

4. POPULATION GROWTH

4.1 Sungai Petani

Population projections for Sungai Petani were made by the following four (4) studies, and the results of their projections are as summarized in Table II-1.

- (a) The Statistics Department projections which are based on the cohort survival method and the inter district migration study (1993);
- (b) The Kuala Muda Structure Plan Study which made projections for the MPSP from 1995 to 2010 based on growth rates of population which are relatively higher than (1);
- (c) The Local Plan Study for Sungai Petani which estimated population growth for the Town from 1995 to 2010; and
- (d) The National Water Resources Study which made population projections for the Metropolitan Areas including Sungai Petani and Alor Star from 1995 to 2050 in order to project water demand. (*The population projection in this Study applied annual average growth rates ranging from 2.7% in 1995 to 1.7% in 2020 based on the past trends.)

These three population projections were used as a basis for project population growth from 1998 to 2020 for the Study Aarea. The following assumptions and methodology was used in the projections. As a result, the population in the study area is projected at 371,952 by 2020 as shown in Table II-1.

(1) Assumptions

- (a) The study area of Sungai Petani is about 10,063ha and includes a major part of the Sungai Petani town area. The study area is expected to continue its robust growth especially with the development of the new township of Aman Jaya where large scale residential, industrial, and commercial areas have been planned.
- (b) The population projections undertaken in this study, however, also takes into consideration the State's policy of balanced growth utilizing the spatial strategy of "concentrated decentralization" and pushing development from the

traditionally well developed Sungai Petani area to other growth centers in the State such as Gurun and Kulim.

(2) Methodology

- (a) The base year adopted is the 1991 population for Sungai Petani Local Plan Study which had a population of 120,128 persons as indicated in the Population Census 1991.
- (b) The 1991 population was updated for 1998 using the study area's housing stock for 1998. The estimated population for 1998 is 173,727 persons. This is derived from the number of existing housing units (38,606 units) multiplied by an average of 4.5 persons per housing unit. The ratio in 1991 was 4.7.
- (c) The AAGR method is used to project population growth at five year intervals from 2000 to 2020. The growth rates selected for each five year interval falls somewhere in between the lower growth rates adopted in the slower growth scenario for the Kuala Muda District (Statistics Department) and that adopted in the higher growth scenario projected in the MPSP Structure Plan Study and the Sungai Petani Local Plan Study. The AAGR method uses the compounding rates formula, $P_c = P_o(1+r)^n$.
- (d) Between 1991 and 1998, the population of the study area increased as a rate of 5.4% per annum. This growth rate is reduced for each subsequent 5-year planning period to 3% by 2020. The assumption is that the study area which experienced a relatively higher growth in the 90's would experience a slower growth rate in the last decade of the planning period as new population growth centers emerge outside the study area especially in the new growth corridor stretching from Butterworth to Kulim Hi-tech Park.

4.2 Melaka

Several population projections were made for the Melaka Tengah District, including projections by the Statistics Department, the Institute of Strategic and International Studies (ISIS), the Melaka Tengah Structure Plan Study, the Melaka Tengah Local Plan Studies, and the National Water Resources Study.

- (a) The Statistics Department projections which are based on the cohort survival method and the inter district migration study (1993);

- (b) The Melaka Tengah Structure Plan projections which are based on growth rates of population and normally, take into consideration, policies as well as the current committed projects and proposed projects.
- (c) ISIS Study which is based on economic analysis and development visions of the study.
- (d) The Local Plan Study estimates which are normally based on the housing stock and land availability considerations.
- (e) The National Water Resources Study which made population projections to the year 2020 in order to estimate water demand in Malaysia including Melaka Town. The growth trends however were confined to the Melaka City Center proper and not the entire study area and based on past growth trends.

The above three population projections are used as basis for a framework to project population growth from 1998 to 2020 for this study. The following assumptions and methodology were used in making the projection.. As a result, the population in the study area is projected to increase to 593,766 by 2020 as shown in Table II-2.

