Appendix 11A: Air Quality Technical Report

11A.1 Introduction

The Federal Highway Administration (FHWA), in cooperation with the Utah Department of Transportation (UDOT), prepared a Draft Environmental Impact Statement (EIS) in accordance with the National Environmental Policy Act (NEPA) for the West Davis Corridor (WDC) Project in Davis and Weber Counties, Utah. The Draft EIS was released in May 1, 2013, and the public comment period closed on September 6, 2013.

> **What is the West Davis Corridor team?**
>
> The WDC team consists of the lead agencies for the WDC Project (FHWA and UDOT).

This technical report provides details of the quantitative air quality analyses (also called the hot-spot or project-level analyses) presented in the project's Final EIS and describes the methodology, inputs, and results for those hot-spot analyses for particulate matter ($PM_{2.5}$ and PM_{10}) and carbon monoxide (CO). In addition, area-wide emission inventories (in tons per year) were prepared for CO, volatile organic compounds (VOCs), nitrogen oxides (NO_x), PM_{10}, greenhouse gases (GHGs), and mobile-source air toxics (MSATs). Transportation conformity requirements apply to any transportation-related criteria pollutants for which a project area has been designated a non-attainment or maintenance area. The WDC study area is in a non-attainment area for $PM_{2.5}$. Since the WDC study area is in an attainment area for carbon monoxide, PM_{10}, ozone (O_3), and nitrogen dioxide (NO_2), a transportation conformity determination is not required for these pollutants.

> **What is the WDC study area?**
>
> The WDC study area is the area described in Section 1.2, Description of the Needs Assessment Study Area.

The WDC is included in the conforming *Amended Wasatch Front Regional Council 2015–2040 Regional Transportation Plan* (WFRC 2016), and the design concept and scope of the WDC Project are consistent with the project evaluated as part of the regional emissions analysis for the plan's conformity determination. This regional emissions analysis found that all of the regionally significant transportation projects included in the Wasatch Front Regional Council's (WFRC) Regional Transportation Plan, including the WDC Project, would conform to the CO and PM_{10} emissions budgets in the State Implementation Plan (SIP) as well as to the applicable $PM_{2.5}$ regulatory requirements that were in place at the time of the analysis.

> **What is a State Implementation Plan (SIP)?**
>
> A State Implementation Plan explains how a State will comply with the requirements of the federal Clean Air Act of 1990, as amended.

As stated in Section 11.4.3.2, Project-Level Quantitative Analyses for PM_{10} and $PM_{2.5}$, of the Final EIS, no hot-spot analysis is required for $PM_{2.5}$ because the WDC Project is not a project of air quality concern under 40 Code of Federal Regulations (CFR) 93.123(b). Since there is no approved SIP for $PM_{2.5}$, 40 CFR 93.117 (compliance with $PM_{2.5}$ control measures in the SIP) does not apply. Thus, the WDC Project complies with all applicable conformity requirements of 40 CFR 93.

11A.1.1 Air Quality Study Area

The affected air quality environment for the WDC Project is described in Section 11.3, Affected Environment, of the Final EIS. The specific boundaries of the WDC study area are:

- Northern boundary: 3000 South in Hooper and West Haven
- Southern boundary: about Parrish Lane in Centerville
- Western boundary: just east of the Great Salt Lake
- Eastern boundary: Interstate 15 (I-15)

The WDC study area is the portion of western Davis and Weber Counties where traffic volumes on the roadway network would be affected by the WDC. The WDC study area was used to prepare emissions inventories (that is, mass quantities in tons per year or tons per day as appropriate) for CO, PM_{10}, $PM_{2.5}$, MSATs, and GHGs.

The emissions inventory evaluation included all major roads (including I-15) in the WDC study area. Traffic volumes and vehicle speeds used in the emissions inventory evaluations were derived from the travel demand model used for the WDC Project.

What is a travel demand model?

A travel demand model is a computer model that predicts the number of transportation trips (travel demand) in an area at a given time. The travel demand model used for the WDC Project is maintained by WFRC.

The WDC team derived additional MOVES2014a input parameters such as vehicle-miles traveled (VMT) fractions (monthly, daily, and hourly), vehicle source types (such as cars, trucks, and buses, among others), road types (freeways, ramps, local arterials), vehicle age distribution, inspection-maintenance parameters, and local fuel parameters from regional data provided by WFRC. (For more information about the MOVES2014a model, see Section 11A.2, Methodology.)

In addition to emission inventories, the WDC team performed detailed project-level hot-spot analyses at one interchange in the WDC corridor (the Alternative B1 Antelope Drive interchange). Hot-spot analyses were performed for CO, $PM_{2.5}$ (particulate matter less than or equal to 2.5 microns in diameter), and PM_{10} (particulate matter less than or equal to 10 microns in diameter).

