
16.Public Facility	100m	2.110(1)	80m	5(1)	75m	19(1)
17.Military Installation	100m	2.110(1)	80m	5(1)(b)	75m	19(1)
18.Power line - Right of Way	100m	2.110(1)	80m	5(1)	75m	19(1)
19.Railway - Right of Way	100m	2.110(1)	80m	5(1)	75m	19(1)
20.Pipeline - Right of Way	100m	2.110(1)	80 m	5(1)	75m	19(1)
21.School/Church	100m	2.110(1)	80m	7(1)(c)	75m	19(1)
22.Water Well	200m	2.020(3)	200m	5(5)	*	19((1)
23.Surface Improvement	100m	1.020(2)28	80 m	5(1)	75m	19(1)
24.Water Bodies (normal high water mark)	100m	2.120(2)	100m	5(4)	75m	19(c)
25.Flame Type Equipment to oil storage Tanks	25m	8.090(4)	25m	62(e)		
26.Crude Oil Storage Tanks	50m	8.090(3)	50m	62(h)	45m	
27.(High Vapor Pressure Hydrocarbon Storage)	50m	8.110(2)b				
28.Diesel Engines without Air Shut-offs	25m	8.100(1)	25m	60(2)	23m	
29.Internal combustion motor exhaust	6m	8.090(9)				
30.Tank Dike to Surface Improvement	60m	8.030(2)	60m	64(3)		
31.Fuel Storage Tanks			25m	60(5)		
32.Smoking	25m	8.120	25m	59		
33.Pressure Vessel, treater, dehy, flame type equipment.	25m	8.090(4)	25m	62(e)	23m	
34.Internal combustion engine	25m	G-36		60(l)	6m	
35.Class III (ws) Accumulator system	25m	8.145(6)	25m	26(6)		
36.Class I & II (ws) controls (remote)	7m	8.145(5)				
37.Drilling remote Accumulator & Controls	15m	8.133(6)				
38.Divert lines on Oil Sands Evaluation Wells	15m	ID 89 - 2				
39.Well to drill choke manifold			20m	21(2)a		
40.Setback HVP Pipelines & Public Institutions	200m	GB 99.4				
41.Electrical Appliances i.e. Toasters, Coffeepot	25m	8.090(1)				
42.Rubbish incinerator from well	50m	8.090(2)	50 m	62(a)		
43.Wells (non-sour) to surface improvement	100m	IL 95-07	80 m	5(1)		
44.Municipal Setback Requirements	100m	IL 95-07				
45.Level 2 Sour well, pipeline or facility to permanent dwelling, unrestricted country devlp.	100m	ID 97-6	100 m	***		
46.To public facility or Urban Center	500m	ID 97-6	500 m	***		
47.Level 3 Sour well to permanent dwelling	100m	ID 97-6	100 m	***		
48.to unrestricted Country Development	500m	ID 97-6	500 m	***		
49.To public facility or Urban Center	1500m	ID 97-6	1500 m	***		
50.Level 4 Sour Well, pipeline or facility to permanent dwelling	100m	ID 97-6		***		