(1) Assumptions

- (a) The Study area covers a large part of Melaka Tengah District and Mukim Rembia in Alor Gajah District. According to the 1991 Census, approximately 50% of the state population is located in this area. The total study area is 19,157ha which is almost twice as large as the Sungai Petani Study Area.
- (b) With Melaka's target of achieving " City State" status by 2010, it can be assumed that the study area would remain, the population heartland of the State during the study period.
- (c) This assumption takes into consideration the State's policy of balanced growth along the selected growth corridors.

(2) Methodology

- (a) The base year adopted is the 1991 population for Melaka (ISIS) with 540,200 persons, out of which 266,007 persons were in the study area in 1991.
- (b) The 1991 population was updated for 1997 based on growth rates adopted in the Local Plan Studies (1997-2015) for the study area. Growth rates selected

for each five-year interval of the planning period are also taken from those found in the Local Plan Studies.

- (c) This growth scenario is selected because the study area encompasses a number of planned growth centers such as Ayer Keroh, Batu Berendam, Cheng Baru, Tanjung Kling and Sungai Udang which are the focus of the state's industrialization and urbanization strategies. The population targets proposed in the Local Plans are considered to be achievable.

5. EMPLOYMENT GROWTH

5.1 Sungai Petani

The employment growth in the study area is projected, through the following methodology as shown in Table II-3.

- (a) The proportion of the workforce is taken from the population projection by five year age groups, from the Statistics Department
- (b) The workforce participation rate is taken from the "Manpower Studies of the Northern States" 1995
- (c) The proportion of the workforce in industries is based on the 1991 Census with 33% of the workforce in the study area concentrated in this sector. The industrial workforce is projected to increase its share from an estimated 35 to 40% of total employment by 2020. This increase is justifiable because of large industrial projects committed in the study area such as Aman Jaya.
- (d) The commercial and business sector contributed 35% of employment in 1998. This sector would increase its share in employment to 50% of total employment by 2020.
- (e) The increase is expected to be in the business sector as the need for information technology, education and global trade and business increases. Secondly, a large area of the commercial heartland of Aman Jaya is located in the study area offering a high potential for new employment opportunities within this sector.

- (f) “Other employment” category is treated as the residual component and will decrease its share to total employment. Included in this category would be government services, the utilities, construction etc.

Total employment is projected to increase from 65,788 in 1998 to 158,359 by 2020.

5.2 Melaka

The employment growth in the study area is projected through the following methodology, and the results of the projections are derived as shown Table II-4.

- (a) The proportion of the workforce is taken from state ratios obtained from the Statistics Department
- (b) The labor force participation rate (LFPR) is taken from the Melaka Strategic Development Plan (ISIS, 1995).
- (c) The proportion of the workforce in industries is based on the 1991 Census with 25.5 percent of the workforce in the study area found in this sector.
- (d) From data obtained from the State SEDC, it can be estimated that there were approximately 50,000 industrial workers in the study area in 1998 and this comprised 38 percent of total employment in the study area.
- (e) The industrial workforce is projected to increase from an estimated 38 percent to 45 percent of the total workforce by 2020 taking into consideration the state’s policy of becoming fully industrialized by 2010. By this period, the total workforce is expected to make up 45 percent of the total workforce. This increase is justifiable because of large industrial projects committed in the study area such as at Bt. Rambai area, Ayer Keroh and existing large scale industries at Batu Berendam etc.
- (f) As in the study area for Sungai Petani, the commercial sector in the Melaka study area contributed 40 percent of employment in 1997. It is a highly labour intensive sector as highlighted in the ISIS study (1995).
- (g) This sector, though still the most significant sector would increase its share in employment generation to about 46 percent of total employment by 2020.
- (h) The “Others” category is a residual component but its share is expected to decrease. Included in this sector are government services, utilities and

construction. The government services is expected to continue to play an important role but could downsize its workforce as it switches towards a more high-tech environment and inevitably adopts a “paperless” and “electronic government” work practices and thus becomes less labor intensive.

Total employment in the Study Area is expected to increase from 134,635 (1997) to 267,555 by 2020.

6. PRESENT LAND USE

6.1 Data Collection and Constraints

Land use data for both the study areas was collected from the respective local authorities which compiled these information as part of the Local Plan exercise. However, there were some inconsistencies with the data. Some of the local plans were prepared at different times and for different planning periods; for example the Sg Petani local plan was prepared in 1994 for the planning period of between 1996-2010. The Melaka Study area on the other hand, involved two local plans. The Local Plans for the Bandar Melaka Area (Block 1 & 2) was done in 1995 for a planning period between 1996-2010 whereas the Local Plan for Block 3, 4, 5 & 6 was done for a planning period between 1998-2015. There were also some areas within the study area, which were not covered by any Local Plan.

The River Basin area for Melaka covers an area of 19,156ha including a major portion of Melaka Tengah which is divided into a part of Block 1 and 2 (Melaka Local Plan), Block 3, 4, 5 and 6 (Draft Local Plan) and part of Mukim Rembia in Alor Gajah. Existing Land use information for Block 3, 4, 5 and 6 was based on a land use survey done in 1997 whereas information for Block 1 and 2 was based on the land use survey of 1995. Areas outside the MPMBB (Melaka Tengah) particularly in the Alor Gajah District were not covered by any specific land use survey. Such land use information was compiled based on field visits and site observation and discussions with officials.

In the case of Sg. Petani, land use information was based on the 1994 land use survey done by the State Town and Country Planning Department. This information was overlaid on to the digitized layout base prepared by the Municipality. The total area of the Sg. Petani Study Area was much smaller than that of Melaka at 10,063ha.

6.2 Land Use Classification

Both the study areas had different land use activities that had to be rationalized into common categories for comparison. The main categories were :

- (a) Residential use: This included all types of residential use including both housing schemes and informal housing including village settlements. Housing under construction was not included in this category.
- (b) Commercial: This included shops, retail and office uses.
- (c) Industrial: This included factories, warehouses, go-downs and service industries.
- (d) Institutional: This land use category included mainly government related uses such as schools, government buildings, military camps, religious use and airports.
- (e) Recreation: This included open spaces, parks and other recreational facilities.
- (g) Natural Areas: This included forest, mangrove swamps and nature protected areas.
- (h) Agriculture: This included both tree crops and paddy land.
- (i) Roads and Railways : Only trunk roads, highways and railway tracks were included in this category. Roads in housing schemes were excluded
- (j) Others: This category generally included vacant land and cemetery.

6.3 Present Land Use in Sungai Petani

The summary of land uses for Sg. Petani is shown in Table II-5. The total study area for Sg. Petani covers the mukims of Sg. Petani and a part of Sg. Pasir. Within the local plan area, the study area covers the Block1 (Bandar Sungai Petani and a part of Aman Jaya (Block 2), a part of Jalan Kuala Ketil (Block 3) and a part of Block 4 (Tikam Batu) and a part of Block 5 (Bedong). The study area is at a stage of rapid development with several large projects, which are committed and approved in the area. Total built up area is currently about 50% of the study area. The present land use is shown in Figure II-7.

(1) Residential

Total residential land use amounted to 2,758ha or 27.4% of the total area. Some of the major housing schemes are at Taman Aman Jaya, Taman Ria Jaya, Taman Keladi. All these schemes are to the east of the Federal Highway. Other major housing schemes include Taman Sejati Indah near the Southern Toll Plaza. Traditional Village housing are found along the road to Sg. Pasir and the areas near Sg. Layar where there are several paddy fields. There were also several squatters housing of approximately 1,124 houses along the Sg. Petani River reserve and other reserves. Most of these squatters have been relocated to low cost public housing at Paya Nahu and Kuala Ketil. There are also several new housing projects under construction especially in the north near Sg. Lalang such as Bandar Laguna Merbok, Taman Ria and Bandar Aman Jaya.

(2) Commercial Uses

Total area under commercial use was 244ha or 2.43% of the total area. The main commercial areas were at the downtown Bandar Sungai Petani. The other major commercial development projects were the town center of Aman Jaya and the Cayman Development alongside the Sg. Petani River. Several sub-centers have also been developed in housing schemes to cater to retail needs of the resident population. Large commercial retail projects such as Bandar Sri Utama and the Plaza Mutiara project have been put on hold in view of the depressed economic situation. Many of the large commercial complexes including the SP Plaza have been reported to be not doing well in terms of commercial turnover suggesting that disposal incomes may not be as high as expected.

(3) Industrial Uses

Total industrial uses accounted for 853ha or 8.5% of the total area. The more established industrial estates were found at the Bakar Arang near the southern toll Plaza and the Sg. Petani Industrial Estate (LPK) near Taman Ria Jaya. Both these industrial estates were developed by the SEDC and are all sold out. There are however several vacant lots in the Sg. Petani Industrial estate without any factory units. Other industrial areas are developed by the private sector and include industrial areas at Kempas in the south and the MIEL Light industrial project near Sg Tukang in the north, light industrial area at Taman Ria Jaya and Taman Arked. Large tracts of industrial development have also been proposed at Taman Bandaran near the MIEL

project and the Bt Makmur Light Industries project near the same area. Other major industrial projects have been proposed in Aman Jaya to the north and at Bandar Puteri Jaya along the road to Baling and at Taman Industry Kemuning near Taman Kristal to the south of the Study Area. The latter two areas are currently outside the study area. The general policy in the Local Plan for Sg. Petani was to position Sg. Petani and Aman Jaya as the major industrial manufacturing center for the district of Kuala Muda. Under the current depressed economic climate several large industrial projects have been put on hold including the Bandar Puteri project along the Kuala Ketil road. There have also been several development applications to convert approved light industrial projects to housing suggesting again that there are too many light industrial premises in Sg. Petani. There are also several completed factory units that are not operational especially at Kempas, the Quilin Industrial area and at Bukit Makmur.

(4) Institutional Uses

Institutional Uses account for 6.3% of the total study area or 634 ha. The major user is the Sg. Petani Military Base which also includes an airstrip. Other locations for institutional uses are found in the downtown area where there are several schools, government buildings, library and the traffic police complex. Other large users are the District Hospital, Prisons, which is located along the Federal Road to Alor Setar. The other concentration of institutional uses are along the Jalan Kuala Ketil which includes the Teachers Training Center, INTAN and the Pusat Serenti.

(5) Recreational Uses

Recreational uses amounted to 103ha or 1% of the total study area. The major recreational uses were the Cinta Sayang Golf club and the public golf club near the Taman Jubilee in the down town area. Open space requirements for housing schemes are usually about 10% of the total area. Other major recreational projects planned include the Sg. Petani River front park, new Golf clubs at Aman Jaya and the public park at Ria Jaya.

(6) Nature Areas

Nature areas including forest and mangroves account for 600ha or 6% of the total area. Most of the existing nature areas are found near the confluence of Sg. Pasir and Sg. Petani and Sg. Merbok. These areas are part of the Merbok Forest reserve. Other locations are along the tributaries of Sg. Merbok.

(7) Agricultural Uses

Agriculture land accounts for 43% of the study area (4,358ha). Most of the agricultural areas are planted with rubber or paddy areas. Paddy areas in the study area accounted for 570ha. and most of them were found in the Sg. Layar, Sg Pasir, and the Kuala Ketil area. Most parts of Aman Jaya were also part of an earlier rubber plantation.

(8) Roads and Railway

The major trunk roads and railway accounted for 4.1 % of the total area. Several road projects including the Inner Ring Road and the Outer Ring Road have been planned as part of the traffic dispersal scheme. Other spinal road networks will also be provided in Bandar Aman Jaya.

(9) Others

This includes vacant land and cemetery uses. This only accounted for 1% of the total area although this percentage would be much higher if current projects under construction are included into the category. This is particularly so for projects in the north at Aman Jaya and near Sungai Lalang.

6.4 Present Land Use in Melaka

A summary of the land uses for the Study Area by Drainage Basins is shown in Table II-6. Non built up areas account for 71% of the Study Area with about 48% of the Study Area under agriculture. The present land use is shown in Figure II-8.

(1) Residential Use

Total area under residential use was 3,007ha. or 15.7 % of the area. Most of the formal housing schemes are found in Bandar Melaka, Batu Berendam and the Air Keroh area (Block 1, 2 & 3). Small housing schemes are also found along the Federal Road 19 to Paya Rumput and Alor Gajah. It is likely that the future spread of development from Melaka City will be along this corridor. Most of the housing in the outlying areas of Sungai Udang, Tangga Batu and Bukit Rambai are generally traditional village housing spread along the major roads.

(2) Commercial Use

The total area under commercial use was 246ha. or merely 1.3% of the total area. Most of the commercial uses are located in the downtown Bandar Melaka area. The other commercial areas were found in local townships at Bachang, Air Keroh, Malim Jaya, Batu Berendam, Cheng, Paya Rumput, Sg. Udang, Tangga Batu, Bt. Rambai, Tg. Minyak and Rembia. Most of the commercial uses operating outside Bandar Melaka were small retail premises.

(3) Industrial uses

Existing industrial land use accounted for 1,220ha or 6.3% of the total study area. The main industrial areas are at Air Keroh, Batu Berendam, Malim Jaya, Cheng, Bukit Rambai, Tg. Minyak, Petronas Oil Refinery at Tangga Batu and at Rembia. In line with the policy to make Melaka an industrial state by 2010 new industrial areas have been identified at Krubong including the Composite Technology Industry near the old airport at Batu Berendam. About 160 ha of land has been earmarked for the development of the Composite City which will focus on the manufacture and repair of light aircraft.

(4) Institutional Uses

The total area under institutional uses was 556ha or 2.9% of the total study area. The main institutional uses included the airport at Batu Berendam and several parcels of government land and public facility land at Air Keroh and near the Bachang area. Large institutional facilities included the Hospital, Police Stations, Schools and Religious uses.

(5) Recreational Uses

Recreational Uses accounted for 236ha or 1.2 % of the total area. Again most of the recreational uses were found at Air Keroh

(6) Nature Areas

Nature areas and forested areas were mainly located along Federal Road 5 near the Terendak Military Camp. The total area is estimated at 563ha or 2.9% of the total area. The rest of the study area is basically cultivated or developed.

(7) Agricultural Area

About 48% of the study area or 9233ha is still under agriculture. This includes basically tree crops such as rubber and food crops such as vegetable farms and paddy. Paddy cultivation is mainly carried out at Mukim Bukit Rambai with patches of paddy land in most of the mukims in Block3, 4, 5 and 6. In the next 20 years, it is expected that these areas will be transformed from an agricultural area to an urbanized region.

(8) Roads

Trunk roads only account for 2.7% or 518ha. This indicates the relatively underdeveloped state of the sub-region. With the proposed urbanization of the sub-region, new trunk roads including the proposed new Coastal Highway is expected to pass through the area.

(9) Others

Vacant land and cemetery areas were significant at 3,577 ha or 18.7% of the total study area. Large areas of vacant land were found at the Air Keroh area, Batu Berendam, Cheng and Tg. Minyak area. Most of these areas have been cleared for development. The study area also had large Chinese cemeteries at Batu Berendam and the famous Bt. Cina in the Melaka town area.

7. PROJECTED LAND USE

The projection of land use for the study area were made in the respective local plans of Sungai Petani and Melaka. The projection year by the municipal council for Melaka is set at 2015, while that by the municipal council of Sungai Petani is 2010. According to these projections by municipal councils, the future land use for the Study Area are classified as below (refer to Tables II-7 to II-8 and Figures II-9 to II-10).

| Classification of land Use | (unit: ha) | | | |
|-----------------------------|-----------------------|----------------|----------------|----------------|
| | Sungai Petani in 2010 | | Melaka in 2015 | |
| | Area (ha) | Percentage (%) | Area (ha) | Percentage (%) |
| 1. Built-up Area | | | | |
| 1.1 Residential Area | 5,130 | 51.0 | 8,255 | 43.1 |
| 1.2 Commercial Area | 1,111 | 11.0 | 649 | 3.4 |
| 1.3 Industrial Area | 1,350 | 13.4 | 2,818 | 14.7 |
| 1.4 Institutional Area | 647 | 6.4 | 1,066 | 5.6 |
| 1.5 Recreational Area | 622 | 6.2 | 743 | 3.9 |
| 1.6 Road | 938 | 9.3 | 868 | 4.5 |
| Sub-total | 9,798 | 97.3 | 14,399 | 75.2 |
| 2. Non-Built up Area | | | | |
| 2.1 Natural Area | 266 | 2.6 | 265 | 1.4 |
| 2.2 Agricultural Area | 0 | 0.0 | 3,811 | 19.9* |
| 2.3 Others | 0 | 0.0 | 682 | 3.5 |
| Sub-total | 266 | 2.6 | 4,758 | 24.8 |
| Grand Total | 10,063 | 100.0 | 19,157 | 100.0 |

*: The area is designated for future development land, but remained as agricultural land use in 2015.

