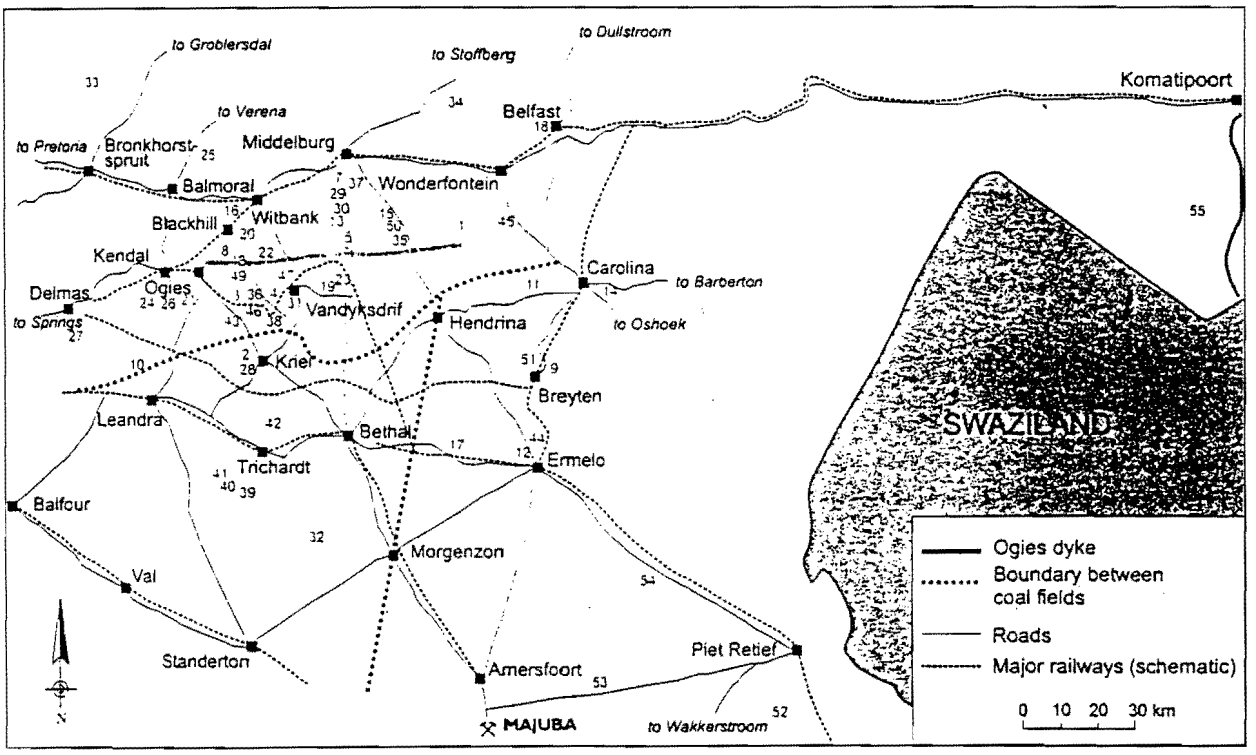
Chapter 4

THE STUDY AREA

The chosen study area includes a number of mines and power stations in the Witbank and Middelburg Dam Catchment areas, situated in South Africa's Mpumalanga Province. All the sites included in the study, as well as a number of other mines in the Witbank coal field, are indicated in Figure 3.



Collieries in Mpumalanga. 1. Anglo Power (Arnot), 2. Anglo Power (Kriel), 3. Arthur Taylor, 4. ATCOM, 5. Bank 2, 6. Bank 5, 7. Blackwattle, 8. Boschmans, 9. Bothasrust, 10. Delmas, 11. Dover, 12. Driehoek (Wesselton), 13. Duvha, 14. Eastside, 15. Eikeboom, 16. Elandsfontein, 17. Ermelo, 18. Glisa, 19. Goedehoop, 20. Greenside, 21. Khutala, 22. Kleinkopje, 23. Koornfontein, 24. Lakeside, 25. Landau (Kromdraai), 26. Leeuwfontein, 27. Leeuwpan, 28. Matla, 29. Mavela, 30. Middelburg, 31. New Clydesdale, 32. New Denmark, 33. Northfield, 34. Olifantslaagte. 35. Optimum, 36. Phoenix, 37. Polmaise, 38. Rietspruit, 39. Secunda: Bosjesspruit, 40. Secunda: Brandspruit, 41. Secunda: Middelbult, 42. Secunda: Syferfontein, 43. South Witbank, 44. Spitzkop, 45. Strathrae, 46. Tavistock, 47. Van Dyks Drift, 48. Waterpan, 49. Witbank Consolidated, 50. Woestalleen (Noodhulp Section), 51. Consbrey Dump, 52. Protea, 53. Mpisi, 54. TBS, 55. Nkomati Anthracite (after Smith and Whittaker 1986; Jordaan 1986; Schoeman and Boshoff 1996).