What is a hot-spot analysis?

A hot-spot analysis is a project-level analysis that looks at local air quality impacts, such as at intersection crosswalks or residences near a roadway.

For the hot-spot analyses, the WDC team used the MOVES2014a model to generate project-specific, speed-related vehicle emission rates, which were then used in the latest version of the CAL3QHCR air quality dispersion model (dated 13196 and described in Model Change Bulletin Number 8 dated July 15, 2013) (EPA 2013) along with other meteorological data and traffic parameters to predict pollutant concentrations at specific residential receptor locations near the Alternative B1 Antelope Drive interchange. The pollutants modeled were $PM_{2.5}$, PM_{10}, and CO.

The WDC team used the CAL3QHCR model output to determine whether the vehicle emissions from the WDC when added to a background concentration would cause the applicable National Ambient Air Quality Standards (NAAQS) for PM_{10}, $PM_{2.5}$, or CO to be exceeded at specific receptor locations near the interchange.

The Alternative B1 Antelope Drive location was used for the hot-spot analyses because it would be the interchange with the largest number of residences located close to the interchange, as well as a nearby school (the Syracuse Arts Academy). There are no nearby industrial sources of $PM_{2.5}$ and PM_{10} that could affect project-related emissions at this interchange. Figure 11A-1, Antelope Drive Air Quality Model Receptors and Links, in Volume IV shows the receptors and interchange links modeled in the hot-spot analyses.

11A.2 Methodology

The FHWA publication *Guidance for Preparing and Processing Environmental and Section 4(f) Documents* (FHWA 1987) suggests procedures for evaluating air quality impacts associated with transportation projects and provides guidance on completing regional and project-level air quality evaluations. In addition, guidance from the U.S. Environmental Protection Agency (EPA) provides details about the applicability of detailed MOVES2014a and CAL3QHCR modeling requirements for quantitative hot-spot analyses that involve CO, $PM_{2.5}$, and PM_{10} (EPA 2015a, 2015b, 2015c). The WDC team used EPA guidelines, as well as materials used in EPA-sponsored training classes (for example, "Completing Quantitative PM Hot-Spot Analyses: 3-Day Course"), in these evaluations.

The MOVES2014a model is the mobile-source emission factor model used in this analysis. MOVES2014a provides great flexibility to capture the influence of time of day, vehicle speeds, and seasonal weather effects on vehicle emission rates.

Depending on the availability of project-specific inputs, MOVES2014a calculates a number of emission-related parameters such as total mass emissions, speed-related emission rates, and total energy consumption, among other outputs. From this output, emission rates (for example, grams per vehicle-mile or grams per hour) can be estimated for a wide variety of spatial and time scales. MOVES2014a can also produce emission inventory outputs (that is, area-wide emissions in tons per year or tons per day as appropriate to the pollutant under consideration) and emission rates at the project level for a specific group of roadway segments or links.

Both methods were used in this evaluation; the emission inventory mode was used for estimating area-wide CO, $PM_{2.5}$, PM_{10}, and MSAT emissions for the WDC study area, and project-specific emission rates were used for $PM_{2.5}$, PM_{10}, and CO dispersion modeling at the Alternative B1 Antelope Drive interchange using the latest version of the CAL3QHCR dispersion model (dated 13196 and described in Model Change Bulletin Number 8 dated July 15, 2013) (EPA 2013).

At the project level, MOVES2014a requires site-specific input data for traffic volumes and other parameters that can change by the time of day or the season of the year. By using site-specific data, the emission results reflect the site-specific traffic characteristics in the WDC study area in great detail.

11A.2.1 Transportation Conformity Requirements and Need for Hot-Spot Analyses

The transportation conformity requirements apply to any transportation-related criteria pollutants for which the project study area has been designated as a non-attainment or maintenance area. In addition, project-level analyses are required only for projects that are considered to be “projects of air quality concern.”

What is transportation conformity?

Transportation conformity is a way to ensure that federal funding and approval goes to those transportation activities that are consistent with air quality goals. Conformity applies to transportation plans, transportation improvement programs, and projects funded or approved by FHWA in areas that do not meet or previously have not met the NAAQS for ozone, CO, PM, or NO_2. These areas are known as *non-attainment areas* or *maintenance areas*, respectively. An *attainment area* is an area that meets (or “attains”) the NAAQS for a given air pollutant.

11A.2.1.1 Carbon Monoxide (CO)

The regulation at 40 CFR 93.123(a) describes procedures for determining the need for a CO hot-spot analysis. The most important consideration in this determination is whether or not the proposed project is located in a non-attainment or maintenance area for CO.