**Interprovincial Spacing Requirements
6-Mar-03**

Required distance from well head to:	Alberta (EUB)		B.C.		Saskatchewan	
51. Minimum setback will be approved by EUB, but not less than level 3 requirements.		ID 97-6		***		
52. Glycol dehydrator to permanent residence	750 m	IL 97-4				
53. Abandoned well to Permanent structure	5m	Advisory land use document				
54. Abandoned well to underground utilities	3m	Advisory land use document				
Workplace Health & Safety (Alberta)						
55. motor vehicles to well bore	25 m	218(1)Ⓞ	25 m	23.62(2)(b)	25 m	439 (c)
56. fuel storage, except diesel and the fuel in the tanks of operating equipment	20	199	25 m	23.62	20 m	424
Public Highways Development Act. (Alberta)						
57. Primary highway, all 3 digit highways	100 m**	AB Transportation				
Forest and Prairie Protection Act (regs Part I)						
58. Flair Pit/Tank Fire Guard Width (mineral soil)	8 m	Sec. 14				
59. Flair Pit/Tank Debris Free Clearing	30 m	Sec. 14				
60. Sour Gas (Permanent) Flair Stack Debris Free Clearing	2.5 times height	Sec. 15				
Public Lands						
61. Well site edge to waterbody/watercourse (high water mark)	100 m	Public Lands Handbook	100 m	PN&G reg 5(3)		
62. Boring (geo-technical) to waterbody/watercourse (high water mark)	45 m	PLD Directive 2002 - ()				
Fish and Wildlife						
63. Well site edge to river breaks	100 m	Public Lands Handbook				
Alberta Private Sewage Systems Standard of Practice 1999						
64. Sump pit (lagoon) to water well	90 m	11.2.2				
65. Sump pit (lagoon) to building/trailer (camp)	10 m	MA/AENV/S	6 m			
66. Sump pit (lagoon) to creek	90 m	11.2.2	30 m			
67. Septic tank/Treatment plant to building/trailer	1 m	5.2.1				
68. Septic tank/Treatment Plant to water well	9 m	5.2.1				
69. Discharge point to watercourse	90 m	3.2.2				
70. Discharge point to other surface water	45 m	10.2.1				
71. Discharge point to water well	45 m	10.2.1				
72. Discharge point to building	45 m	10.2.1				
<p>* Additional setback restrictions may be dictated by other regulatory authorities</p> <p>* H2S release rates may increase setback spacing requirements</p> <p>* Refer to specific regulations for exceptions.</p> <p>** Authorization required within 100 m</p> <p>*** Sour pipeline Regulation 3</p>						

LEASE CONSTRUCTION SPACING INFORMATION

1 LOCATION:
LSD _____ SEC _____ TWP _____ RGE _____ W _____ M _____

2 WELL TYPE: GAS OIL
 SWEET SOUR

3 WELL DEPTH: _____ m

4 FUTURE PLANS/ TYPE OF COMPLETIONS/ PRODUCTION: SKETCH #: _____

5 RIG TYPE: SINGLE DOUBLE TRIPLE COILED TUBING UNDERBALANCE RIG

6 MUD SYSTEM: GEL CHEM HYDROCARBON BASED

7 DRILLING WASTE DISPOSAL: OFFSITE SUMP ONSITE SUMP

SUMP AREA REQUIRED: SUMP/SPOIL PILE _____ m X _____ m =

8 FLARE REQUIREMENTS FOR DRILLING AND PRODUCTION:
 50m 35m 25m FLARE PIT
 FLARE TANK
 FLARE STACK

POSITION OF FLARE PIT/TANK (I.E. SW CORNER) _____

9 FLARE TANK SPACING REQUIREMENT: 50m 25m (Heavy Oil)

10 WINTER DRILL: YES NO **If summer, 30m tree-free clearing required around flare
Maintain 8 m bare mineral soil around the flare pit.**

11 BERM REQUIREMENTS: YES NO **Width Required: _____ m**

12 Drainage Ditch: YES NO **Width Required: _____ m**

13 IS BRUSH STORAGE REQUIRED: YES NO
EXPLAIN (I.E. FIRE HAZARD) _____

14 SOIL STORAGE:
STRIPPING REQUIRED: YES NO **Width Required: _____ m**
 TOPSOIL SUBSOIL

15 CONSTRUCTION METHOD: PAD CUT/FILL MINIMAL DISTURBANCE

SLOPE SPACING REQUIREMENTS: **Width Required: _____ m**
EXPLAIN (I.E. SOIL TYPE) _____

16 WELL SITE SIZE: **Total Area** _____ m X _____ m = _____
Working Area _____ m X _____ m = _____

17 ADDITIONAL NOTES:

