National Energy Board

Office national de l'énergie

Short-term **Natural Gas** Deliverability

from the

Western **C**anada **S**edimentary **B**asin

2003 - 2005

An **ENERGY MARKET ASSESSMENT** • December 2003

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Acronyms

B.C.	British Columbia
CBM	Coal Bed Methane
EMA	Energy Market Assessment
NEB	National Energy Board
NE	North East
NW	North West
PSAC	Petroleum Services Association of Canada
SE	South East
SW	South West
WC	West-Central
WCSB	Western Canada Sedimentary Basin

Units

m^3	=	cubic metres
Mcf	=	thousand cubic feet
MMcf	=	million cubic feet
Bcf	=	billion cubic feet
m^3/d	=	cubic metres per day
Mcf/d	=	thousand cubic feet per day
MMcf/d	=	million cubic feet per day
Bcf/d	=	billion cubic feet per day

Conversion Factor

1 million m^3 = 35.3 MMcf

FOREWORD

As part of its mandate under the *National Energy Board Act*, the National Energy Board (NEB or the Board) is required to study and keep under review a broad range of energy matters over which Parliament has jurisdiction. In keeping with this responsibility, the Board continually monitors the supply of all energy commodities in Canada (including electricity, oil, natural gas and natural gas liquids) and the demand for Canadian energy commodities in both export and domestic markets. The Board publishes reports on energy, known as Energy Market Assessments (EMAs), which examine various facets of Canada's energy market. These reports include both long-term assessments of Canada's energy future and specific reports on current and near-term energy market issues.

In addition to its mandate to monitor energy markets in Canada, the Board has specific monitoring responsibilities pursuant to its regulatory responsibilities. The Board is required to monitor Canadian energy markets to ensure that markets are operating such that Canadian energy requirements are being met at fair market prices.

This EMA report, titled *Short-term Natural Gas Deliverability from the Western Canada Sedimentary Basin, 2003-2005*, examines the factors which affect gas supply in the short-term and presents an outlook for deliverability through to the year 2005. The main objective of this report is to advance the understanding of the short-term gas supply situation by examining recent trends in the production characteristics of the Western Canada Sedimentary Basin (WCSB) and applying these trends to provide an outlook for short-term deliverability from the WCSB. Further, this report is an update to the Board's December 2002 EMA, titled *Short-term Natural Gas Deliverability from the Western Canada Sedimentary Basin, 2002- 2004*.

During the preparation of this report, a series of meetings and discussions were conducted with natural gas producers, pipeline companies, industry associations and government agencies. The NEB appreciates the information and comments it received.

OVERVIEW

The WCSB is a key source of natural gas supply in North America, serving practically all of Canada's domestic requirements for natural gas and providing export volumes that amount to approximately 15% of total market consumption in the United States. Between the mid-1980s and the late 1990s production from the WCSB grew rapidly, more than doubling from approximately 205 million m^3/d (7.3 Bcf/d) in 1986 to just under 453 million m^3/d (16.0 Bcf/d) by 1998. Production has not increased significantly since 1998. The basin produced at an all-time high level in 2001 at an average daily production rate of 474 million m^3/d (16.7 Bcf/d). In 2002, production decreased slightly to an average daily rate of 466 million m^3/d (16.4 Bcf/d). Due to the importance of the WCSB to North American gas supply, there is considerable interest in the outlook for production. The purpose of this report is to provide an outlook for deliverability from the WCSB through to the end of 2005.

This report breaks the WCSB down into areas in which wells have generally common development and production characteristics. The methodology of this EMA involves, for each area, an estimation of future deliverability from already producing wells based on extrapolation of current production trends, and an assessment of the productivity and number of future gas well connections that can be expected over the projection period. Production decline analysis provides a sound basis for the projection of deliverability from already producing wells. The productivity of future gas well connections in each area is estimated with reasonable accuracy using production decline trends evident in wells connected over the past four or five years. The number of future gas well connections is estimated on the basis of industry projections of future gas well drilling in the various areas.

This assessment indicates that the decline rate of the typical gas well for areas across the WCSB has stabilized over approximately the last four years. The initial productivity of the typical gas well connection has also stabilized from the significant decreases that occurred between 1996 and 2000; however, a slight downward trend in this factor is still evident in most areas of the WCSB. Due to the decrease in initial productivity of the typical gas well in the WCSB since 1996, more gas wells are required in the present environment to achieve the levels of deliverability recorded in the past from new gas well connections.

Market conditions over 2003 have been very favourable for the development of gas resources. Industry associations project that gas well drilling in 2003 will amount to approximately 13,900 wells, approximately 4,800 more than the number of gas wells drilled in the WCSB in 2002. Industry associations also project that approximately 11,900 gas wells will be drilled in 2004. The Board anticipates that demand for natural gas will continue to be strong throughout the projection period, and thus expects that the gas well drilling activity projected for 2004 will be repeated in 2005. This level of drilling activity is expected to result in new gas well connections totalling approximately 14,400 in 2003, 13,850 in 2004, and 12,850 in 2005[1].

1 Despite the same amount of wells expected to be drilled in 2004 and 2005, connections are expected to be higher during the former period due to the carry-over from high drilling activity in late 2003.

Based on these trends, the Board expects that deliverability associated with new gas well connections over the projection period, plus a small but growing contribution from coal bed methane, will approximately offset the decline that will occur in existing production. **The Board projects deliverability from the WCSB to decrease from 462 million m3/d (16.3 Bcf/d) at the end of 2002 to 448 million m3/d (15.8 Bcf/d) by the end of 2005.**

INTRODUCTION

The WCSB is a key source of natural gas supply in North America, accounting for almost one-quarter of the combined production of Canada and the United States (U.S.) in 2002. The WCSB was relied upon to supply almost all of the incremental demand growth in the U.S. from 1986 to 1999, during which time gas exports from Canada more than quadrupled. However, in the last few years, production has flattened out and there was actually a slight decline in 2002.

Due to the WCSB's strategic importance to North American natural gas supply, there is considerable interest in the outlook for production from this basin over the next few years. The purpose of this report is to provide the Board's current outlook for natural gas deliverability from the WCSB to the end of 2005.

In its last report, released in December 2002, the Board projected that deliverability from the WCSB would decline slightly from 470 million m^3/d (16.6 Bcf/d) at the end of 2001 to 461 million m^3/d (16.3 Bcf/d) at the end of 2002 and then further to 450 million m^3/d (15.9 Bcf/d) by the end of 2004. The actual deliverability for the WCSB at the end of 2002 was approximately 462 million m^3/d (16.3 Bcf/d). In this EMA, the same methodology as was used in the December 2002 EMA is applied to provide an update of the Board's short-term deliverability outlook.

Chapter 2 provides background on the WCSB, including a description of the geographic extent and nature of the basin, a description of the geographic areas comprising the basin that are used in this EMA, and the historical production of the basin. Chapter 3 describes the methodology used in this study. The methodology involves the analysis of production decline trends in the WCSB resulting in parameters quantifying the deliverability expectations from existing wells, and the parameters defining the production characteristics that may be expected from future gas well connections. The procedure for assessing gas development activity over the projection period is also described. Chapter 4 presents the results of this study, detailing the estimated production characteristics for future typical gas well connections, and the number of gas well connections expected over the projection period. The Board's outlook for deliverability from the WCSB is presented in Chapter 5. The conclusions and possible implications of study results are discussed in Chapter 6.