As projected above, only 2.6% of the area in Sg. Petani (around river mouth of Sg. Petani) will remain as natural mangrove area by 2010. The rest of the area will be fully developed as built-up areas. As for Melaka, about 75% of the study area will be developed as built-up area by 2015. Thus, the substantial part of the study area is projected to be the built-up area in 2010 for Sungai Petani and 2015 for Melaka.

With reference to the latest regional development frameworks and the projected population targets in this study an attempt was made to review the landuse projections for residential, industrial and commercial landuse components of the Study Area up to the year 2020 as against the targets recommended in the Local Plans.

The basic methodology used in estimating land requirement was using land – man ratios (persons/workers per hectare) on projected population and employment targets for year 2000. The planning standards that were applied to determine land requirement were based on the following factors:

- (a) Existing base line ratios which essentially reflects the existing composition of building types
 - (b) Location and extend of future expansion areas. For example, expansion areas close to the Central Business Distric (CBD) will have higher ratios than sub-urban areas
 - (c) Type of built-forms, plot ratios and the density controls applied to the future expansion areas.
 - (d) Likely property market demand for the built types in Study Area.
- (1) Projection on Residential Area

The methodology used to project industrial land use is based on the projected population divided by a specific residential density standard. There are three (3) variations as enumerated below:

- (a) The standard of 75 persons per hectare is normally applied for landed type development, inclusive of a grossing factor for open space and community facilities;

- (b) This ratio may be increased to 100 persons per hectare for mixed residential areas comprising landed residential and some flats, apartments or condominiums:
- (c) In a highly urbanized areas such as Kuala Lumpur, a higher ratio of 150 persons per hectare is normally applied.

For the Sungai Petani study area, the population/residential land use is 63 in 1998. This suggests that housing in Sungai Petani are mostly the landed type. A planning standard of 75 persons per hectare is applied for the urban expansion areas as most of the committed development in these areas were of the landed type. For the interim period of 2000, an interpolated ratio of 66 persons per hectare was used.

For the Melaka study area, the population/residential land use ratio for 1997 was 110 persons per hectare which suggests a wide variation of housing types. This ratio is relatively high as the population is mainly concentrated in the town center. However, in the future, with the growth of new centers such as Paya Rumput, Bukit Rambai, Sungai Udang, Cheng and Rembia which are located in the suburban areas, a lower ratio, related to more modern landed property types (i.e., terrace, semi detached or link houses) can be expected. The ratio is gradually reduced for each subsequent period to an average at 75 persons per hectare to the year 2020 as urban expansion proceeds to the outlying areas. The interpolated ratio for 2000 is 96 persons per hectare.

The results for both projections are summarized as below:

| Description | Present | 2000 | 2005 | 2010 | 2015 | 2020 |
|-------------------------------|---------|---------|---------|---------|---------|---------|
| Sungai Petani | | | | | | |
| Projected Population | 173,727 | 191,534 | 233,030 | 276,767 | 320,849 | 371,952 |
| Increase of Population | | 17,807 | 41,496 | 43,737 | 44,082 | 51,103 |
| Persons/ha | 63 | 66 | 75 | 75 | 75 | 75 |
| Additional Land Required (ha) | | 269 | 553 | 583 | 588 | 681 |
| Cumulative Land Required (ha) | 2,758 | 3,027 | 3,580 | 4,163 | 4,751 | 5,432 |
| Melaka | | | | | | |
| Projected Population | 332,453 | 367,323 | 431,192 | 499,744 | 550,875 | 593,766 |
| Increase of Population | | 34,870 | 63,869 | 68,552 | 51,132 | 42,890 |
| Persons/ha | 110 | 96 | 75 | 75 | 75 | 75 |
| Additional Land Required (ha) | | 363 | 852 | 914 | 682 | 572 |
| Cumulative Land Required (ha) | 3,007 | 3,370 | 4,222 | 5,136 | 5,818 | 6,390 |

As estimated above, the residential land in Sungai Petani will increase from 2,758ha at present to 5,432ha in 2020. The property market in Sungai Petani had been fairly active up to 1998 with major housing schemes launched in Aman Jaya, Taman Ria Jaya, Taman Keladi and Taman Laguna.

