Chapter XI Air Quality Conformity

An air quality analysis is performed on the Long Range Transportation Plan (LRTP) and the Transportation Improvement Program (TIP) in order to determine the impact of major transportation system improvements on vehicle emissions. The Federal Highway Administration and the Environmental Protection Agency require that the implementation of projects in the TIP and the LRTP does not result in mobile source emissions greater than the current emission budget assigned for the Grand Rapids Metro Area in the State Implementation Plan (SIP).

The Grand Rapids Metropolitan Area was previously designated as a non-attainment area for Ozone. The recent re-designation to a Maintenance area still requires careful monitoring of air quality in the region. Therefore, the TIP and LRTP air quality conformity analysis examines changes in Volatile Organic Compounds (VOC) and Oxides of Nitrogen (NOx). The emission levels are then compared to numerical emission budgets developed by the state in the regional maintenance plan.

Air Quality Assessment Criteria

The Transportation plan conformity determination finding was made in compliance with all applicable conformity requirements. The Transportation plan satisfies the following conformity criteria and procedures set forth in the USEPA's Transportation Conformity Rule:

1. The conformity determination was based on the latest planning assumptions.
2. The conformity determination was based on the latest emission model available.
3. The conformity determination was made according to the consultation procedures of the final conformity rule and the implementation plan revision.
4. The determination was made that the Transportation Plan does not increase the frequency or severity of the existing violation of the NAAQS for which the area is designated in non-attainment. Completing the components of the Transportation Plan does not increase emissions over the option of not building during the same time period.

Background

The following documentation describes the best practices available for the travel demand estimation and analysis in Kent and Ottawa Counties. The Grand Valley Metropolitan Council (GVMC) and the Macatawa Area Coordinating Council (MACC) have approved socioeconomic data for 1998, 2000, 2005, 2006, 2010, 2015, 2020 and 2025. These data are the basis for forecasting travel demand in the respective study areas, which in turn generates the inputs required for air quality conformity analysis. These inputs are the amount of travel expressed as vehicle miles of travel (VMT) and average speed by National Functional Classification (NFC) or a combination of similar functional classified facilities grouped together to address the new Mobile 6 model input data structure. One of the latest travel demand forecasting technologies available, the TranPlan model has been used in all urban area travel demand forecasting efforts. However, air quality conformity analysis must be performed on a county wide basis, and the urban area travel demand forecast models cover all of Kent and portion of Ottawa Counties. Procedures must therefore be employed to estimate VMT and speed for the portion of Ottawa County which is not covered by a travel demand model.

The VMT and speed data generated by the TranPlan models for the GVMC and MACC areas, and county wide Highway Performance Monitoring System (HPMS) VMT figures provide the basis for the estimation of present and future VMT and speeds by NFC for the entire counties. The air quality conformity analysis performed for the 2004-2006 Transportation Improvement Program includes the following assumptions:

1- Emission budget for VOC of 64 tons/day based on Mobile 5
2- Emission budget for NOx of 61 tons/day based on Mobile 5
3- Emission budget for VOC of 48.8 tons/day based on Mobile 6
4- Emission budget for NOx of 58.3 tons/day based on Mobile 6
5- Projects are included in either year 2006, 2015, or 2025 depending when they could be open to traffic.
6- Include off model credits from 1995-2000 approved CMAQ projects and Transit fleet turnover.
7- No Inspection/Maintenance (I/M) program.

Modeling Procedures

GVMC has developed and calibrated the travel demand model (TranPlan) which covers all of Kent and eastern part of Ottawa Counties. The travel demand model uses the standard four-step transportation planning process.

1- Trip generation model
2- Trip distribution model
3- Mode choice model
4- Highway assignment model

The *trip generation model* uses a combination of local and QRS (NCHRP 187) trip generation rates. The trip generation variables used in the model are Dwelling units, Retail Employment, and Non-retail Employment. The *trip distribution model* uses the standard model to estimates origin/destination tables. It also uses Friction Factors for trip attractiveness. The *mode choice model* is a single mode model. It uses vehicle occupancy rate to estimate vehicle trips on the network. Transit trips are estimated separately using different post processing methods. The *trip assignment model* uses two different techniques, all-or- nothing and capacity restrained algorithms. The model was calibrated according to the strict calibration standards used by MDOT and suggested by FHWA. The model includes 734 traffic analysis zones and 5904 links. The network is coded to output information based on area type, facility type, number of lanes, speeds, national functional classification, capacity, street names, and vehicle assignment. The MACC has a similar model which was developed and calibrated by the Michigan Department of Transportation (MDOT).

Model Data

The modeled VMT and speeds for the portions of each study area within Kent and Ottawa Counties are summarized in Tables 7 thru 12. The overall modeled speed by NFC is determined by dividing total VMT by total VHT generated by the travel demand models.

Table 7 **Kent County Year 2006 Vehicle Miles of Travel & Speed**

KENT COUNTY	HPMS	MODELED	MODELED	NORMALIZED	2006
2006	**1998 VMT**	**1998 VMT**	**2006 VMT**	**2006 VMT**	**SPEED**
NFC					
Rural Interstate/Freeway	734,000	804,970	1,418,443	**1,293,387**	**46.39**
Rural Major & Minor Arterial/Collector/Local Street	2,104,000	2,116,899	2,320,281	**2,306,142**	**33.97**
Urban Interstate/Freeway	3,428,000	2,856,224	5,032,251	**6,039,638**	**46.33**
Urban Principal & Minor Arterial/Collector/Local Street	7,484,000	8,085,905	7,895,729	**7,307,981**	**27.43**
TOTALS	**13,750,000**	**13,863,998**	**16,666,704**	**16,947,148**	

Table 8 **Kent County Year 2015 Vehicle Miles of Travel & Speed**

KENT COUNTY	HPMS	MODELED	MODELED	NORMALIZED	2015
2015	**1998 VMT**	**1998 VMT**	**2015 VMT**	**2015 VMT**	**SPEED**
NFC					
Rural Interstate/Freeway	734,000	804,970	1,566,997	**1,428,843**	**46.07**
Rural Major & Minor Arterial/Collector/Local Street	2,104,000	2,116,899	2,732,250	**2,715,601**	**33.31**
Urban Interstate/Freeway	3,428,000	2,856,224	5,538,547	**6,647,287**	**46.97**
Urban Principal & Minor Arterial/Collector/Local Street	7,484,000	8,085,905	8,681,554	**8,035,309**	**29.60**
TOTALS	**13,750,000**	**13,863,998**	**18,519,347**	**18,827,040**	

Table 9 **Kent County Year 2025 Vehicle Miles of Travel & Speed**

KENT COUNTY	HPMS	MODELED	MODELED	NORMALIZED	2025
2025	**1998 VMT**	**1998 VMT**	**2025 VMT**	**2025 VMT**	**SPEED**
NFC					
Rural Interstate/Freeway	734,000	804,970	1,656,325	**1,510,297**	**46.00**
Rural Major & Minor Arterial/Collector/Local Street	2,104,000	2,116,899	3,104,625	**3,085,707**	**32.43**
Urban Interstate/Freeway	3,428,000	2,856,224	5,921,121	**7,106,446**	**46.54**
Urban Principal & Minor Arterial/Collector/Local Street	7,484,000	8,085,905	10,025,467	**9,279,183**	**27.97**
TOTALS	**13,750,000**	**13,863,998**	**20,707,538**	**20,981,633**	

***Table 10 Ottawa* County Year 2006 Vehicle Miles of Travel & Speed**

OTTAWA COUNTY	HPMS	MODELED	MODELED	NORMALIZED	2006
2006	**1998 VMT**	**1998 VMT**	**2006 VMT**	**2006 VMT**	**SPEED**
NFC					
Rural Interstate/Freeway	1,186,000	351,590	1,344,282	**1,344,282**	**52.66**
Rural Major & Minor Arterial/Collector/Local Street	978,000	809,514	1,142,492	**1,142,492**	**35.98**
Urban Interstate/Freeway	328,000	610,129	361,620	**361,620**	**47.69**
Urban Principal & Minor Arterial/Collector/Local Street	2,502,000	2,116,682	2,944,491	**2,944,491**	**31.59**
TOTALS	**4,994,000**	**3,887,915**	**5,792,884**	**5,792,884**	

