4.1.1 DEVELOPMENT PLAN DESIGN FACTORS

As discussed in Section 1.5, five design factors were considered in selecting the basic components of the development plan for Parsons Lake. These factors are:

- safe facilities and work practices
- technical quality
- environmental protection and the preservation of traditional land use
- community input
- economic viability

This section discusses the subsurface component of the development plan.

4.1.1.1 Assurances of Safety

Safety considerations in the development plan target zero incidents of injury to employees, contractors and community residents.

4.1.1.2 Technical Feasibility

The development plan's technical feasibility depends on using proven systems for drilling, operations and evaluations, and is intended to optimize resource recovery by:

- using long-reach drilling technology
- selecting an appropriate well count and drilling order
- creating an effective well testing and reservoir monitoring plan
- applying compression, as appropriate

4.1.1.3 Mitigation of Environmental Impacts

Mitigating environmental impacts in the development plan includes:

- reducing all footprints, wastes and emissions
- reducing impacts on wildlife

4.1.1.4 Community Considerations

Community considerations in the development plan include:

- identifying stakeholders' interests and issues

4.1.1.4 Community Considerations (cont'd)

- enhancing development decisions through stakeholder participation
- developing a plan that ensures a sustainable future for the operations

4.1.1.5 Economic Viability and Optimization

The development plan's economic viability depends on:

- reducing capital investment by optimizing the well count and drilling reach, and minimizing the number of pads and duplication of facilities
- reducing long-term operating costs by:
  - maximizing individual well rates
  - optimizing the well design and completion strategy to reduce the number and complexity of well interventions
- optimizing the production rate in line with the nature and size of the resource and commercial factors for the overall development

4.2.1 OBJECTIVES

The objectives of the reservoir simulation of the Parsons Lake gas field were to:

- quantify the original gas-in-place
- investigate the effects of various reservoir uncertainties on production performance
- generate a base production forecast
- propose an optimized depletion plan

4.2.2 RESERVOIR MODELS

Fine-grid geocellular models based on rock facies were constructed using Petrel software. A large number of models were developed to evaluate a continuum of resource depletion scenarios. The case that is described here is a scenario on that continuum that approximates the mode (most likely) volume estimate. The output from the base case model was scaled up, and transferred into Eclipse 100, a Geoquest reservoir simulator, for reservoir simulation studies. Later, the Eclipse models were converted to Sensor, a ConocoPhillips reservoir simulator, to complete the reservoir simulation work. The reservoir simulator provided the basis for modelling the depletion scenarios considered in the development of the depletion plan.

The initial reservoir characterization of the full field model in this section is based on the data discussed in Section 2, Geology Geophysics and Petrophysics, and Section 3, Reservoir Engineering.

4.2.2.1 Depletion Plan Model

The reservoir model was used to evaluate uncertainties in reservoir properties, such as:

- the size and strength of the aquifer
- fault transmissibility
- compartmentalization
- vertical connectivity (k_v/k_h) within the reservoir

4.2.2.1 Depletion Plan Model (cont'd)

The results were used to help:

- develop a depletion plan
- determine the number and location of wells

A base case depletion plan was determined, which optimized bottomhole locations considering structure, distance to faults and proximity to underlying water. Wells were located using available drilling and completion technology.

4.2.3 AVERAGE ANNUAL RATES

The average annual rate forecasts for the base case are shown in Figure 4-1. These forecasts were based on the plateau sales gas rate of about 9.0 Mm^3/d (324 MMcf/d) at the wellhead and 8.5 Mm^3/d (300 MMcf/d) at the northern Alberta boundary. The difference is an estimate of the fuel gas required to run the Parsons Lake facility, the Inuvik area facility and the compression facilities associated with the project. For a 25-year forecast, this production will amount to about 61 Gm^3 (2.1 Tcf) of sales gas and 3 Mm^3 (18.7 million barrels) of NGLs.