As for Melaka, 3,007ha of land has been developed as the residential land. Most of the major housing schemes are presently concentrated in Bandar Melaka, Batu Berendam and Air Keroh. The areas outside these three (3) main settlements consists of small housing schemes and traditional village housing spread along major roads. As the study area becomes urbanized, new housing development is expected to spread westwards, i.e., towards Paya Rumpit and Sungai Udang. The total area of residential land in 2020 is estimated at 6,390ha.

(2) Projection on Industrial Area

The industrial area in 2020 was projected using the following assumptions and methodologies:

- (a) The number of workers for industries by 2020 are as projected in Section 1.5 (refer to Tables II-3 and II-4).
- (b) The present average density of workers for industry is estimated at 27 workers/ha for Sungai Petani and 42 persons/ha for Melaka. This density is based on the number of total workers employed in the industrial sector divided by the total area used for industrial sector. The average density of Sungai Petani (i.e., 27 workers/ha) is deemed to be relatively low as compared with that of Melaka. This could be attributed to the conditions, that some industrial areas are not occupied by any factory.
- (c) The above present average density of industrial workers is assumed to gradually increase to 45 workers/ha. A moderate density was adopted for industrial land projection to accommodate ancillary uses such as land for workers housing, open space, retention ponds and surface carparks.

The results of the projection are summarized as below; whereby, the projected industrial areas for 2020 is 1,777 ha for Sungai Petani and 2,759 ha for Melaka.

| Description | Present | 2000 | 2005 | 2010 | 2015 | 2020 |
|-------------------------------|---------|--------|--------|--------|---------|---------|
| Sungai Petani | | | | | | |
| Projected Industrial workers | 22,980 | 25,603 | 38,327 | 45,878 | 53,283 | 63,343 |
| Increase of Workers | | 2,682 | 12,724 | 7,551 | 7,405 | 10,061 |
| Workers/ha | 27 | 32 | 45 | 45 | 45 | 45 |
| Additional Land Required (ha) | | 84 | 283 | 168 | 165 | 224 |
| Cumulative Land Required (ha) | 853 | 937 | 1,220 | 1,388 | 1,553 | 1,777 |
| Melaka | | | | | | |
| Projected Industrial workers | 51,565 | 59,503 | 80,399 | 99,444 | 110,918 | 120,400 |
| Increase of Workers | | 7,938 | 20,896 | 19,045 | 11,474 | 9,482 |
| Workers/ha | 42 | 43 | 45 | 45 | 45 | 45 |
| Additional Land Required (ha) | | 185 | 464 | 423 | 255 | 211 |
| Cumulative Land Required (ha) | 1,221 | 1,406 | 1,870 | 2,293 | 2,548 | 2,759 |

(3) Projection on Commercial Area

In the same way as the foregoing projection of the industrial area, the projection of the commercial area is based on the ratio of commercial workers/ha as below:

- (a) The present ratio of workers/ha for Sungai Petani is 94 workers/ha, while the future ratio is assumed to slightly increase to 100 workers/ha. The value of 100 workers/ha could be applied as a planning standard in the development of three-story shop/office, which will be the predominant commercial built form in the urban expansion areas of Sungai Petani.
- (b) The present ratio for Melaka is 219 workers/ha. This higher ratio is attributed to higher plot ratios permitted in Melaka City Council for infill developments. The plot ratio is generally the floor space divided by the lot area and permitted at 6 for Melaka City, while it is 3 for Sungai Petani. A falling ratio is used as commercial expansion proceeds to the outlying areas. The workers per hectare would gradually decrease to 150 workers per hectare as commercial expansion in the interim period up to 2010 is expected to take place mostly within the city limits and at suburban locations such as Paya Rumpit, Batu Berendam and Cheng. This standard could accommodate a mix of four story shop-office premises, purpose built offices and commercial buildings. The standard will eventually average to 100 workers per hectare as commercial expansion proceeds to the outlying areas in Sungai Udang, Tangga Batu and Tanjung Kling which would generally accommodate low rise commercial buildings. The standard for year 2000 was interpolated at 193 workers per hectare.