***Table 11 Ottawa* County Year 2015 Vehicle Miles of Travel & Speed**

OTTAWA COUNTY	HPMS	MODELED	MODELED	NORMALIZED	2015
2015	**1998 VMT**	**1998 VMT**	**2015 VMT**	**2015 VMT**	**SPEED**
NFC					
Rural Interstate/Freeway	1,186,000	351,590	1,733,380	**1,733,380**	**55.11**
Rural Major & Minor Arterial/Collector/Local Street	978,000	809,514	1,293,790	**1,293,790**	**35.86**
Urban Interstate/Freeway	328,000	610,129	549,705	**549,705**	**48.17**
Urban Principal & Minor Arterial/Collector/Local Street	2,502,000	2,116,682	3,341,458	**3,341,458**	**32.04**
TOTALS	**4,994,000**	**3,887,915**	**6,918,334**	**6,918,334**	

***Table 12 Ottawa* County Year 2025 Vehicle Miles of Travel & Speed**

OTTAWA COUNTY	HPMS	MODELED	MODELED	NORMALIZED	2025
2025	**1998 VMT**	**1998 VMT**	**2025 VMT**	**2025 VMT**	**SPEED**
NFC					
Rural Interstate/Freeway	1,186,000	351,590	1,930,748	**1,930,748**	**54.54**
Rural Major & Minor Arterial/Collector/Local Street	978,000	809,514	1,440,321	**1,440,321**	**35.36**
Urban Interstate/Freeway	328,000	610,129	589,768	**589,768**	**48.37**
Urban Principal & Minor Arterial/Collector/Local Street	2,502,000	2,116,682	3,687,470	**3,687,470**	**31.02**
TOTALS	**4,994,000**	**3,887,915**	**7,648,306**	**7,648,306**	

Highway Performance Monitoring System (HPMS) Data

HPMS data provides statistically valid estimates of 1990 and 1998 VMT for the entire Kent and Ottawa counties, stratified by NFC. Between 1990 and 1998, the NFC coding used to tabulate HPMS data changed due to the expanding urban boundaries of the urbanized areas. To maintain consistency between HPMS and modeled VMT, and among the milestone years, the 1998 HPMS VMT distribution was normalized to 2006, 2015, and 2025 distribution among the functional

classes. Thus, the 1998 total HPMS VMT remained the same while the distribution changed to reflect what it would have been had the 1998 NFC coding been identical in the model. Shown in Tables 7 thru 12 are the original 1990 and 1998 HPMS VMT estimates for Kent and Ottawa Counties.

Rural (Donut) VMT

Since only portions of Ottawa County is covered by an urban travel demand model, the VMT for the modeled areas is subtracted from total 'donut' HPMS VMT to determine the magnitude of the county-wide VMT outside of the modeled areas. This is referred to as the 1998 "non-urban model" rural VMT.

The VMT by NFC for the non-urban model rural portion of each county is estimated by the statewide model. The 1998 model VMT is expanded to the 1998 HPMS VMT, and the expansion factors are applied to all future years. This process is employed as the statewide model network does not represent all links, and the VMT estimates it provides are only for the incorporated links. Local roads are not incorporated into the statewide model, so HPMS figures are used as a default. Growth for those functional classes is assumed to parallel growth on collectors, and future year VMT figures are calculated accordingly.

The VMT for the non-urban portion of the urban model, and the expanded statewide VMT are then combined to represent all non-urbanized area VMT.

Since only a portion of Ottawa County is covered by the urban travel demand models, the VMT for the modeled areas is subtracted from total 1998 factored HPMS VMT to determine the magnitude of county wide VMT not accounted for by the models.