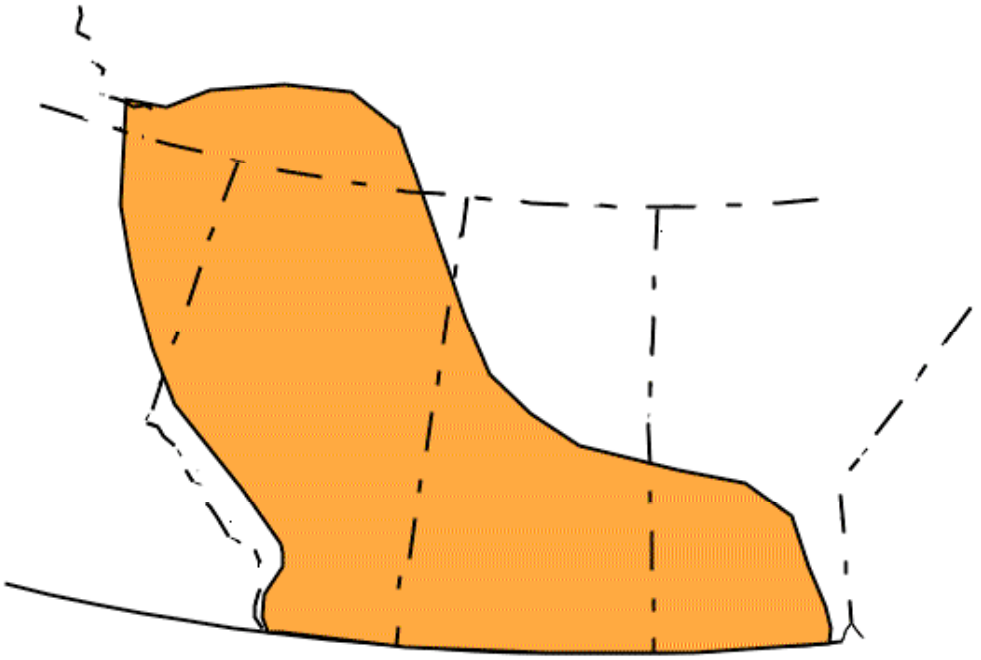
BACKGROUND

2.1 Western Canada Sedimentary Basin

The WCSB includes most of Alberta, significant portions of British Columbia (B.C.) and Saskatchewan, as well as parts of Manitoba and the Yukon and Northwest Territories (Figure 2.1). Within this vast area, the topography and geology vary significantly, thereby influencing the exploration and development strategies of the gas industry. For example, physical access to lands for drilling is essentially unrestricted in the south-eastern part of the basin, which tends to be flat prairie, while in the western part of the basin, adjacent to the Rocky Mountains, access is more difficult. In addition, there tend to be more restricted areas for environmental reasons in the western portion of the basin. Toward the northern end of the basin, areas are often covered with muskeg, so drilling has to be carried out in winter when the ground is frozen. The investment needed to drill a well varies with the topographical characteristics and environmental restrictions of the location. Generally, limitations to access, whether due to topography or environmental restrictions, increase the cost and reduce the amount of drilling and development.

FIGURE 2.1

Western Canada Sedimentary Basin



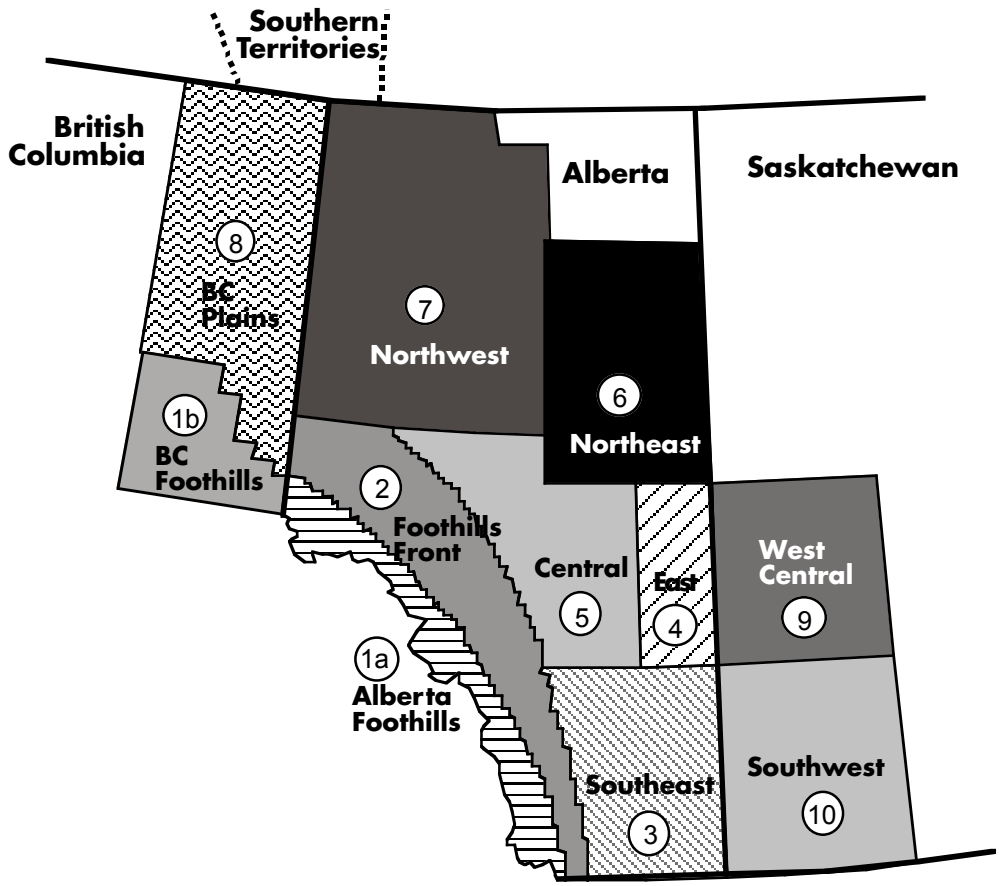
Regional geology can also have a great impact on drilling and costs. Geological formations in the WCSB dip to the SW, resulting in increasing drilling depths and increasing drilling complexity from east to west. Together, these differences in physical access and depths result in very large differences in drilling costs across the WCSB. To illustrate, a shallow well in SE Alberta or SW Saskatchewan may cost less than $100,000 whereas a deep well in the Foothills may cost more than $10 million.

Gas recovery and productivity per well also tend to vary according to area. The shallow wells in south-eastern Alberta generally have initial productivity rates of 4.5 thousand m^3/d (0.16 MMcf/d). In contrast, the typical well in the B.C. Foothills exhibits initial productivity rates of 225 thousand m^3/d (8 MMcf/d).