Figure 3: Collieries in Mpumalanga Province (Snyman, 1998)

4.1 Geology

Although there are a number of variations in the thickness of the formations in the regional geology, a general overview is given in Figure 4.

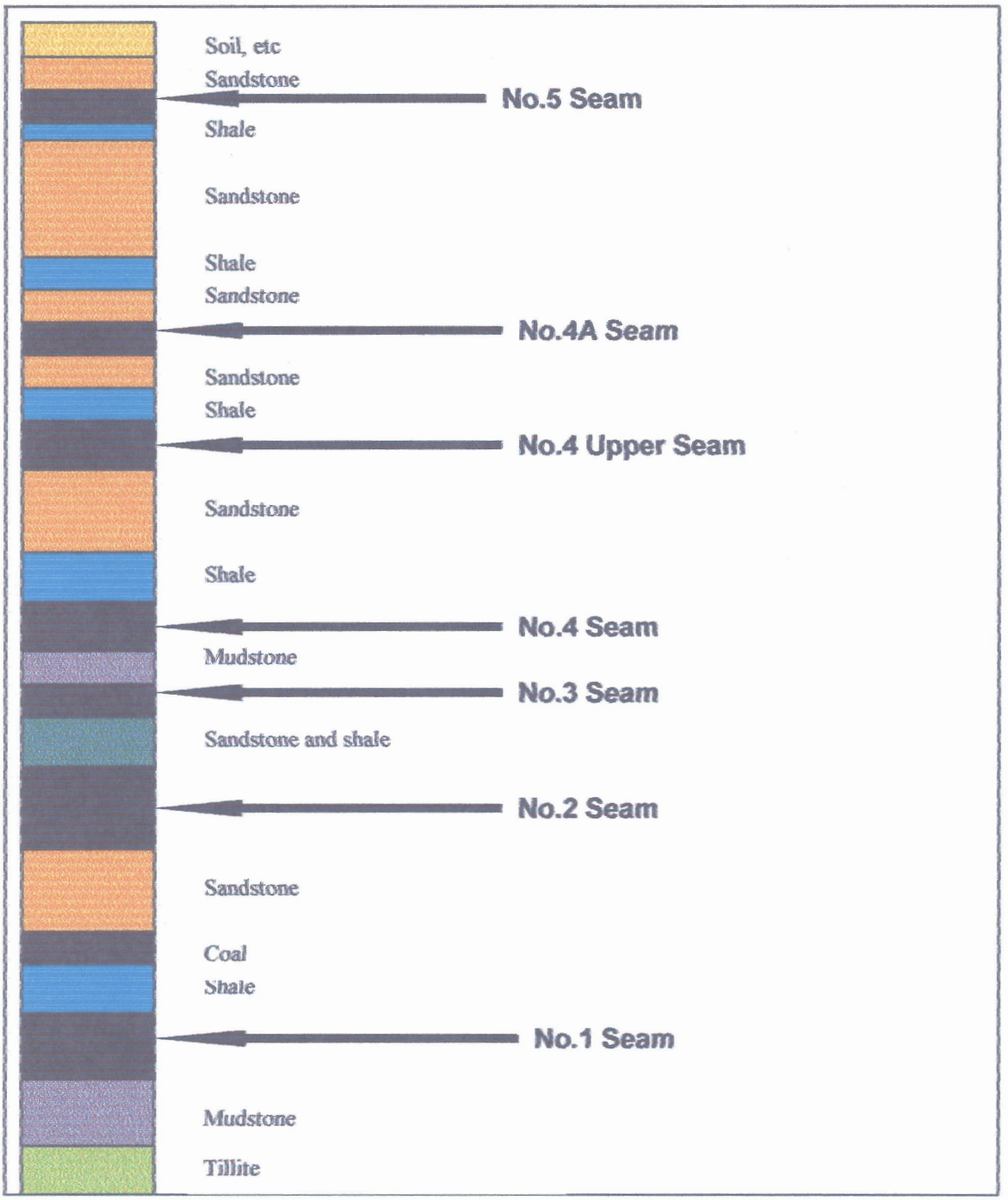


Figure 4: Schematic representation of geology in the study area (Lurie, 1987)

Five coal seams of varying grade are contained in a 70m thick succession. The geology consists mostly of sandstone with some siltstone and mudstone. The No.1 seam ranges from 1.5 to 2m thick in the vicinity of Arnot. Elsewhere it occurs as irregular patches. The No.2 seam contains the majority of the coal in the area (Figure 5) and averages 6.8m in thickness in the centre of the Witbank coal field. This seam may consist of up to 5 benches and it is