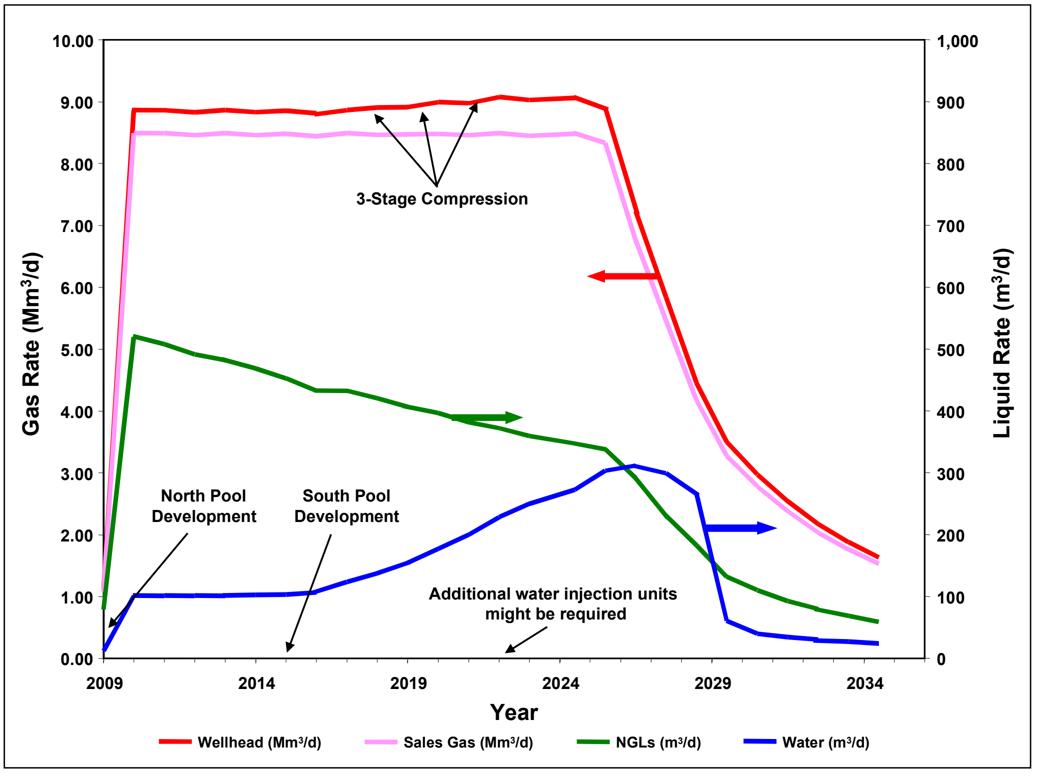

Figure 4-1: Average Annual Rates

4.2.4 COMMINGLED PRODUCTION STRATEGY

The Parsons Lake reservoir model is subdivided into 42 compartments because of multiple faults and multiple sands (A, A1, B and C). Of these compartments, 19 contain gas with an OGIP ranging from 0.9 to 16.4 Gm^3 (32 to 580 Bcf).

In order to effectively and economically deplete these compartments, it will be necessary to commingle production from multiple sands. The advantage of this approach is that it will:

- reduce the well count
- reduce the project's footprint
- reduce the number of recompletion programs and associated production downtime
- enable recovery from smaller reserve compartments and tighter and thinner sands
- increase recovery from small reserve compartments that might otherwise be shut in early

Production from individual sands can still be monitored through periodic production logs.

A base-case reservoir simulation model was built with 12 producing wells:

- nine in the north pool
- three in the south pool

To date, an additional three bottomhole locations have been identified, but are currently deemed contingent. The base reservoir model was used to compare various development scenarios and options considered. Some of the options considered include changing the timing of:

- drilling the wells
- developing the south pool
- installing compression

The results were used to select the proposed development plan.

4.3.1 START-UP

Parsons Lake field will likely start up in November 2009 with:

- five producing wells from the north pad
- one well to dispose of produced water into the Kamik C sands
- one well for cuttings injection

4.3.2 MAINTAINING PRODUCTION

When the initial wells can no longer maintain sales gas rates, additional wells will be brought on production. If the structure of the Parsons Lake reservoir is more complex than expected, contingent wells might be required to optimize gas recovery.