The large regional differences in physical characteristics within the WCSB require that the basin be divided into smaller areas with similar characteristics for production decline analysis. For this report, the WCSB has been split into gas producing areas following some of the designations developed by the Petroleum Services Association of Canada (PSAC). In addition, PSAC's Foothills area was further subdivided by province (1a - Alberta Foothills and 1b - B.C. Foothills). Finally, this study added the southern Territories for a total of 12 areas (Figure 2.2). Each of these areas was analysed independently and individual deliverability outlooks were generated for each area. Any information presented for a larger area, such as the entire WCSB, is derived by summing the results of the individual areas.

FIGURE 2.2

WCSB Geographic Areas



2.2 WCSB Production History

Figure 2.3 shows the monthly marketable gas volumes produced from the WCSB from 1990 to the present with production volumes split by connection year. The WCSB experienced a large increase in marketable gas production between 1990 and 1998, from an annual average of 303 million m^3/d (10.7 Bcf/d) to an annual average of approximately 453 million m^3/d (16 Bcf/d). Since 1998, production from the basin has remained relatively level at an annual average just over 453 million m^3/d (16 Bcf/d).

The following can be observed from Figure 2.3:

- Decline Rates of Existing Connections

  In recent years, the annual decline rate for production from all existing connections has been in the range of 23 percent. At this rate of decline for existing gas well connections, the marketable gas production from the WCSB would decrease over a one year period from 453 million m^3/d (16 Bcf/d) to approximately 363 million m^3/d (12.8 Bcf/d), without additional supply from new connections.

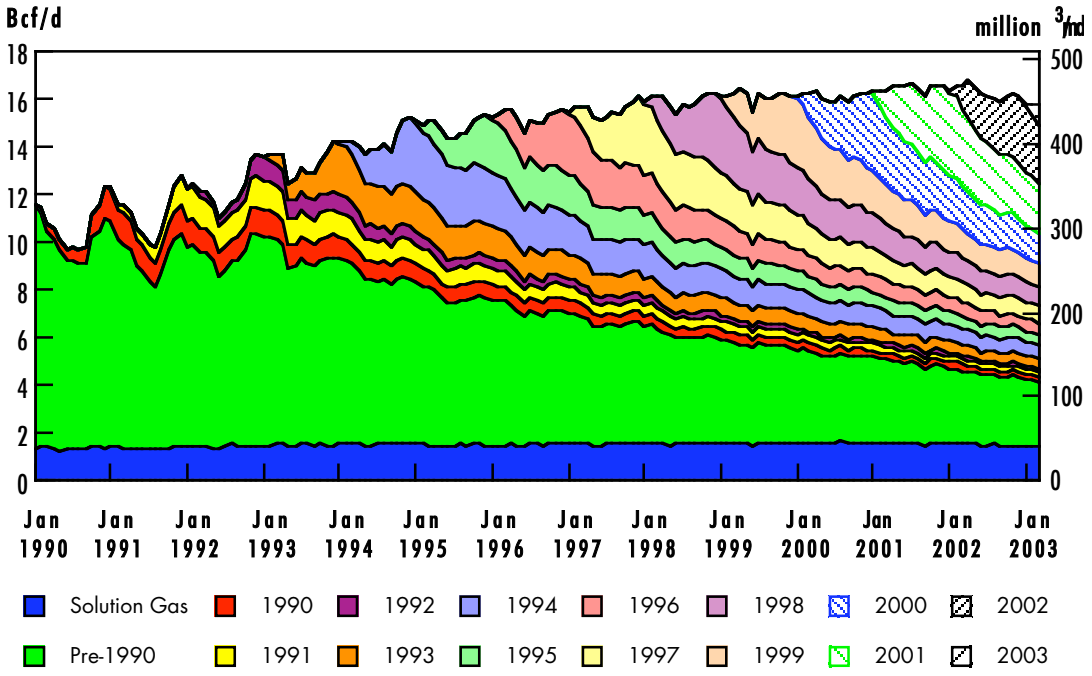
- Large Contribution of New Wells to Current Production

  Large volumes of marketable gas production from new gas well connections have been brought on stream every year, making up the loss from declining older wells. These new wells are becoming a substantial portion of total WCSB gas production at any given point in time. In fact, approximately 50 percent of the total marketable gas production over the past several years comes from gas well connections that are less than five years old at that time. Prior to 1998, new connections increased overall production every year. Since 1998, however, production from new connections has been approximately equal to the decline in production from existing connections; thus, total production from the WCSB has remained relatively flat over this period.

Estimation of future deliverability from the WCSB requires an accurate assessment of deliverability from existing wells, and an assessment of the deliverability that will come from future connections. The methodology used in this report to address these factors is detailed in Chapter 3.

FIGURE 2.3

WCSB Marketable Natural Gas Production by Connection Year



Source: GeoScout Well Production Data

METHODOLOGY

The general methodology utilized in this EMA in estimating deliverability for the WCSB through to the end of 2005 can be summarized as follows:

Future Deliverability = (Future Deliverability from Existing Gas Well Connections) + (Deliverability from Future Gas Well Connections) + (Solution Gas Deliverability)

The above formula is applied to each of the geographic areas identified in Chapter 2 to obtain an estimate of short-term deliverability for the WCSB.

For the purpose of this report, Existing Gas Well Connections are considered to be those brought on stream prior to January 1, 2003, and Future Gas Well Connections are considered to be those brought on stream after January 1, 2003.

To obtain an estimate of **Future Deliverability from Existing Gas Well Connections** in each geographic area, gas well connections were grouped by connection year and production decline analysis was performed to determine the parameters that define the future deliverability of the group.

To estimate the **Deliverability from Future Gas Well Connections**, production decline analysis was performed on production data for the "typical gas well connection" in each geographic area. The analysis done on the typical gas well connections is very similar to that performed for existing gas well connections, except that the focus is more on defining the production characteristics in the earlier stages of production, rather than emphasizing the most recent production history. The trends seen in the historic data were used to establish parameters that define the deliverability to be expected from future gas well connections. The number of gas well connections expected in future years is estimated and applied to the expected productivity of the typical gas well connection of future years to obtain the Deliverability from Future Gas Well Connections.

Solution Gas Deliverability is a minor component of total WCSB deliverability, currently accounting for approximately 8.5 percent of total WCSB natural gas production. Historical natural gas production data was totalled for all oil well connections within each geographic area, and production decline analysis was performed to obtain the parameters which define Future Solution Gas Deliverability.

3.1 Production Decline Analysis

3.1.1 Alberta, B.C. and Saskatchewan

3.1.1.1 Existing Gas Well Connections

Production decline analysis was performed on the geographic areas in Alberta, B.C. and Saskatchewan to obtain parameters necessary to estimate future deliverability. All connections that produced gas and/or oil were categorized as either gas ("gas well connections") or oil ("oil well connections") based on each connection's cumulative production and cumulative gas-oil ratio. The gas well connections within each geographic area were grouped together on the basis of the year in which production first occurred (the "connection year").