usually the lower three seams that are mined for economic reasons. The distribution and attitude of the No.1 and 2 seams depends on the pre-Karoo topography. The No.3 seam is rarely more than 0.5m thick and is generally not mined because it is considered to be uneconomical. The No.4 seam ranges from 2.5 to 6.5m in thickness. The No.5 seam has an average thickness of 1.8m. The distribution of the No.4 and 5 seams is determined by the present-day surface.

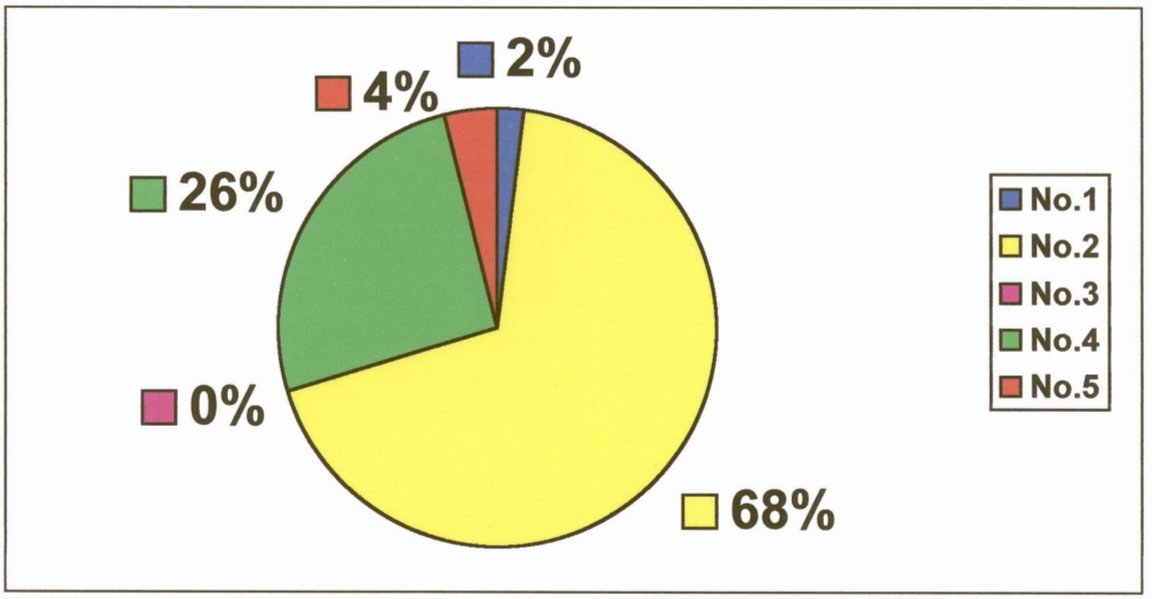


Figure 5: Contribution of seam to in situ demonstrated coal resources (Snyman, 1998)

The Ogies dyke (Figure 2) is approximately 15m thick and covers a distance of 100km. Considerably smaller dykes and sills also occur and they are more common south of the Ogies dyke than to the north.