This will maintain the total sales gas rate, while accommodating newer, highly productive wells.

Simulation results indicate that certain zones in some wells will eventually water out. If this occurs, well interventions will be undertaken to maintain production. Logs will be run on producing wells to determine gas and water production from individual sands and to assist in intervention planning.

Intervention strategies and techniques will also be employed to enable:

- uphole zones to be completed to add to a well's production

- low-pressure zones to be segregated from higher pressure zones to prevent cross flow

4.3.3 OPTIMIZING WELLS

After start-up, production and pressure will be monitored and used to determine which fault blocks and which sands are not being drained effectively. This will enable a more accurate estimate to be made of the number and location of the wells required to produce the remaining natural gas.

By the time these wells are required, drilling technology will likely allow for greater reach from the pad. However, if bottomhole locations cannot be reached

4.3.3 OPTIMIZING WELLS (cont'd)

from the main pad, individual wells might be required to ensure efficient resource recovery.

These wells could be drilled during the winter from ice pads. Therefore, location, timing and number of wells might change somewhat from those identified by the current simulation. See Section 4.5 for a further discussion on well count uncertainty.

The south pad is expected to be brought on production in about 2015. Wells will be drilled over three winter seasons, eliminating the need for summer access.

4.3.4 INSTALLING COMPRESSION

Reservoir simulation suggests that, beginning in about 2018, compression will need to be installed to maintain productivity and increase recovery of the resource.

4.3.5 CONTINGENT WELLS AND ALTERNATIVE DRILLING LOCATIONS

The development plan assumes that all currently proposed wells will be drilled from common drilling pads at either:

- the abandoned D-20 well site in the north pool
- near the abandoned L-43 well site in the south pool

However, uncertainty in geological, geophysical and reservoir engineering interpretations means that the locations of wells drilled after start-up depend on production and drilling results. Despite the significant amount of information already known about the field, production data is needed to verify much of the geological modelling.

For example, subseismic interpretable faults could compartmentalize the reservoir even further than discussed in Section 2, Geology, Geophysics and Petrophysics, and Section 3, Reservoir Engineering. Consequently, additional wells beyond those identified as base or contingent might be required to deplete the resource. Simulation and analysis to date indicate a low probability of this being necessary, although it cannot be dismissed.

4.3.5.1 Contingent Well Locations

Bottomhole locations for the proposed wells might move up to 200 m as a result of changes in structural interpretation as seismic reprocessing continues. Other locations might become more attractive as technology and understanding of the reservoir sands improve. This includes the potential for wells targeting:

- resources in SDL 30
- a structural high in the extreme northeast corner of SDL 32

For these reasons, the concept of satellite well pads, with one or more wells similar to the south pad or smaller, is included in the development plan.

North Pool

Based on current interpretations, several potential locations have been identified for contingent wells. In the north pool, wells M-58 and K-29 are designated as contingent locations. In the case of M-58, the well was made contingent because the size of the reserve compartment and its connectivity were not well enough understood.

Well K-29 was classified as contingent because of a connectivity issue and uncertainty about whether its resources could be produced by other wells. If specific faults are proven to seal, these compartments could contain a significant quantity of gas. However, additional drilling data, logs, cores and production performance data are needed to establish this.

A contingent well in the north pool, at H-03, would target the structurally high horst block sitting in the northeast section of the pool. The current economic analysis does not support drilling a well in this horst block because it is:

- considered small with few resources
- far from the north pad, necessitating either an expensive long-reach well or a vertical satellite well

However, additional resources or reduced costs might make this a viable drilling location later.

South Pool

A contingent well in the south pool, at P-41, would target a sand in the A shale interval. The areal extent, reservoir quality and, thus, OGIP of this sand development are uncertain. Further analysis of the existing data might resolve this uncertainty.

