FORECASTING AGGREGATES DEMAND- A TECHNICAL SUMMARY

Introduction

1. This note summarises the ODPM's proposed approach to forecasting the demand for aggregates. This has been used to prepare the draft national and regional guidelines for aggregates provision for 2001 to 2016. The approach has been the subject of informal discussion with relevant experts in industry, planning departments and environmental groups.

2. Previous forecasts of demand (in the 1994 edition of MPG6) were based on a simple regression-based relationship between construction activity and the demand for primary aggregates. Advantages of this methodology included its simplicity, but it was also criticised on a number of points, particularly its overprediction of aggregates demand in the mid-1990s, and its failure to take explicit account of government objectives to encourage the use of recycled/secondary materials as aggregate.

3. The new methodology aims to deal with these shortcomings, while remaining as simple to understand as possible. The revised approach also takes account of design issues identified in the October 2000 Consultation Document – *Planning for the Supply of Aggregates in England*:

   - the appropriate period for forecasting.
   - a more satisfactory link between national and regional forecasts.
   - taking accounting of changes in 'intensity of use' (see paragraph 6).
   - explicitly estimating the demand for total aggregates (including alternatives) at the outset, rather than estimating for primary aggregates and then adjusting the total afterwards; and
   - taking account of policy changes, such as the aggregates levy and future government expenditure plans.
   - the option of a review period to reflect the possibility that forecasts may become less accurate over a number of years.

4. This note explains the modelling and forecasting process. In general terms it involves the preparation of a national (Great Britain) model, before going on to examine regional forecasts. At both national and regional level, it describes the split between primary and alternative sources of aggregates.

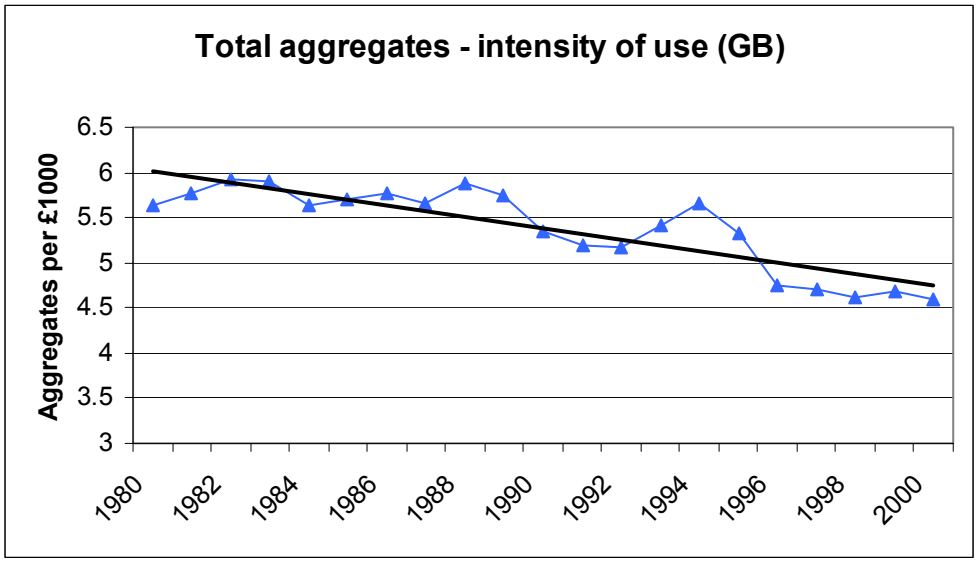
Methodological approach

5. Like the previous forecasts, the new methodology employs a regression-based approach, which is simple and transparent, using easily obtained data. The method now allows the influence of more variables to be taken into account in explaining the variation in aggregates usage than did the previous model. Doing this improves the 'explanatory power' of the model,

i.e. its ability to explain the variation in aggregates demand, so lessening the likelihood of overprediction.

6. The main driver of aggregates demand is construction activity, although the relationship between the two appeared to weaken in the 1990s. This could be because different types of construction activity can vary in terms of the amounts of aggregates that they use. For example expenditure on road building buys different quantities of aggregates to expenditure on house construction, or repair and maintenance. This varying 'intensity of use' (defined as tonnes of aggregate used per £000 of construction output) provides a rationale for disaggregating construction expenditure into its component parts.

7. The October 2000 consultation paper acknowledged that there appears to be evidence of declining intensity of use of aggregates in construction output. This would seem to be confirmed by the graph below, and might happen for two reasons. Firstly, different types of construction use different amounts of aggregates, so changes in construction patterns would partially explain changes in aggregate use. Secondly, there may be changes in aggregate intensity of use for each type of construction, if for instance, methods or designs change. Whichever is the case, the overall fall is shown by the graph.