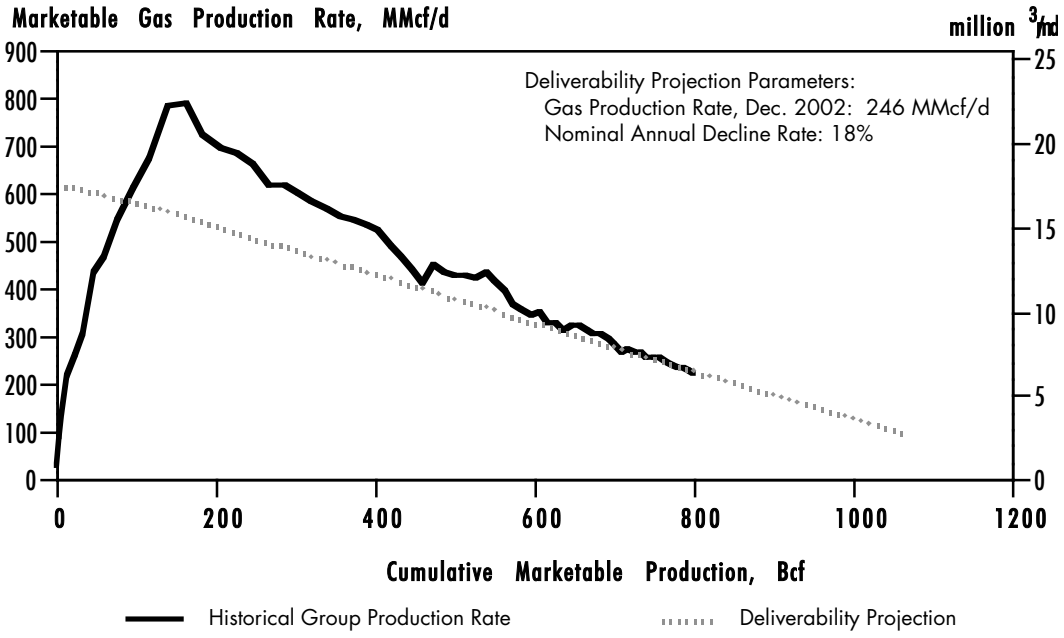
For each grouping of gas well connections (grouped by geographic area and connection year), the total marketable gas production for each calendar month was calculated and a plot of group production rate versus cumulative production was constructed to determine the following parameters for each group:

- group deliverability as of December 31, 2002, and
- current exponential decline rate for the group.

The above parameters can be applied to estimate future deliverability for each grouping of existing gas well connections. Figure 3.1 shows the plot generated for the Alberta Foothills Front area for 1998 as an example of the method used for determining decline parameters for the group. The exponential decline rate is determined as the slope of the line formed by the production history data

FIGURE 3.1

Example of Group Production Decline Plot
Alberta Foothills Front Area, 1998 Connection Year



Source: GeoScout Well Production Data

on the plot of production rate vs. cumulative production. The decline rate determined in this manner is the nominal annual decline rate.

3.1.1.2 Future Gas Well Connections

A second production decline analysis was performed on each grouping of gas well connections (grouped by geographic area and connection year) aimed at assessing the performance of the typical gas well connection. This assessment of typical gas well connection performance in past connection years provides the basis for the estimation of the performance of typical gas well connections that will be brought on stream in the future.

For the decline analysis of the typical gas well connection, the production history data for the group is totalled by "normalized month" rather than calendar month. For production relating to any calendar month, the "normalized month" is the number of months between the month when production occurs and the month when production started for the gas well connection. The "normalization" process brings all gas well connections in the group to a common starting point, which is very desirable in the evaluation the typical gas well performance of the group. The group production (summed by normalized month) is divided by the number of gas well connections in the group to obtain a representative production history for the "typical gas well connection" for the group.

For each geographic area and connection year a plot of production rate vs. cumulative production was created and production decline analysis performed to obtain the following parameters:

- initial production rate;
- first decline rate;
- months to second decline rate; and
- second decline rate.

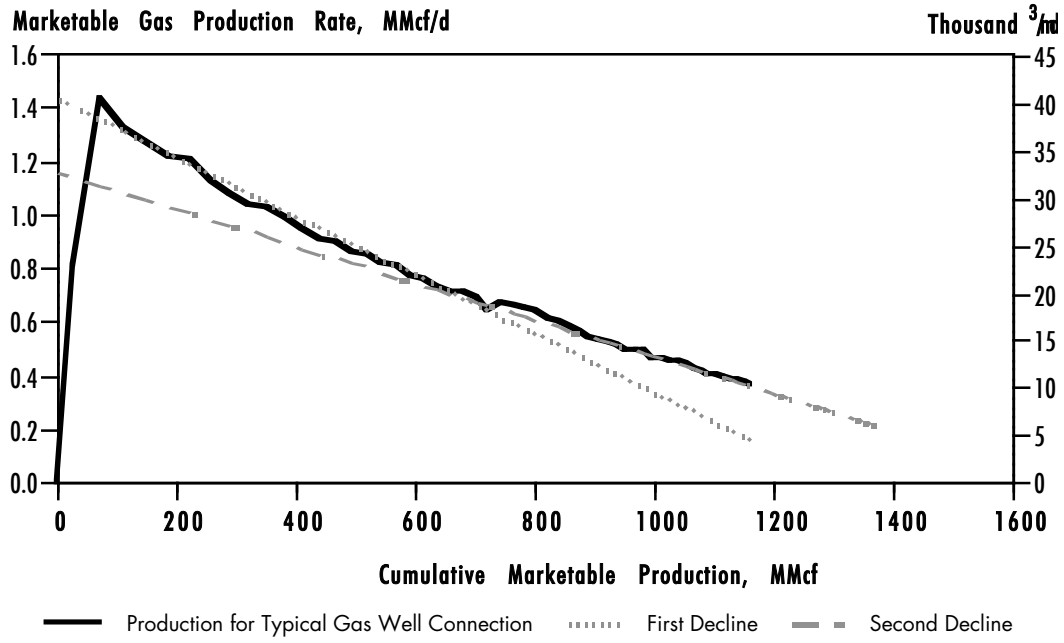
Figure 3.2 provides an example of the type of plot generated in conducting production decline analysis of the typical gas well connection. Figure 3.2 relates to the Alberta Foothills Front area for gas well connections brought on stream in 1998. Plots of this nature were generated for all geographic areas in Alberta, B.C. and Saskatchewan, and for all connection years between 1990 and 2002.

The production decline analysis (as shown in Figure 3.2) performed on the typical gas well connection data results in parameters that define the productivity of typical gas well connections in past years (for details see Appendix 4). To examine the performance of typical gas wells for different connection years, graphs of the nature shown in Figure 3.3 were generated for each geographic area in Alberta, B.C. and Saskatchewan (see Appendix 1). Figure 3.3 is a plot of production rate vs. cumulative production for the typical gas well connections in the WCSB for the past six connection years. The trends evident in this type of plot were used in deriving initial productivity to be applied to future gas well connections in each geographic area.

The production decline analysis of the typical gas well connection in each geographic area thus ultimately produces the parameters that define the productivity of future gas well connections. To assess the total deliverability that will occur from these future connections, an estimate of the number of future gas well connections is also required. The methodology for assessment of the number of future gas well connections is described in section 3.2.