Growth factors for the analysis years 2006, 2015, and 2025 are calculated based on the modeled growth in VMT on the rural links contained within the urban models. The growth factors represent the compound nature of VMT growth, since the socioeconomic forecasts which drive the VMT forecasts have been developed using compound growth formulas.

Reviews of local area and statewide statistics have indicated that VMT growth in rural areas is approximately half that of urbanized areas, so the calculated growth factors are halved. The calculated, adjusted growth factors are applied to the 1998 un-modeled rural VMT to estimate 2006, 2015, & 2025 un-modeled rural VMT. Where the modeled VMT exceeds the HPMS VMT, the growth rates are applied to this difference, so the appropriate amount of VMT will be subtracted from the modeled VMT for the future years.

Modeled VMT

The modeled urban VMT from the GVMC and MACC models is combined and compared to the urbanized area 1998 HPMS VMT for each urban functional class. Adjustment factors are calculated for each urban NFC to fit the modeled

VMT estimate to the HPMS VMT estimate. The adjustment factors are then applied to all forecast years to appropriately scale the forecasts.

The modeled urban VMT from the GVMC and MACC models is combined, and compared to the factored 1998 HPMS VMT for each urban functional class. In several instances, the 1998 modeled VMT estimate for a particular urban NFC exceeds the 1998 factored HPMS VMT estimate for the same class. In other cases, the modeled urban VMT estimate is lower than the HPMS estimate. Adjustment factors are calculated for each urban NFC to "fit" the modeled VMT estimate to the HPMS VMT estimate. These factors are then applied to all forecast years to appropriately scale the forecasts.

Total Rural VMT and Speeds

For the rural links contained within each urban travel demand model, speeds are based on the urban models. The speeds for the non-urban model rural portion of each county are based on the statewide model. The speeds from the urban and statewide models are weighted by VMT and averaged to provide one speed per NFC. As local roads are not incorporated in the statewide model network, the speeds for these classes are estimated as the average of the speeds generated by all of the small urban area models.

Total rural NFC VMT is obtained by adding the modeled and un-modeled VMT. The speeds on un-modeled rural links are assumed to be the same as the speeds on modeled rural links. In addition, these speeds in rural Ottawa County are assumed to be constant over time, as substantial excess capacity generally exists on rural roads. The VMT for all rural links is combined, as well as the VHT. Dividing the total VMT by total VHT provides the total rural link speed estimates. Average speed for each urban NFC is calculated by dividing the total VMT by the total VHT for that NFC.

Conformity Analysis

GVMC staff combined estimates of VMT and Speed from the Kent and Ottawa Counties to use with the emissions output from MOBILE 6. The conformity is performed using the MOBILE6 program. MOBILE6 is a computer program that estimates volatile organic compounds (VOC), carbon monoxide (CO), and oxides of nitrogen (NOx) emission factors for gasoline-fueled and diesel highway motor vehicles. The model was developed by the United States Environmental Protection Agency (USEPA). MOBILE6 calculates emission factors for eight individual vehicle types in two regions of the country. MOBILE6 emission factor estimates depend on various conditions such as ambient temperatures, average travel speed, operating modes, fuel volatility, and mileage accrual rates. Many of the variables affecting vehicle emissions can be specified by the user. The analyses cover 2006, 2015, & 2025. The analysis is based on comparing the total emissions from the Long Range Transportation Plan and the Transportation Improvement Program projects to the official emission budget in the SIP and a calculated budget by Mobile 6 and the analysis does not include I/M Program.

Tables 13 thru 16 reflect the emissions of VOC and NOx with the implementation of projects included in the Long Range Transportation Plan and the Transportation Improvement Program.