8. In order to improve the definition of the construction expenditure/use of aggregates relationship, we need to be able to identify different types of construction. The available data (from the DTI *Construction Statistics Annual*, previously the DOE/DETR *Housing and Construction Statistics*), can be disaggregated into eight separate components from 1980 onwards. Each has a different level of aggregate intensity; for example, road building, road repair and house building are much more aggregate

intensive than industrial and commercial building[1]. By dividing the eight elements of construction into two groups of four, we can then create two new construction variables representing those activities with greater and less intensity of use of aggregates, as follows:

'More' aggregates intensive	'Less' aggregates intensive
New housing	Industrial
Infrastructure	Commercial
Other new work (public)	Housing repair
Other public repair	Other private repair

9. The model can be written as:

$$AGGCON = f(IC, LIC, trend)$$

This says that the consumption of aggregates (AGGCON) is a function of two categories of construction that are more (IC) and less (LIC) aggregates-intensive, and of a general trend in the reduction of aggregates intensity.

10. The aggregates data are derived next. The previous forecasts were prepared on the basis of forecasting the demand for primary aggregates only, which were then factored up by 10% to take account of the available evidence on the use of recycled/alternative materials as aggregate. This method was used because there was insufficient historical data available on the levels of demand for alternative materials. Therefore it was not possible to take more explicit account of projected increases in the demand for secondary and recycled aggregates to reduce the demand for primary aggregates.

11. The problem of insufficient recycled/alternative data remains, but what data there is has been combined with informed assumptions to help create an estimated time series for alternatives, and therefore total aggregates data.

12. Primary aggregates consumption data is available from the BGS UK Minerals Yearbook, table 3-16. For alternatives, the main sources of data are the following:

- assumptions about construction and demolition waste are derived from the Environment Agency *Construction and Demolition Waste Survey (2001)*
- assumptions about 'secondary materials' are derived from the British Geological Society *Collation of the Results of the 1997 Aggregate Minerals Survey for England and Wales - table 15, page 36*

[1] Intensity based on 1990 figures, from Ecotec report for DoE (1995) – *Aggregates in Construction – Current Practice, Scope for Substitution and Intensity of Use (page 47)*

- assumptions about asphalt planings derived from Arup Economics and Planning *Occurrence and Utilisation of Mineral and Construction Wastes 1991 - table 3.4, page 34*

13. These figures are added together to give an estimate for the year 1999. There are also data for 1990, but for no other year between 1980 and 2000. Anecdotal evidence leads, therefore, to an assumption that usage in England and Wales was about 30mt per year between 1980 and 1990, before growing by about 1mt per year until 1998, and by about 2mt in 1999[2]. Scottish consumption was assumed to be one-eighth of the England and Wales total, based on 1999 data. Therefore secondary usage is summarised in the following table:

	England and Wales	Scotland	Great Britain
1980-1990	30	3.8	33.8
1991	31	3.9	34.9
1992	32	4.0	36.0
1993	33	4.1	37.1
1994	34	4.3	38.3
1995	35	4.4	39.4
1996	36	4.5	40.5
1997	37	4.6	43.6
1998	38	4.8	42.8
1999	40	5.0	45.0
2000	41	5.1	46.1

14. These figures are then added to the corresponding primary data to give approximate total aggregates consumption.

15. An ordinary least squares (OLS) regression of the data identifies a relationship giving the 'best fit' between construction and aggregates consumption. The results of the model are summarised as:

$$\underset{}{AGGCON} = \underset{(46.01)}{-144.758} + \underset{(0.0023)}{(0.0139*IC)} + \underset{(0.0008)}{(0.0055*LIC)} + \underset{(0.71)}{(-4.265*trend)}$$