FIGURE 3.2

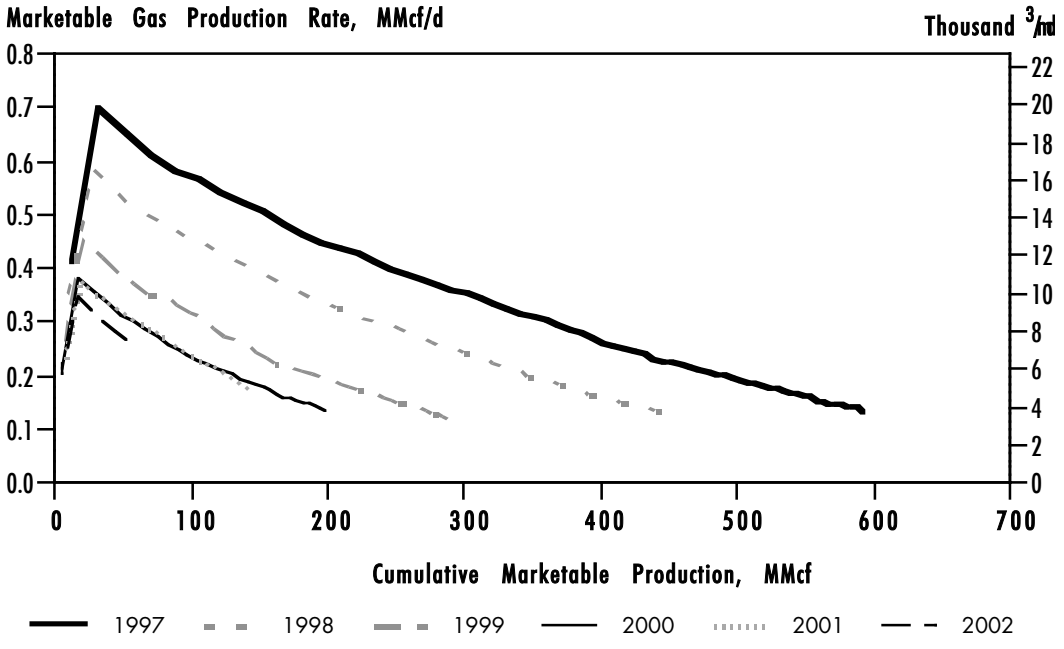
Example of Typical Gas Well Connection Production Decline Plot Alberta Foothills Front Area, 1998 Connection Year



Source: GeoScout Well Production Data

FIGURE 3.3

Production Profiles of Average Gas Well Connections in the WCSB for Recent Years



Source: GeoScout Well Production Data

3.1.1.3 Solution Gas

Solution gas is natural gas produced in conjunction with oil production. Solution gas accounts for only 8.5 percent of total WCSB production, and thus a less rigorous type of analysis is performed to assess solution gas deliverability. To estimate future deliverability of solution gas, a plot of production rate vs. cumulative production was utilized to obtain the current production rate and the decline rate for solution gas in each geographic area in Alberta, B.C. and Saskatchewan.

3.1.2 Southern Territories

The Southern Territories are relatively undeveloped and thus this area is not well-suited to the type of statistical analysis performed on the areas in Alberta, B.C. and Saskatchewan. The Southern Territories involve a small number of areas that produce natural gas located in both the Yukon and Northwest Territories. At present, the Southern Territories produce approximately 2.8 million m^3/d (100 MMcf/d) of marketable gas. Production decline analysis was performed on each of the main gas producing areas to determine the future deliverability of existing gas well connections. The deliverability to be expected from future gas well connections was determined using the Board's estimate of future connections and typical connection deliverability parameters that apply to the region.

3.1.3 Coal Bed Methane

Coal bed methane (CBM) has attracted a growing level of attention in recent years. A number of pilot projects are currently underway to determine the commercial viability of this resource. The NEB expects that approximately 350 CBM wells will be drilled in 2003 in various projects in the WCSB. The Board believes that activities to date in the development of CBM in the WCSB have not yet resulted in a clear consensus on the level of success that may be expected in the exploitation of this resource. However, due to the current level of activity and interest in CBM, the large potential of this resource in the WCSB, and the fact that there is some CBM production occurring in the WCSB now, it is appropriate to account for some level of CBM production within the scope of this EMA.

This EMA estimates that coal bed methane activity will increase steadily, from approximately 300 new wells connected in 2003 to 1200 new wells connected in 2005, resulting in total coal bed methane deliverability of approximately 5.7 million m^3/d (200 MMcf/d) by year end 2005.

3.1.4 Special Considerations

Ladyfern

In 2000, the prolific Ladyfern gas field was discovered in the B.C. Plains area, and during 2001 and 2002 approximately 40 wells were drilled to fully exploit the discovery. The highly productive Ladyfern wells are very different from the typical new gas well connections in the B.C. Plains region. Due to the number of wells associated with Ladyfern, the anomalously high production rates associated with these wells, and the high decline characteristics of the wells, Ladyfern wells were excluded from the rest of the B.C. Plains area for production decline analysis. A separate production decline analysis was performed on the Ladyfern field, and was later added to the B.C. Plains area projection.

NE Alberta Wells Shut in for Bitumen Conservation

In the summer of 2003, the Alberta Energy and Utilities Board produced a list of 938 gas wells in NE Alberta where continued production represented a potential threat to the recovery of bitumen resources. The wells involved are required to be shut in unless, for any given well, it can be demonstrated that continued production from the well will not harm bitumen recovery. The process of identifying which of the 938 wells are to be exempted from being shut in is in progress as of the writing of this report.

At the end of 2002, the total deliverability from all of these 938 well was approximately 5.95 million m^3/d (210 MMcf/d). The Board makes the assumption that approximately 50 percent of the deliverability associated with the 938 wells will be ultimately shut in by the end of 2003. To account for this situation, a correction is applied to the deliverability outlook for the NE Alberta area.

3.2 Gas Well Drilling Activity and Gas Well Connections

New gas well connections contribute a large and critical component to total basin gas production at any given time. To estimate the deliverability associated with new gas well connections, an estimate of individual gas well connection productivity is required as well as an estimate of the number of connections that will be made. In section 3.1.1.2, the methodology for determining typical gas well connection performance parameters for future years was discussed. In this section, the method used in estimating the number of gas well connections in 2003, 2004 and 2005 is described.