4.2 Climate

The climate is generally moderate and dry with harsh winters coupled with heavy frost. Rainfall is typical of Highveld conditions and occurs mainly during summer. The average rainfall per month, as well as the number of days per month during which rainfall occurs are given in Table 3. The average annual rainfall recorded for the study area is 621 mm per year.

Table 3: Average rainfall per month, over a 10 year period from 1989 to 1999 (DWAF, 1999).

Month	Average number of rainy days per month	Average rainfall per month (mm)
January	9.9	87.5
February	7.1	99.5
March	7.6	82.3
April	2.9	31.6
May	0.8	4.1
June	1.5	14.2
July	0.4	1.6
August	1.0	6.1
September	3.2	30.4
October	6.4	79.1
November	7.8	98.9
December	9.7	85.7

The following statistics presents an overview of the rainfall intensity over specific periods, experienced in the area:

- 60 min (1995) 57 mm
- 24 hours (1994) 95 mm
- 24hours/50 year period 133 mm
- 24 hours/100 year period 158 mm

The highest average monthly temperature is 27°C, recorded for January, while the lowest average minimum monthly temperature is –1.6°C, during July. The average monthly minimum and maximum temperatures are presented in Table 4.

Table 4: Average monthly minimum and maximum temperatures over a 10 year period from 1989 to 1999 (DWAF, 1999)

Month	Maximum (°C)	Minimum (°C)
January	27.0	14.0
February	26.3	13.4
March	25.6	11.7
April	23.8	8.0
May	21.8	3.0
June	18.1	-0.6
July	18.9	-1.6
August	20.7	1.2
September	24.1	6.2
October	25.1	10.1
November	25.2	12.4
December	26.4	14.0

The mean annual wind direction, frequency and speed calculated over the period June 1993 to May 1994, based on daily readings at 08h00, 14h00 and 20h00, are presented in Figure 6.