Table 13 **Kent Year 1996, 2006, 2015 & 2025 VOC & NOX Emissions**

KENT COUNTY			
Functional	**Budget**	**VOC**	**NOx**
Classification	**Year**	**Kg/Day**	**Kg/Day**
Rural Interstate/Freeway	**1996**	**1,557.17**	**2,373.80**
Rural Major & Minor Arterial/Collector/Local Street	**1996**	**5,014.62**	**5,741.22**
Urban Interstate/Freeway	**1996**	**7,659.27**	**10,315.41**
Urban Principal & Minor Arterial/Collector/Local Street	**1996**	**18,794.53**	**20,376.12**
TOTALS		**33,025.60**	**38,806.54**

KENT COUNTY			
Functional		**VOC**	**NOx**
Classification	**Year**	**Kg/Day**	**Kg/Day**
Rural Interstate/Freeway	**2006**	**1,447.03**	**2,455.09**
Rural Major & Minor Arterial/Collector/Local Street	**2006**	**2,822.72**	**3,858.08**
Urban Interstate/Freeway	**2006**	**6,797.05**	**11,536.65**
Urban Principal & Minor Arterial/Collector/Local Street	**2006**	**9,644.14**	**12,563.46**
TOTALS		**20,710.93**	**30,413.27**

KENT COUNTY			
Functional		**VOC**	**NOx**
Classification	**Year**	**Kg/Day**	**Kg/Day**
Rural Interstate/Freeway	**2015**	**812.52**	**1,078.62**
Rural Major & Minor Arterial/Collector/Local Street	**2015**	**1,677.03**	**1,876.68**
Urban Interstate/Freeway	**2015**	**3,790.17**	**5,070.29**
Urban Principal & Minor Arterial/Collector/Local Street	**2015**	**5,157.68**	**5,616.86**
TOTALS		**11,437.40**	**13,642.44**

KENT COUNTY			
Functional		**VOC**	**NOx**
Classification	**Year**	**Kg/Day**	**Kg/Day**
Rural Interstate/Freeway	**2025**	**563.52**	**589.93**
Rural Major & Minor Arterial/Collector/Local Street	**2025**	**1,279.20**	**1,153.59**
Urban Interstate/Freeway	**2025**	**2,654.69**	**2,822.68**
Urban Principal & Minor Arterial/Collector/Local Street	**2025**	**4,062.80**	**3,550.35**
TOTALS		**8,560.22**	**8,116.55**

Table 14 Ottawa **Year 1996, 2006, 2015 & 2025 VOC & NOX Emissions**

OTTAWA COUNTY			
Functional	**Budget**	**VOC**	**NOx**
Classification	**Year**	**Kg/Day**	**Kg/Day**
Rural Interstate/Freeway	**1996**	**2,291.22**	**3,991.38**
Rural Major & Minor Arterial/Collector/Local Street	**1996**	**2,145.46**	**2,499.19**
Urban Interstate/Freeway	**1996**	**675.37**	**977.39**
Urban Principal & Minor Arterial/Collector/Local Street	**1996**	**6,110.29**	**6,624.48**
TOTALS		**11,222.34**	**14,092.44**

OTTAWA COUNTY			
Functional		**VOC**	**NOx**
Classification	**Year**	**Kg/Day**	**Kg/Day**
Rural Interstate/Freeway	**2006**	**1,449.45**	**2,739.35**
Rural Major & Minor Arterial/Collector/Local Street	**2006**	**1,371.87**	**1,914.47**
Urban Interstate/Freeway	**2006**	**403.45**	**700.25**
Urban Principal & Minor Arterial/Collector/Local Street	**2006**	**3,695.11**	**4,952.16**
TOTALS		**6,919.89**	**10,306.23**

OTTAWA COUNTY			
Functional		**VOC**	**NOx**
Classification	**Year**	**Kg/Day**	**Kg/Day**
Rural Interstate/Freeway	**2015**	**946.09**	**1,431.59**
Rural Major & Minor Arterial/Collector/Local Street	**2015**	**781.57**	**893.40**
Urban Interstate/Freeway	**2015**	**310.41**	**425.98**
Urban Principal & Minor Arterial/Collector/Local Street	**2015**	**2,090.18**	**2,316.70**
TOTALS		**4,128.24**	**5,067.67**