The WDC would be located in Davis and Weber Counties. The city of Ogden is classified as a maintenance area for CO (UDEQ 2013). The alternative alignments under consideration for the WDC Project are not in the city of Ogden.

The WDC alternatives are about 8 to 12 miles south and west of the Utah Division of Air Quality’s air quality monitoring station in Ogden. Because the WDC would not be located in a non-attainment or maintenance area for CO, under 40 CFR 93.116(a), a CO hot-spot analysis is not required.

Even though the WDC would not be located in a non-attainment area for CO, the WDC team conducted a project-level hot-spot analysis near the Alternative B1 Antelope Drive interchange because the area around that interchange would have the largest number of residences located near the WDC, as well as a nearby school (the Syracuse Arts Academy). As currently proposed, none of the other proposed interchange locations would be as close to such residential areas or schools.

11A.2.1.2 Particulate Matter (PM_{10})

Similar to the discussion for CO, the regulatory requirement for a PM_{10} hot-spot analysis is determined by the attainment status of the project area. The WDC would be located in a part of Davis and Weber Counties that is designated as an attainment area for PM_{10}. In 2013, EPA determined that the Ogden PM_{10} non-attainment area was currently attaining the standard for

PM_{10}, and the Utah Air Quality Board has adopted a maintenance plan for Ogden demonstrating attainment through 2030. That plan has been submitted to EPA and is awaiting EPA's approval (UDEQ 2017a).

Because the WDC would not be located in Ogden, which might be redesignated to a maintenance area following EPA's review, the WDC Project does not require a PM_{10} hot-spot analysis. However, for the reasons discussed for CO, the WDC team conducted a PM_{10} hot-spot analysis at the Alternative B1 Antelope Drive interchange.

11A.2.1.3 Particulate Matter ($PM_{2.5}$)

Because both Davis and Weber Counties are $PM_{2.5}$ non-attainment areas and the WDC study area and project alternatives are located in a $PM_{2.5}$ non-attainment area (UDEQ 2013), EPA guidance requires a hot-spot analysis for $PM_{2.5}$ if a project is considered to be a project of air quality concern (EPA 2015c). The following two subsections summarize the process UDOT and FHWA used to determine whether the WDC Project is a project of air quality concern. The first subsection, 40 CFR 93.123(b) Criteria, describes the criteria defined in 40 CFR 93.123(b) and then states whether the WDC Project is one of these types of projects. The second subsection, EPA Guidance Criteria, describes the criteria in EPA guidance and then states whether the WDC Project is one of these types of projects.

40 CFR 93.123(b) Criteria

The four subsections below list the types of projects identified in 40 CFR 93.123(b)(i–iv) as projects that require a PM_{10} and $PM_{2.5}$ hot-spot analyses and then states whether the WDC Project is one of these types of projects.

New highway projects that have a significant number of diesel vehicles, and expanded highway projects that have a significant increase in the number of diesel vehicles [40 CFR 93.123(b)(1)(i)]

The WDC would be a new highway intended to reduce traffic congestion in western Davis County and facilitate local traffic movement in that part of the county. The WDC would not connect to I-15 at the north end of the WDC study area and therefore would not be used as an I-15 bypass route for general-purpose traffic or heavy trucks, most of which would be diesel vehicles.

Heavy truck traffic would likely be greater in the southern end of the WDC study area, which is more commercial and industrial and is closer to I-15 than are the residential areas to the north. Heavy truck traffic would be about 3% of total traffic on the WDC, and this percentage is not considered by EPA to be a significant number of diesel vehicles since the EPA guidance suggests that a project of air quality concern would be a project with over 125,000 annual average daily traffic and 8% or more of this traffic is diesel truck traffic.

By this criterion, the WDC Project would not be considered a project of air quality concern under 40 CFR 93.123(b)(1)(i).

Projects affecting intersections that are at level of service (LOS) D, E, or F with a significant number of diesel vehicles, or those that will change to LOS D, E, or F because of an increase in traffic volumes from a significant number of diesel vehicles related to the project [40 CFR 93.123(b)(1)(ii)]

The WDC would not operate with a significant number of diesel vehicles. In addition, the WDC has been designed such that all interchanges throughout the WDC corridor would operate at LOS D or better, including the Alternative B1 Antelope Drive interchange, which is expected to operate at LOS A or B in 2040 (Cluff 2017).

By this criterion, the WDC Project would not be considered a project of air quality concern under 40 CFR 93.123(b)(1)(ii).

What is level of service?

Level of service is a measure of the operating conditions on a road or at an intersection. Level of service is represented by a letter "grade" ranging from A (free-flowing traffic and little delay) to F (extremely congested, stop-and-go traffic and excessive delay).