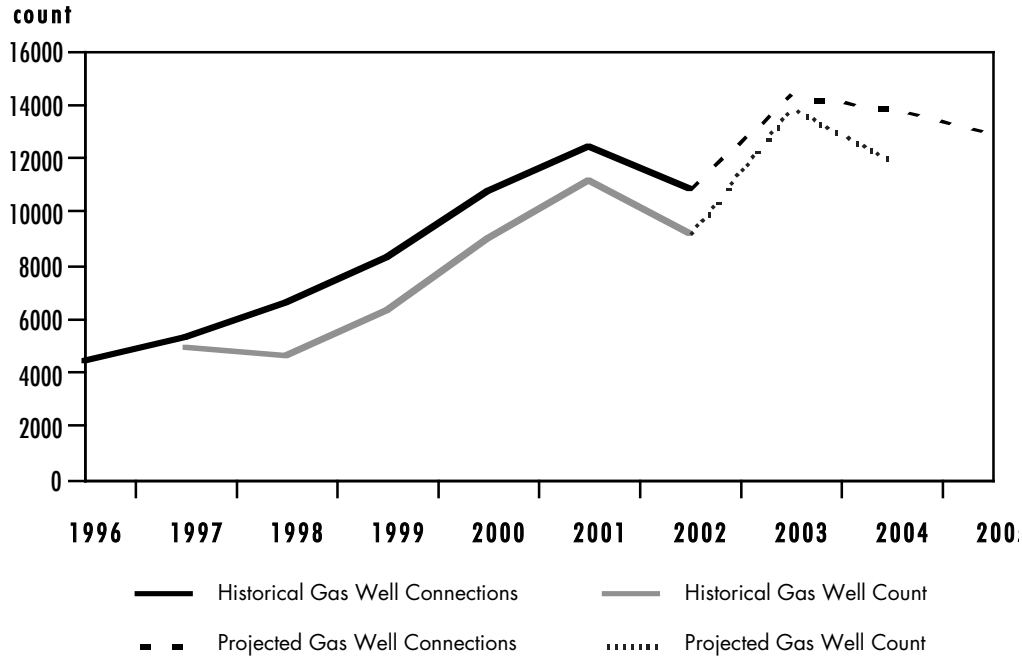
A plot was created for each geographic area showing the number of gas wells drilled in each of the past several years plus an estimate of gas well drilling levels for 2003 and 2004. The "*2004 Canadian Drilling Activity Forecast*", published by PSAC in October 2003, was used to provide estimates of 2003 and 2004 gas well drilling levels in each of the areas of the WCSB. The number of historical gas well connections for each year was also plotted. Figure 3.4 is an example of this type of plot, and shows the data for the entire WCSB. Graphs similar to that shown in Figure 3.4 were created for each geographic area in Alberta, B.C. and Saskatchewan (see Appendix 2). A reasonable correlation exists between number of gas wells drilled and number of gas well connections made in each year in the various geographic areas. Based on the relationships seen in recent years in each geographic area, a ratio of gas well connections per gas well drilled was selected to be applied to the gas well drilling estimates for 2003, 2004 and 2005 to obtain a projection of gas well connections over those years. Because of the high drilling levels expected in the last quarter of 2003, a portion of the gas well connections associated with drilling that occurred in 2003 were allocated to 2004 in this study.

3.3 Summary of Methodology

This chapter described the methodology utilized in this study to determine future natural gas deliverability. Production decline analysis of each production grouping (by geographic area and connection year) provides parameters that can be used to estimate future deliverability for existing gas well connections. Parameters that describe the performance of future gas well connections are obtained from production decline analysis of the typical gas well connections in each geographic area. Current and historical trends in gas well drilling and gas well connections are analysed to obtain an estimate of gas well connections that will occur in the future. The deliverability contribution of future wells is determined by applying the number of future gas well connections to the expected performance parameters for the future typical gas well connections. In addition, future deliverability of solution gas is obtained using the current production decline trends in each geographic area. An estimate of production for coal bed methane is added to the total WCSB deliverability, in the expectation that steady progress occurs in development of this resource.

FIGURE 3.4

Gas Well Drilling and Gas Well Connections, WCSB



Source: Nickle's Daily Oil Bulletin and GeoScout Well Production Data

DELIVERABILITY PARAMETERS – RESULTS

4.1 Decline in Production from Existing Gas Well Connections and Solution Gas

Production decline analysis resulted in an estimation of production rate as of the end of 2002 and the decline rate currently applicable to that production. These values were determined for each geographic area and connection year for existing gas well connections, and for each geographic area for solution gas. The future deliverability of the existing gas well connections and solution gas is projected on the basis of these parameters. A table listing these parameters is included as Appendix 3. The deliverability projections created from these parameters can be summed up and result in a 22.8 percent overall nominal decline rate over the year 2003 for all existing gas well connections and solution gas in the WCSB.

4.2 Future Gas Well Connections

4.2.1 Performance Parameters of Future Typical Gas Well Connections

Due to the large contribution of recent gas well connections to the total WCSB deliverability at any given time, the level of deliverability to be expected from future gas well connections is a key factor in assessing future deliverability. The production decline analysis described in Chapter 3 provided the basis for the establishment of performance parameters for future gas well connections.

In general, it was found that in each geographic area the first decline rate, the second decline rate and the number of months to the second decline rate were fairly constant in recent years. These typical gas well parameters, observed in recent connection years, were applied without modification to future connection years.

For Initial Productivity, a downward trend was evident over the period 1997 to 2002 for most geographic areas. In general though, the year-on-year decrease in Initial Productivity has lessened considerably over the past few years and in some areas the Initial Productivity appears to have stabilized. Graphs of typical gas well connection performance for recent years for each geographic area are contained in Appendix 1.

The performance parameters for future gas well connections established for each geographic area are shown in Table 4.1.

TABLE 4.1

Production Characteristics for Typical Gas Well Connections – 2003, 2004 and 2005

Prov.	Area	First Decline Rate	Months to Start of Second Decline	Second Decline Rate	Initial Productivity					
					2003 Gas Well Connections		2004 Gas Well Connections		2005 Gas Well Connections	
					$10^3m^3/d$	MMcf/d	$10^3m^3/d$	MMcf/d	$10^3m^3/d$	MMcf/d
Alberta	Foothills	0.50	12	0.20	56.63	2.000	56.63	2.000	56.63	2.000
	FH Front	0.50	20	0.25	23.22	0.820	22.65	0.800	22.09	0.780
	SE	0.60	18	0.30	4.39	0.155	4.25	0.150	4.11	0.145
	East	0.60	20	0.30	7.93	0.280	7.65	0.270	7.36	0.260
	Central	0.63	24	0.31	9.49	0.335	9.20	0.325	8.92	0.315
	NE	0.33	27	0.22	7.65	0.270	7.36	0.260	7.08	0.250
	NW	0.55	24	0.32	15.57	0.550	14.87	0.525	14.16	0.500
BC	Plains	0.40	24	0.20	25.49	0.900	24.64	0.870	24.07	0.850
	Foothills	0.20	N/A	N/A	226.54	8.000	226.54	8.000	226.54	8.000
Sask	WC	0.55	18	0.20	6.80	0.240	6.23	0.220	5.66	0.200
	SW	0.46	24	0.24	1.81	0.064	1.76	0.062	1.70	0.060

4.2.2 Number of Future Gas Well Connections

Applying the number of new gas the number of new gas well connections to the performance parameters listed in Table 4.1 generates the deliverability from future gas well connections. The expected number of new gas well connections is obtained by the analysis of industry projections of gas well drilling activity in the WCSB.