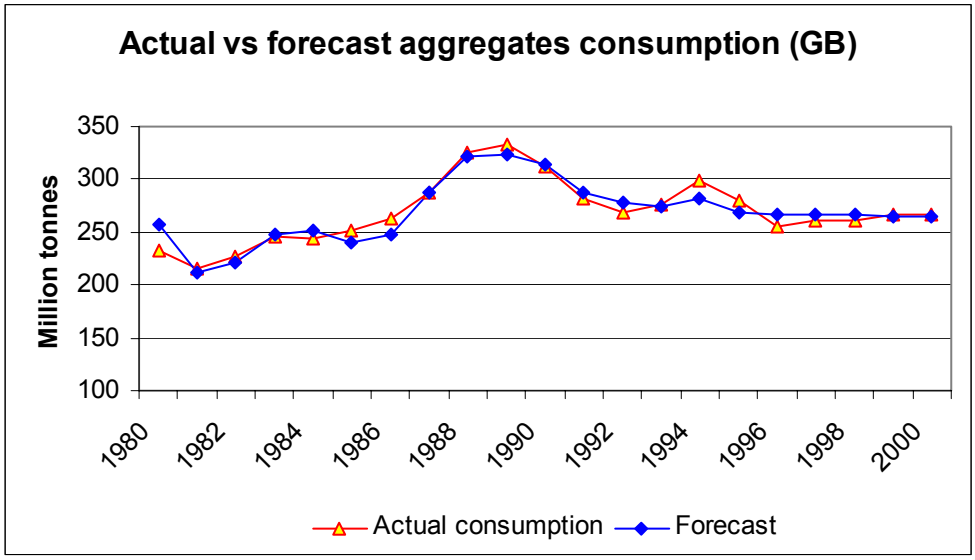
R^2=0.89

16. The first line gives the coefficients associated with each variable. While the negative constant term is slightly surprising, associating a negative consumption figure with zero construction activity, the rest of the equation is more intuitive. It says that increases in both types of construction activity increase the demand for aggregates, with demand increasing by more in the case of 'more-intensive' activity (IC). At the same time the trend coefficient shows a counteracting fall in demand, representing a general reduction in intensity of use. The figures on the second line represent the 'standard errors' of the coefficients - these simply indicate that all the coefficients are 'statistically significant', that is they are robust

[2] An alternative assumption was that usage was 20mt in 1980, rising by 1mt a year until 1990, and then the same as above. These do not give significantly different results, because of the dominance of primary aggregates.

estimates. The R^2 value indicates a high goodness of fit of the model, i.e. the explanatory power of the model is good.

17. The relationship is perhaps better explained graphically:



18. The chart compares aggregates consumption as forecast by the model, against actual aggregates consumption over the 21-year period. The estimated relationship appears to explain the variation in aggregates demand quite well. For example actual consumption in Great Britain in 1997 was 262 million tonnes. Consumption predicted using this model would have been:

AGGCON = -144.758 + (0.0140*21902) + (0.0055*33566) + (-4.265*18)
= 267 mt

Forecasting

19. So far we have established a sound relationship for the years 1980 to 2000 inclusive. We now assume that this relationship will continue to hold up to 2011.

20. In order to provide forecasts for the next few years, we need to make assumptions about the future levels of construction activity. This we do using forecasts of construction gross value added, supplied to ODPM by Cambridge Econometrics. These are updated every six months, taking account of changing economic circumstances and expectations. The forecasts are converted into annual growth rates, which are then applied to the historical construction data in our model, starting from the base year 2000. We assume the same growth rates for both sub-categories of construction.

21. Applying the coefficients derived earlier to the construction forecasts, we are able to derive forecasts of aggregates consumption.

22. However, we then need to make a further adjustment to take account of the effects of the aggregates levy. The levy came into being on 1 April 2002, with all primary aggregates sold being taxed at £1.60 per tonne. This will have an effect on the demand for primary aggregates depending on their degree of importance to users and the availability of alternative untaxed materials. The alternative materials referred to above will not be taxed, in line with Government policy to encourage their use. With the new price advantage over primary aggregates, producers of these materials may decide to raise their prices, depending on market conditions. This could have implications for their demand, and therefore total market demand.

23. Ideally, in order to predict the effect of the levy on total aggregates demand, we would try to calculate the change in prices of different types of aggregates, but data limitations prevent this. Therefore we try to estimate the effect of the levy on the whole market. This is done by calculating the average tax per tonne of aggregates.

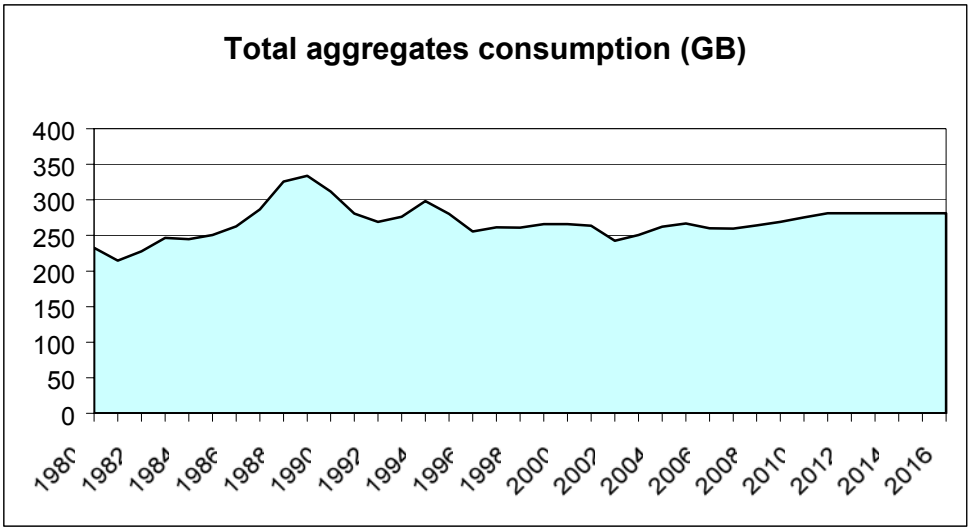
24. The average tax burden depends on the relative shares of taxed primary aggregates (which increase in price by £1.60) and untaxed aggregates (which increase in price by between nothing and £1.60, depending on how much of the tax the producer passes on to the consumer). We assume that the latter increase on average by £1 per tonne, and that their share of total demand is 15% (based on 1999 data). This means that:

Average tax per tonne = (0.85*1.60) + (0.15*1) = £1.51

25. Of course, assuming a higher share of taxable primary aggregates, or a greater price rise of secondary aggregates would increase the average tax per tonne.

26. Therefore, the price of a tonne of aggregates is expected to rise by about 20% (assuming a pre-tax price of £7). Using the same assumptions as those used in the Regulatory Impact Assessment of the aggregates levy, the likely effect of the increase will be to reduce demand for total aggregates by about 9%. However this figure could be subject to a wide margin of error and needs to be reviewed in the light of results of the monitoring of the aggregates levy.

27. The graph below shows the resulting forecasts. Between 2000 and 2011 annual consumption is expected to increase by about 5%. This overall increase is driven by increasing construction activity. It takes account of a continued reduction in aggregates intensity, reinforced by the effects of the aggregates levy, as production techniques become more efficient and consumers switch to alternative materials.



National primary and secondary aggregates

28. The figures derived above are for total aggregates demand, from which figures for primary aggregates demand need to be derived in order to inform the revised guidelines. A feature of the new draft guidelines is that explicit account is taken of the Government's objectives to encourage the use of recycled/secondary materials as aggregates. This is done by reference to the Government's proposed target for their use, which is 60mt per annum in England by 2011. The remaining demand will then be met by primary aggregates.

Regional forecasts

29. The Great Britain forecasts derived above then need to be broken down into England, Wales and Scotland, and then further into the English regions. Data limitations prevent econometric modelling at the regional level - construction statistics and forecasts are available, but not aggregates consumption data. In addition, the national model cannot be applied at the regional level, because the relationship between construction and aggregates use may vary.

30. Therefore the GB forecasts are disaggregated, and the starting point for this is their known regional shares. In the case of *primary* aggregates, although there is regional data in the 1997 Aggregate Minerals Survey, this only covers England and Wales. Comparing these with the GB figure gives an implicit figure for Scotland that is too high. Therefore the key year is 1999, the most recent year for which Scottish *production* data exists. The production figure is used as a proxy for consumption, and is subtracted from the UK figure to give England and Wales. English regional figures can then be derived according to the AM 1997 splits. The table below summarises:

The split of GB primary aggregates consumption 1999

		m tonnes
Great Britain	BGS UK Minerals Yearbook (table 3-16)	221
Scotland (production)	BGS UK Minerals Yearbook (table 3-6)	33.56
England and Wales	Calculated from above	187.44
English regions and Wales	Split according to AM97 shares	

31. For *secondary* aggregates, the regional splits are derived from the surveys discussed in paragraph 12 above, and summed together for 1999. The primary and secondary figures are then added together to give regional figures for 1999. The 1999 shares are assumed to hold in deriving the England, Wales and Scotland forecasts, shown below.

Total aggregates demand

	England	Wales	Scotland
2001	207	18	39
2002	190	17	35
2003	197	17	36
2004	206	18	38
2005	210	18	38
2006	205	18	38
2007	205	17	37
2008	209	17	38
2009	213	18	38
2010	219	18	39
2011-2016	223	18	40

32. Forecasts for the English regions are then derived by factoring up their 1999 figures by regional construction growth forecasts, also provided by Cambridge Econometrics. The forecasts are then constrained to the national totals previously derived, in order to ensure regional and national consistency. Such methodology takes account of projected construction growth in individual regions, although not of any possible regional differences in intensity of use. However, by constraining the regional increases to the national totals, the method is implicitly accounting for intensity of use.

33. The resulting forecasts are for the old planning regions , i.e. the North West and North, and the South East and East Anglia. This is because the only regional consumption data that we have observes these boundaries. However, the draft guidelines are on the basis of the new regions, the North West and North East, and the South East and the Eastern Region. For this reason construction forecasts in the regions in question may be under or over-predicted, with consequences for the resulting aggregates consumption figures.

Regional primary and secondary aggregates

34. The shares of recycled/secondary aggregates within individual regions are assumed to remain the same throughout the forecasting period. Intra-regional shares are based on those for 1999, from the sources discussed

in paragraph 12. They are then constrained in order to sum to the national targets described above. The remaining demand within each region is then met by primary aggregates. As with the national forecasts, these are held level from 2011 to 2016.