4.3.6 WELL SPACING

4.3.6.1 Implications of Draft Regulations on Parsons Lake Well Locations

The well locations in this development plan do not conform to a spacing pattern. If the well spacing of the Draft Spacing Unit Regulations or the Alberta regulations was applied to the Parsons Lake field, most of the currently planned wells would be off-target. The proponents believe that a spacing regime of one section spacing with a target area for gas wells would be inappropriate for the optimal production of gas from the Parsons Lake field. Under Draft Spacing Unit Regulations, the operator would be required to apply for changes to the spacing unit and target area requirements for gas production in SDL 30 and SDL 32.

4.3.6.1 Implications of Draft Regulations on Parsons Lake Well Locations (cont'd)

The initial approach to well location was to place the highly deviated wells to penetrate the producing horizons at structural highs and in superior quality reservoir sands, without regard to potential one-section spacing with a target area for each well. The results of this approach indicate that identifying bottomhole locations on the basis of one well per section and conformity with a central target area within each section would require more wells to achieve the same recovery of natural gas resources. This would result in higher capital and operating costs and, potentially, more separate well pads. Alternatively, it would result in lower gas recovery for the same number of wells, an undesirable result from conservation and commercial perspectives.

4.3.6.2 Proposed Well Spacing

ConocoPhillips proposes that the Parsons Lake field not be subject to a pattern or a spacing unit with a central target approach. The company proposes that well locations within the field should be determined on an individual basis, taking into consideration such factors as:

- reservoir structure, stratigraphy and faulting
- gas recovery
- surface footprint
- costs
- drilling risks

This proposed approach would provide:

- the optimized bottomhole location within a given section
- two or more bottomhole locations to be placed close together, if necessary, within a single section

This allows the possibility for optimum location of some wells where different reservoir compartments exist on opposite sides of a common fault. ConocoPhillips believes that the well locations identified in this development plan are consistent with the proposed approach, based on currently available information.

Applying the proposed spacing methodology will allow the appropriate placement of wells, which should reduce chances of stranding gas in the reservoir and, thus, increase recovery. The proposed spacing methodology will be more efficient, and possibly reduce environmental impact, by:

- reducing reservoir penetrations and surface disturbances
- enabling safe drilling operations
- optimizing costs in a high-cost environment

4.3.6.3 Protection of Adjacent Mineral Interests

ConocoPhillips believes that the proposed spacing method and its potential results are in accord with the public interest, as reflected in the governing legislation, including the Draft Spacing Unit Regulations, provided that the rights of adjacent mineral interest holders can also be safeguarded. Therefore, ConocoPhillips proposes a buffer of 400 m between the area within the Parsons Lake field not subject to spacing restrictions and the Parsons Lake SDL boundaries, except for the common boundary between SDL 30 and SDL 32, to:

- comply with the intent of the Draft Spacing Unit Regulations
- address potential concerns relating to adjacent mineral interests

The buffer distance (see Figure 4-2) is equivalent to the distance between the outside of the target area and the section boundary in one-section spacing, as in the Draft Spacing Unit Regulations or the Alberta regime.

The absence of a buffer between SDL 30 and SDL 32 would allow for the optimal placement of potential wells in the Kamik block, a separate block previously encountered by the Gulf Kamik D-48 well (see Section 3.1, Reservoir Data). Developing Parsons Lake natural gas and natural gas liquids (NGLs) resources might, at some time, require a well or wells that could fall within a 400 m buffer area in either of these two SDLs. Issues of competitiveness do not affect the boundary between SDL 32 and SDL 30, as they are subject to common ownership by the proponents of the Parsons Lake field development plan.