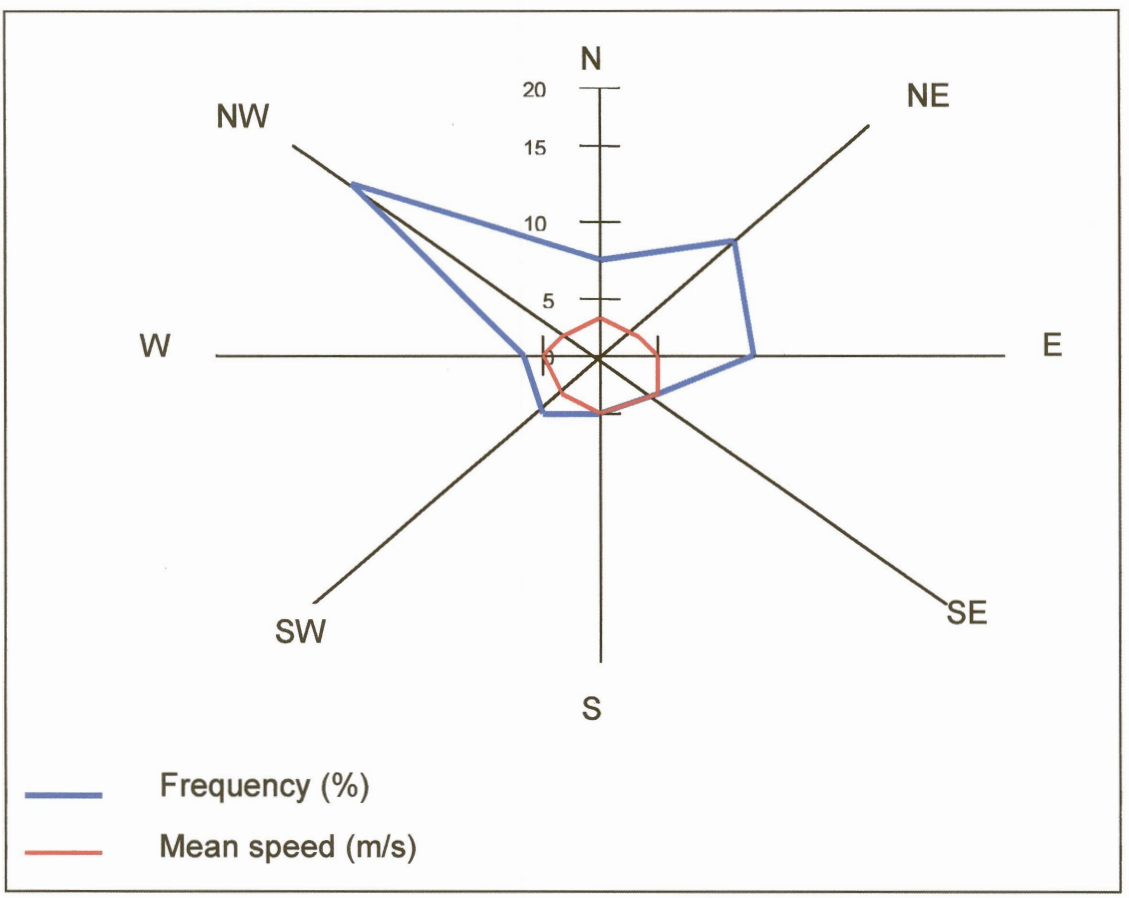


Figure 6: Mean annual wind speed, frequency and direction (DWAF, 1999).

The monthly average evaporation is presented in Table 5. When compared to rainfall data, it becomes apparent that the area has an average water deficit of – 1081 mm per annum.

Table 5: Average monthly evaporation over a 10 year period from 1989 to 1999 (DWAF, 1999).

Month	Evaporation (mm)
January	179.8
February	151.1
March	147.8
April	111.1
May	94.8
June	79.2
July	89.0
August	132.0
September	167.0
October	186.6
November	167.6
December	195.9
Total	1701.5

The following weather features are typical of the study area:

- Thunderstorms 5.7 days/year (1.6%)
- Hail 2.8 days/year (0.8%)
- Snow 0.8 days/year (0.2%)
- Mist 19.0 days/year (5.2%)
- Cloud -08:00 35% of the year
  -14:00 44% of the year
  -20:00 34% of the year

4.3 Topography and drainage

The study area is situated in a fairly flat, softly rolling landscape where the gradient seldom exceeds 1:35. The Olifants River and Steenkoolspruit are the major drainage valleys in the Witbank Dam catchment and the Klein Olifants River is the primary drainage valley in the Middelburg Dam catchment (Wates, 1985).

4.4 Agriculture

The study area is situated in one of the most fertile agricultural regions in the country. Maize is the chief agricultural product. The portion of the catchment area exploited by agriculture will decrease as further coal mining and power generation facilities are developed. Rehabilitated open cast coal mines will hopefully all be returned to grazing. In some cases this has already been done. Irrigation from rivers and constructed farm dams is widely practised in the catchment areas (Wates, 1985).

4.5 Urban development

Several towns contribute urban runoff and discharge purified sewage effluent to the catchment. The future sewage effluent quality with respect to sulphate concentration is expected to remain constant. The actual sulphate concentration will obviously depend on the quality of potable water consumed by the different user communities. Witbank town was originally the only local authority that abstracted raw water from Witbank Dam and catchment. Middelburg town now also relies on some water transferred by the Usutu-Vaal Government Water Scheme to the Upper Olifants River (Wates, 1985).

4.6 Coal mining activity

The majority of collieries in the study area still have a long remaining life. It is hoped that point and diffuse sources of pollution will be changed in the future by the improved house-keeping policies of the collieries, better rehabilitation practices and the separation of clean and dirty stormwater runoff.

Extensive underground and open cast coal mining takes place across the area. A range of coal products is produced for sale on domestic and foreign markets. Two prime coalfields are exploited by the mines i.e. Highveld in the south and Witbank-Springs in the north (Wates, 1985).

4.7 Power generation

There are currently four power stations located in the Witbank Dam catchment. Raw water is supplied by the Usutu-Vaal Government Water Scheme. Atmospheric deposition, although a concern for local interested and affected parties, is not expected to change over the next 20 years. It is also assumed that the ability of the soil profile to abate and adsorb sulphate will not be exhausted over the next 20 years (Wates, 1985).