OTTAWA COUNTY			
Functional		**VOC**	**NOx**
Classification	**Year**	**Kg/Day**	**Kg/Day**
Rural Interstate/Freeway	**2025**	**689.82**	**803.16**
Rural Major & Minor Arterial/Collector/Local Street	**2025**	**578.62**	**534.80**
Urban Interstate/Freeway	**2025**	**217.93**	**237.18**
Urban Principal & Minor Arterial/Collector/Local Street	**2025**	**1,554.28**	**1,385.23**
TOTALS		**3,040.66**	**2,960.37**

Table 15 **Conformity Analysis Total Results**

Conformity Analysis Total Results (Tons/Day)

	Total VOC	Total NOx	VOC	NOx			VOC Emission	Nox Emission
	Before Credit	Before Credit	Credits	Credits	Adjusted VOC	Adjusted NOx	Mobile6 Budget	Mobile6 Budget
Model Year	Tons/Day	Tons/Day	Tons/Day	Tons/Day	Tons/Day	Tons/Day	Tons/Day	Tons/Day
2006 W/O IM	30.5	44.9	-0.19	-0.17	30.27	44.72	48.8	58.3
2015 W/O IM	17.2	20.6	-0.19	-0.17	16.97	20.45	48.8	58.3
2025 W/O IM	12.8	12.2	-0.19	-0.17	12.60	12.04	48.8	58.3

Conformity Analysis Total Results (Kg/Day)

	Total VOC	Total NOx	VOC	NOx			VOC Emission	Nox Emission
	Before Credit	Before Credit	Credits	Credits	Adjusted VOC	Adjusted NOx	Mobile6 Budget	Mobile6 Budget
Model Year	Kg/Day	Kg/Day	Kg/Day	Kg/Day	Kg/Day	Kg/Day	Kg/Day	Kg/Day
2006 W/O IM	27,630.8	40,719.5	-168.73	-154.22	27462.09	40565.28	44,247.9	52,899.0
2015 W/O IM	15,565.6	18,710.1	-168.73	-154.22	15396.91	18555.90	44,247.9	52,899.0
2025 W/O IM	11,600.9	11,076.9	-168.73	-154.22	11432.14	10922.70	44,247.9	52,899.0

Table 16 **Conformity Analysis Total Results**

Conformity Analysis Total Results (Tons/Day)

	Total VOC	Total NOx	VOC	NOx			VOC Emission	Nox Emission
	Before Credit	Before Credit	Credits	Credits	Adjusted VOC	Adjusted NOx	Mobile5 Budget	Mobile5 Budget
Model Year	Tons/Day	Tons/Day	Tons/Day	Tons/Day	Tons/Day	Tons/Day	Tons/Day	Tons/Day
2006 W/O IM	30.5	44.9	-0.19	-0.17	30.27	44.72	64.0	61.0
2015 W/O IM	17.2	20.6	-0.19	-0.17	16.97	20.45	64.0	61.0
2025 W/O IM	12.8	12.2	-0.19	-0.17	12.60	12.04	64.0	61.0

Conformity Analysis Total Results (Kg/Day)

	Total VOC	Total NOx	VOC	NOx			VOC Emission	Nox Emission
	Before Credit	Before Credit	Credits	Credits	Adjusted VOC	Adjusted NOx	Mobile5 Budget	Mobile5 Budget
Model Year	Kg/Day	Kg/Day	Kg/Day	Kg/Day	Kg/Day	Kg/Day	Kg/Day	Kg/Day
2006 W/O IM	27,630.8	40,719.5	-168.73	-154.22	27462.09	40565.28	58,058.5	55,337.0
2015 W/O IM	15,565.6	18,710.1	-168.73	-154.22	15396.91	18555.90	58,058.5	55,337.0
2025 W/O IM	11,600.9	11,076.9	-168.73	-154.22	11432.14	10922.70	58,058.5	55,337.0

Conclusion

Tables 15 and 16 clearly indicate that implementing the Transportation Improvement Program projects will result in lower emissions than the emission budget. Consequently, the Grand Valley Metro Council and the Macatawa Area Coordinating Council's 2004-2006 TIPs complies with the transportation plan conformity criteria contained in the USDOT/USEPA Conformity Guidance, and therefore meet the requirement of the CAAA and related TEA-21 provisions.