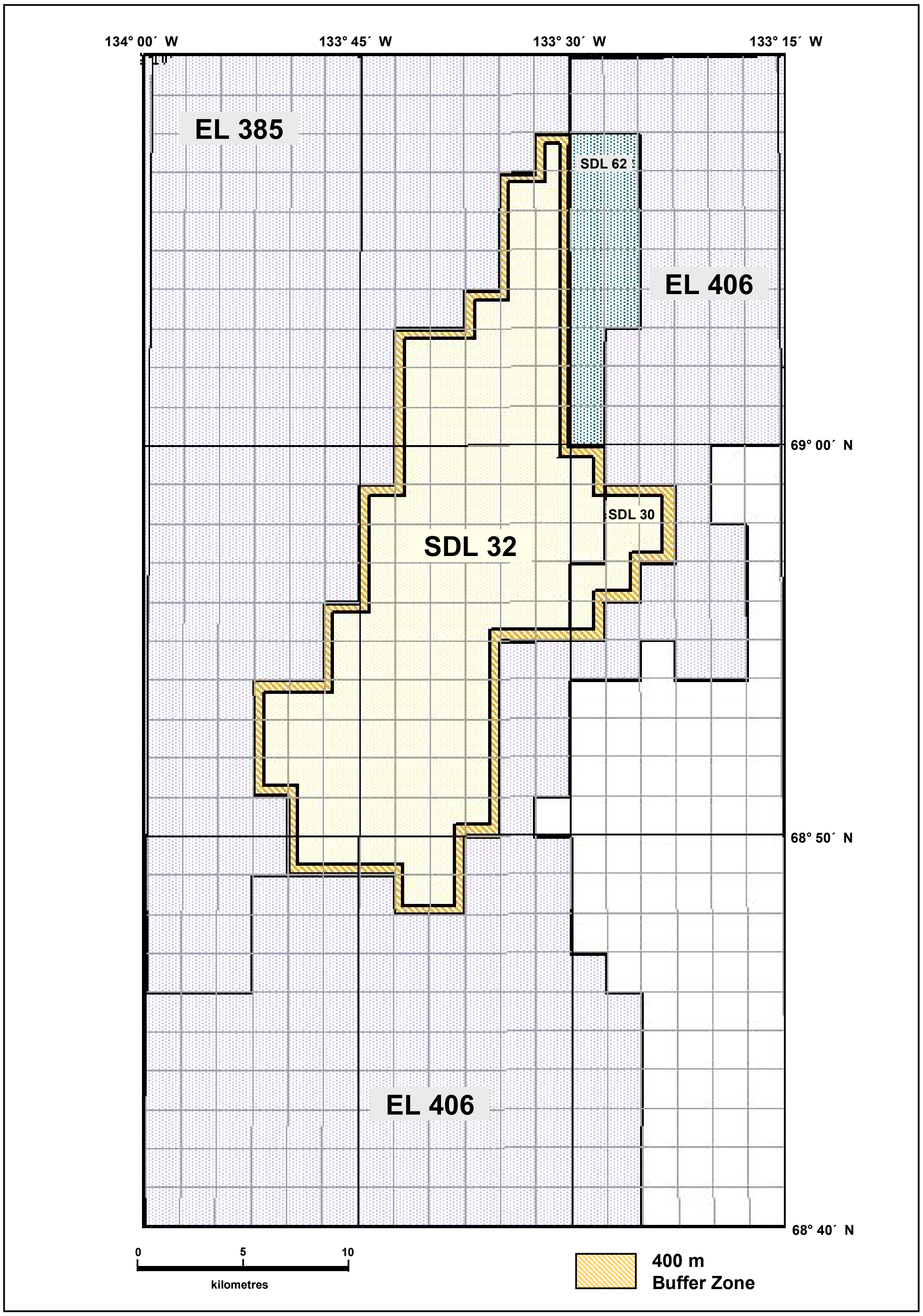

Figure 4-2: Proposed Buffer Zone

4.4.1 WELL PLAN

A well-by-well plan for testing and coring the first five wells will be prepared. A combination of drill stem tests (DSTs) and repeat formation tests (RFTs) will be used to establish the initial reservoir pressure and formation parameters. Following completion of the wells, production tests will be done on selected individual zones or a group of commingled zones, using modern equipment to:

- acquire additional reservoir information
- evaluate the efficiency of the completion practices
- evaluate the influence of any nearby fault

Core will be cut from various zones while drilling the first five wells. Where possible, core will be obtained from the wells with the lowest deviation. The intent is to obtain core from:

- producing sands for follow-up special core analyses
- injection zones of the waste disposal well and the cuttings-injection well

4.4.2 WELL MONITORING

Plans for well monitoring will be developed in accordance with both regulatory and proponents' requirements. Production and injection rates and wellhead pressures will be monitored at all production and injection wells. ConocoPhillips is also considering the use of permanent downhole gauges to measure bottomhole pressures and temperatures.