Based on the above assumptions, the future commercial area was projected as shown below. The projected commercial areas for 2020 is 812 ha for Sungai Petani and 766 ha for Melaka.:

| Description | Present | 2000 | 2005 | 2010 | 2015 | 2020 |
|-------------------------------|---------|--------|--------|---------|---------|---------|
| Sungai Petani | | | | | | |
| Projected Commercial workers | 22,921 | 29,260 | 38,327 | 51,613 | 66,603 | 79,179 |
| Increase of Workers | | 6,339 | 9,067 | 13,286 | 14,990 | 12,576 |
| Workers/ha | 94 | 95 | 100 | 100 | 100 | 100 |
| Additional Land Required (ha) | | 67 | 91 | 133 | 150 | 126 |
| Cumulative Land Required (ha) | 245 | 312 | 403 | 536 | 686 | 812 |
| Melaka | | | | | | |
| Projected Commercial workers | 53,854 | 62,478 | 82,268 | 101,654 | 113,383 | 123,075 |
| Increase of Workers | | 8,264 | 19,790 | 19,386 | 11,727 | 9,692 |
| Workers/ha | 219 | 193 | 150 | 150 | 100 | 100 |
| Additional Land Required (ha) | | 45 | 132 | 129 | 117 | 97 |
| Cumulative Land Required (ha) | 246 | 291 | 423 | 552 | 669 | 766 |

(4) Overall of Projection for Land Use in 2020

The foregoing projections by the year 2020 are summarized and compared with the projections in the Local Plans as shown below:

(unit : ha)

| Land Use Item | Sungai Petani | | Melaka | |
|------------------|----------------------------|-----------------------------|----------------------------|----------------------------|
| | By Local Plan (in 2010) | In this Study (in: 2020) | By Local Plan (in 2015) | In this Study (in 2020) |
| Residential Area | 5,129 | 5,432 (+5%) | 8,255 | 6,390 (-23%) |
| Industrial Area | 1,350 | 1,777 (+31%) | 2,817 | 2,759 (-2%) |
| Commercial Area | 1,111 | 812 (-27%) | 649 | 766 (+18%) |

Note: The figures in parenthesis are incremental rate of the projection value in this study as compared with that in Local Plan.

The projections in this study of residential areas for Sg. Petani and industrial areas for Melaka were close to the target estimated in the Local Plans (is less than 5%). In another words, the projections in the Local Plans for Sungai Petani and Melaka which were done for the target years of 2010 and 2015 respectively, could be shifted to the target year 2020 as far as the residential areas for Sungai Petani and industrial areas for Melaka are concerned. This is probably because the Local Plans were prepared in early of 1990s with an assumption of very optimistic socio-economic growth.

As for commercial area for Sungai Petani and residential area for Melaka, the projections by Local Plan significantly exceed the projection in this study. That is, Local Plan is likely to provide an excessive commercial area of about 300ha for Sungai Petani and residential area of about 1,900ha for Melaka by the year 2020. However, the land development works have been committed and started for a substantial part of these areas as seen in Bandar Aman Jaya in Sungai Petani. Accordingly, in spite of the excessive land development, the projections in the Local Plan is deemed to be realized by the year of 2020.

In contrast to the above excessive land development, the Local Plan for the Study area provided less industrials areas for Sungai Petani and commercial areas for Melaka as compared with the projected values by 2020 in this study. However, the Local Plan has provided to accommodate this shortfall in locations immediately outside the study area. Due to these conditions, no further increase in commercial and industrial landuse to that projected by Local Plan is needed by the year 2020.

In summary, the overall land use projections in the Local Plans correspond to the required extent of residential, industrial and commercial areas for the Study area by the year of 2020, and therefore applied as the planning framework for this study.