As mentioned in Chapter 3, PSAC's "*2004 Canadian Drilling Activity Forecast*" was used to obtain estimates of 2003 and 2004 gas well drilling levels. In this EMA, gas well drilling activity in 2005 is assumed to be the same as what was projected for 2004 in the PSAC report. The 13,900 gas wells estimated by PSAC for 2003 are a large increase over the 9,100 gas wells drilled in 2002. This projected increase in activity is widespread throughout the WCSB, with the exception of the areas of NE Alberta and East Alberta which are experiencing only marginal increases in gas well drilling. The 2003 drilling levels estimated for the B.C. Plains and SE Alberta areas were particular strong, showing 90 percent and 70 percent increases in gas wells drilled, respectively, compared to 2002 levels. For 2004, the PSAC report estimates that 11,900 gas wells will be drilled in the WCSB, which, though a decrease from 2003, is nevertheless very high drilling activity relative to historical levels. According to the PSAC report, the most significant decreases in drilling activity between 2003 and 2004 are projected to occur in the areas on the eastern side of the WCSB. The Alberta areas of SE, East, NE, and Central, and the two Saskatchewan areas of SW and WC, taken as a whole, are projected to have approximately 1,800 fewer wells drilled in 2004 than 2003. With regard to the shallow gas areas of SE Alberta and SW Saskatchewan, even though there is a decrease in 2004 gas drilling compared to the very high levels of 2003, the projected 2004 drilling levels still amount to high drilling activity relative to the historical levels in these areas. Drilling activity in 2004 in the areas on the western side of the basin is expected to be sustained at levels closer to 2003, with the B.C. Plains area expected to see a slight increase in activity over 2003 gas well drilling levels.

In considering the decrease in the total number of gas wells projected to be drilled in 2004 relative to 2003, the Board observes the increasing focus in drilling activity towards the north and western areas of the WCSB, and particularly towards the B.C. Plains area. The Board also observes that the PSAC report projects less drilling activity for 2004 relative to 2003 for the areas in the eastern portion of the WCSB. In general, wells in the northern and western areas are deeper, more costly, and more productive than wells in the eastern and southern portions of the basin. Thus, the decrease in total

number of gas wells projected to be drilled in 2004 vs. 2003 is partially due to increased drilling emphasis in the north and west areas of the WCSB. The level of drilling projected for 2004 is also tempered by concerns that 2004 price levels may not match those of 2003, resulting in a reduced level of industry cash flow.

In this EMA, the number of gas well connections in each year and each area are estimated primarily based on gas well drilling projections combined with the historical trends in the ratio of gas well connections to gas wells drilled. With the heavy levels of gas well drilling in the last half of 2003, and the expected lag time between completion of drilling operations and the date of first production for gas wells, a portion of the gas well connections attributable to gas wells drilled in 2003 were allocated to 2004 in this EMA. Based on these factors, the Board's projection of gas well connections by area is as shown in Table 4.2.

TABLE 4.2

Projected Gas Well Connections by Geographic Area

Province	Area	Projected Gas Well Connections		
		2003	2004	2005
Alberta	Foothills	77	77	77
	Foothills Front	1273	1274	1202
	SE	6475	6019	5739
	East	576	580	480
	Central	1346	1250	1036
	NE	480	350	330
	NW	1024	1018	963
B.C.	Plains	750	870	825
	Foothills	9	9	9
Sask.	WC	218	194	155
	SW	2170	2215	2041
WCSB Total		**14398**	**13856**	**12857**

DELIVERABILITY OUTLOOK

Combining the level of future gas well connections with the performance expectations from these future gas well connections, and factoring in the decline associated with existing producing wells, the Board derives an estimate of deliverability for each area as shown in Table 5.1.

The key Alberta supply areas of the Alberta Foothills Front and SE Alberta, which together account for almost 43 percent of production from the WCSB, are expected to exhibit relatively stable deliverability over the projection period. The slight decline expected in the Alberta Foothills Front is approximately offset by the small increase in deliverability from SE Alberta. Deliverability from the two Saskatchewan areas is also expected to be practically flat over the projection period. The Alberta Foothills and the B.C. Foothills areas are expected to exhibit increased deliverability over the projection period due to strong drilling activity and the high production rates expected from wells in these two regions. Similarly, in the B.C. Plains area, the increasing level of gas well drilling activity projected for this area is expected to result in steadily increasing deliverability through to the end of 2005. However, growth in deliverability from these three areas is more than offset by the Alberta areas of NE, East, NW and Central which are projected to decline steadily in deliverability over the projection period.

TABLE 5.1

WCSB Deliverability Outlook by Geographic Area

Province	Area	Production December 2002		Year End Deliverability					
				2003		2004		2005	
		10^6 m³/d	MMcf/d	10^6 m³/d	MMcf/d	10^6 m³/d	MMcf/d	10^6 m³/d	MMcf/d
Alberta	Foothills	15.1	533	16.5	583	17.3	612	17.9	633
	Foothills Front	119.8	4 229	119.3	4 211	117.8	4 157	114.2	4 030
	SE	78.5	2 771	83.3	2 939	82.7	2 918	80.4	2 839
	East	19.3	680	18.3	645	17.7	625	16.7	588
	Central	46.4	1 638	45.3	1 600	43.2	1 524	40.0	1 410
	NE	34.5	1 218	29.4	1 037	26.0	918	23.4	827
	NW	59.8	2 112	57.3	2 023	55.3	1 954	52.4	1 850
B.C.	Plains	59.9	2 113	60.3	2 129	64.6	2 280	66.5	2 348
	Foothills	8.2	291	8.3	293	8.7	306	9.0	318
Sask.	WC	5.0	178	5.3	188	5.2	185	5.0	177
	SW *	13.1	463	13.7	484	13.9	491	13.7	483
S. Terr.	Terr	2.6	92	2.3	83	3.4	119	2.9	104
WCSB Coal Bed Methane		0.2	6	1.0	35	2.6	92	5.7	202
Total WCSB		**462.4**	**16 324**	**460.3**	**16 250**	**458.4**	**16 182**	**447.9**	**15 810**

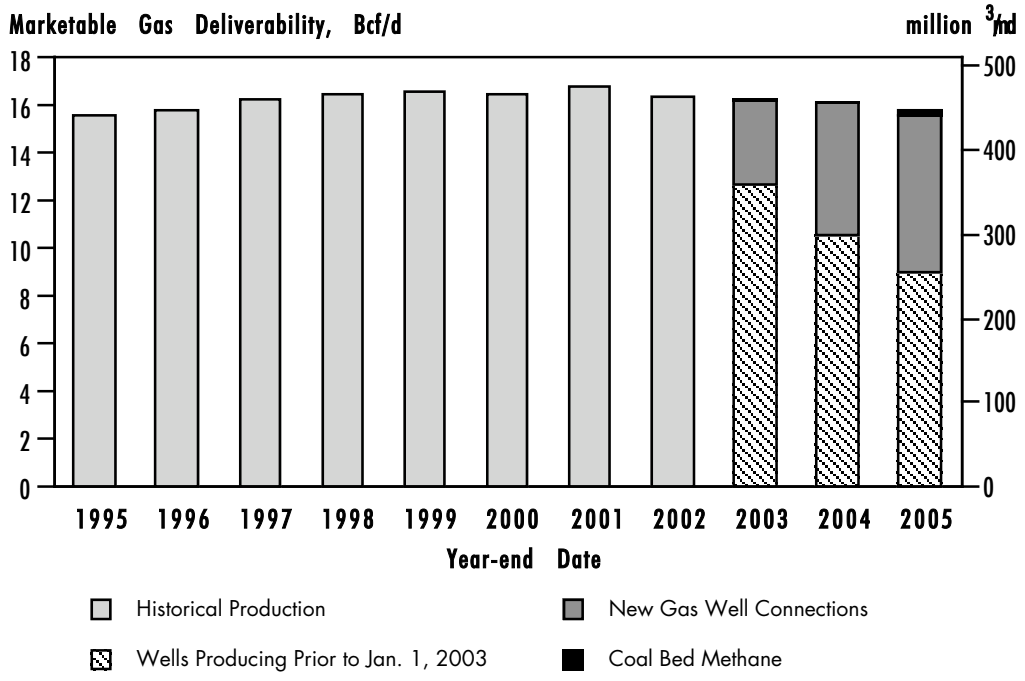
* Note: The deliverability outlook for SW Sask includes volumes for solution gas produced from SE Sask.