4.4.2.1 Well Data and Tests

All surface and downhole data will be used to update reservoir engineering studies. Reservoir simulation models will be calibrated to match production, injection and pressure data. These models will be used as a reservoir management tool to guide in:

- selecting follow-up well locations
- performing well recompletions
- allocating production rates

Bottomhole pressure data will be used to calculate reservoir permeability and calibrate the reservoir simulation model. Where production wells lie on opposite

4.4.2.1 Well Data and Tests (cont'd)

sides of a fault, bottomhole pressures will be used to calculate the transmissibility across the fault. This data will then be used to guide decisions on later contingent wells.

Step-rate injection tests, followed by a pressure fall-off period, will be done on the waste disposal well.

4.4.2.2 Well Sampling

While drilling and soon after start-up, reservoir fluid samples will be collected from each production well. These samples will establish the initial composition and provide reservoir fluid for analyses. Samples will also be collected and analyzed, as required, throughout the production life of the wells.

4.4.2.3 Logging Program

Key development wells will be cored to better define petrophysical relationships between log and core parameters and enhance the reservoir description. Standard open-hole and cased-hole logging programs will be implemented.

Production logging tools will be used to identify the source of any major water production where A, A1 and B sands are commingled in a wellbore. Sands with excessive water–gas ratios will be worked over to shut off the water production, to try to maximize gas production from an individual sand.

ALTERNATIVE DEPLETION SCENARIOS

4.5.1 PURPOSE

Several reservoir simulations were done to study the effect of various depletion scenarios using the design factors described in Section 4.1, Introduction. These scenarios were compared to the base case development scenario described in Sections 4.2 and 4.3, with emphasis on the production and capital profiles, and overall gas recovery. Safety and technical aspects were essentially equivalent for all of the alternatives and the base case.

4.5.2 SIMULTANEOUS SOUTH POOL DEVELOPMENT

An alternative to the two-phase development scenario was evaluated, and included the north and south pools being drilled simultaneously with the south pool wells available at start-up. Results indicate that the simultaneous south pool development:

- did not affect gas recovery significantly
- was less economical because additional capital would be required for start-up

Therefore, the base case scenario, which assumes north pool development first, followed by south pool development when gas volume is required, was chosen. Phased development also helps to spread economic opportunities for the region over a longer period, helping to reduce the potential loss of opportunities caused by activity exceeding regional capacities.

4.5.3 COMPRESSION TIMING

The development plan proposes that compression will be installed after about nine years of production. The suction pressure will be reduced from 11 to 3.1 MPa (1,595 to 450 psi) for the first three stages of compression. An alternative development scenario assumes that compression is available at, or shortly after, start-up in 2009. The advantage of installing compression early is that the plateau gas rate of the project can be sustained by lowering wellhead pressures rather than bringing new wells on stream. However, because of the higher capital required for compression, accelerating compression is not economically attractive. Delaying compression also helps mitigate any potential impacts of noise over time.

4.5.4 PLATEAU RATE

The development plan proposes a plateau rate of 9 Mm/d (324 MMcf/d) at the wellhead and 8.5 Mm^3/d (300 MMcf/d) of sales gas at the Northwest Territories–Alberta boundary).

Other scenarios considered were:

- lower plateau rates for a longer period. This resulted in poorer economics because of lower gas revenue.
- higher plateau rates for a shorter period. This resulted in better economics but increased the risk of not being able to maintain the sales gas rate for the contracted time and incurring a penalty.

The rate chosen for the development plan is an optimum rate considering these issues.

4.5.5 DRILLING ALTERNATIVES

Drilling alternatives are reviewed in Section 6, Drilling and Completions. For a discussion of these scenarios, see Section 6.2, Completions.