Production from the Ladyfern field in the B.C. Plains area had a large impact on WCSB deliverability in the past three years. Discoveries of this nature are quite anomalous in the current supply environment and, hence, the Board is not projecting any other new discovery of this nature over the study period.

By summing up the expected deliverability, the Board's outlook for the WCSB can be portrayed as in Figure 5.1. This outlook shows total deliverability for the WCSB declining slightly over the projection period from 462 million m^3/d (16.3 Bcf/d) at the end of 2002 to 448 million m^3/d (15.8 Bcf/d) by the end of 2005, with the majority of the decline occurring in 2005.

FIGURE 5.1

Outlook for Gas Deliverability from the WCSB



CONCLUSIONS AND IMPLICATIONS

In its December 2002 EMA, the Board estimated that WCSB deliverability would decline from 470 million m^3/d (16.6 Bcf/d) at year end 2001 to 450.5 million m^3/d (15.9 Bcf/d) by year end 2004, representing a decrease of 4.3 percent over that three year span. In this EMA, the factors affecting deliverability from the WCSB were investigated, resulting in an update of the Board's outlook of short-term deliverability from the December 2002 EMA.

The overall decline rate of currently producing connections is a major factor in the deliverability expectations from the basin. The overall nominal annual decline rate of gas production from all connections producing at the end of 2002 is estimated to be 22.8 percent over the year 2003. This decline rate in currently producing connections has been roughly the same for each of the past four years. At this level of decline, and at marketable production of approximately 455 million m^3/d (16.0 Bcf/d), the reduction in deliverability due to decline in production from currently producing connections for a one year period is about 94 million m^3/d (3.3 Bcf/d).

Deliverability associated with new gas well connections serves to offset the declining deliverability of already producing connections. In recent years, deliverability additions due to new gas well connections have been roughly equal to the decline in deliverability of older gas well connections, resulting in a relatively flat production profile for the WCSB since 1998. However, an increasing number of connections have been needed to keep the profile flat. The Board now estimates that new gas well connections in 2003 will total 14,400 which is substantially higher than the level anticipated in the December 2002 EMA. The number of gas well connections for 2004 and 2005 is expected to be 13,850 and 12,850 respectively. The initial productivity of the new gas well connections in 2003 is generally lower than anticipated in the December 2002 EMA and is expected to decline slightly in most areas of the WCSB between 2003 and 2005.

As a result of these recent trends, the Board now projects that deliverability from the WCSB will decline from 462 million m^3/d (16.3 Bcf/d) at the end of 2002 to 448 million m^3/d (15.8 Bcf/d) by the end of 2005. This represents about a three percent decrease in marketable gas production over that three year span. The large contribution to deliverability from new gas well connections is expected to continue for the projection period, but it will not completely offset the decreasing deliverability from already producing wells.

Implications

The Board believes that the deliverability outlook for the WCSB, in an environment of strong natural gas demand, will contribute to a continuation of the relatively high prices for gas. The relatively high price for natural gas will have an impact on the upstream sector. For example, the high price will promote the exploitation of natural gas resources in the WCSB that have not received attention in the past, and will support high drilling levels.

Untapped small gas pools are believed to exist in abundance in many areas in the WCSB. The high gas price, coupled with the application of improved technology, will make development of smaller gas pools more attractive.

Perhaps more significantly than small gas pools, resources contained in unconventional deposits in the WCSB will be a focus for development. Large accumulations of natural gas have been known to exist in low quality formations for many years, but the lower commodity prices and lesser experience and technical abilities of past years did not permit large scale exploitation. With the relatively high natural gas prices and the continued improvements in technology, the large scale exploitation of such gas resources is beginning. Coal bed methane is an unconventional gas resource of very large magnitude in the WCSB. The currently prevailing gas supply/demand situation has spurred recent efforts aimed at unlocking some of the potential of this resource.

In summary, as a result of a decline rate whereby almost one-quarter of current production must be replaced each year, and lower initial productivities from new wells, the upstream sector must drill flat out just to maintain production levels. Considering the trend of exploitation of increasingly smaller pools, the Board is projecting a three percent decrease in deliverability from the WCSB over the projection period, assuming the continuation of current market conditions. If market conditions change and lower prices prevail for natural gas, then a drop in gas development activity in the WCSB is expected. Those projects which would have been developed under a higher price environment would not proceed, and gas deliverability from the WCSB would decline at a higher rate than projected in this report.

GLOSSARY

2002 EMA	NEB Report published in December 2002 titled *Energy Market Assessment, Short Term Natural Gas Deliverability from the Western Canada Sedimentary Basin 2002 – 2004*.
Connection Year	The Year associated with the "On Production Date" for a Gas Well Connection or an Oil Well Connection.
Connection	A geological horizon within a Well for which oil and/or natural gas production is reported.
Decline Rate	A term used to describe the decrease in production rate over time as a resource is depleted. It is usually expressed as a percentage per year. The most commonly used form of decline rate is the nominal decline which is the slope exhibited when production rate is plotted against cumulative production. When a linear relationship exists between production rate and cumulative production the decline is referred to as exponential decline.
Deliverability	The amount of natural gas a well, reservoir, storage reservoir or producing system can supply at a given time.
Gas Well Connection	A geological horizon within a Gas Well for which natural gas production has been reported. If the Well Connection has both oil and gas production, the ratio of cumulative gas production to cumulative oil production is used to classify the connection as gas or oil.
Gas Well	A well bore with one or more geological horizons capable of producing natural gas
Marketable Gas	Natural gas that has been processed to remove impurities and natural gas liquids. It is ready for market use.
Oil Well Connection	A geological horizon within a well for which oil production has been reported. If the Well Connection has both oil and gas production, the ratio of cumulative gas production to cumulative oil production is used to classify the connection as gas or oil.
Solution Gas	Natural gas that is produced from an Oil Well Connection.

APPENDICES

Available at
http://www.neb-one.gc.ca/energy/EnergyReports/EMAGasSTDeliverabilityWCSB2003_2005_e.htm

Appendix 1- Typical Gas Well Connection Performance for Recent Years

Appendix 2- Gas Drilling Activity and Gas Well Connections by Geographic Area

Appendix 3- Group Performance Parameters Applicable to Existing Production

Appendix 4- Historical Performance Parameters for Typical Gas Well Connections

Canada