New bus and rail terminals and transfer points that have a significant number of diesel vehicles congregating at a single location [40 CFR 93.123(b)(1)(iii)]

The WDC is a proposed transportation facility designed to serve local traffic in Davis County. It would not be a bus or rail terminal with a significant number of diesel vehicles congregating at a single location.

By this criterion, the WDC Project would not be considered a project of air quality concern per 40 CFR 93.123(b)(1)(iii).

Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location [40 CFR 93.123(b)(1)(iv)]

The WDC would not be a bus or rail terminal with a significant number of diesel vehicles congregating at a single location.

By this criterion, the WDC Project would not be considered a project of air quality concern per 40 CFR 93.123(b)(1)(iv).

EPA Guidance Criteria

EPA has also published guidance describing the types of projects that would likely be considered projects of air quality concern and would require $PM_{2.5}$ and PM_{10} hot-spot analyses (EPA 2015c). The following criterion is most relevant to the WDC Project.

A project on a new highway or expressway that serves a significant volume of diesel truck traffic, such as facilities with greater than 125,000 annual average daily traffic and 8% or more of such traffic is diesel truck traffic

The WDC would be a new highway, but it is not intended to serve a significant volume of diesel truck traffic. The highest daily traffic volumes associated with the WDC in 2040 are expected to be less than 30,000 vehicles per day, which is about 24% of the total daily traffic volume at which a $PM_{2.5}$ or PM_{10} hot-spot analysis could be warranted.

Also, as stated above, diesel-fueled heavy trucks are expected to be about 3% of the WDC's total traffic volume.

By this criterion, the WDC Project would not likely be considered a project of air quality concern.

In addition to those projects that could warrant hot-spot analyses, Appendix B.3 of the EPA guidance provides examples of projects that do *not* require hot-spot analyses. The following example is most relevant to the WDC Project.

Any new or expanded highway project that primarily services gasoline vehicle traffic (that is, does not involve a significant number or increase in the number of diesel vehicles), including such projects involving congested intersections operating at LOS D, E, or F

The WDC is designed to reduce congestion on local roads and accommodate traffic in western Davis County. Because the WDC is designed to serve mostly local traffic, it would be used mostly by gasoline-fueled vehicles. The daily volume of traffic (less than or equal to 30,000 vehicles per day) on the WDC would be small compared to the volume of traffic that could warrant a hot-spot evaluation for $PM_{2.5}$ or PM_{10} (that is, 125,000 vehicles per day).

In addition, the volume of diesel truck traffic expected on the WDC is a small proportion of the overall traffic (about 3%). Finally, all interchanges on the WDC have been designed to operate at LOS D or better.

Using this example, the WDC Project would not likely be considered a project of air quality concern.

11A.2.1.4 Conclusion

Based on the evaluation criteria discussed above using EPA guidance, the WDC Project does not rise to the level of being a project of local air quality concern for which quantitative hot-spot analyses are required. For CO or PM_{10}, the WDC is not a project of local air quality concern because the project is not within the nonattainment areas for those criteria pollutants. For $PM_{2.5}$, the WDC is not a project of air quality concern because the WDC is a low-volume facility, designed to operate at an acceptable level of service (LOS D or better in 2040), with a small proportion of diesel truck traffic.

Notwithstanding UDOT and FHWA's determination that the WDC Project is not a project of local air quality concern, the WDC team conducted hot-spot analyses for CO, PM_{10}, and $PM_{2.5}$ to address public comments concerning the air quality impacts of the WDC and to provide additional information to decision-makers. The analyses discussed below used the relevant EPA guidance for each criteria pollutant.

What are criteria pollutants?

Criteria pollutants are the six pollutants for which EPA has established air quality standards (criteria).

11A.3 Particulate Matter (PM_{10}) 24-hour Project-Level (Hot-Spot) Analysis

Section 11A.3.1 below describes the methodology used to conduct the detailed PM_{10} hot-spot modeling. As previously discussed in Section 11A.1, Introduction, the WDC Project complies with all applicable conformity requirements of 40 CFR 93. The analyses and methodologies discussed in the following subsections were not conducted to satisfy conformity requirements, but did use the EPA's conformity guidance for technical decisions that are used in the modeling efforts.

The sections discussing the detailed hot-spot modeling for $PM_{2.5}$ and CO refer back to this section since the methodology was the same for the input files that were not specific to PM_{10}.

11A.3.1 Methodology

11A.3.1.1 Modeling Location and Input Files

Based on EPA guidance and public comments during the NEPA scoping phase of the WDC Project, the WDC team selected the Alternative B1 Antelope Drive interchange for detailed PM_{10} hot-spot modeling based on its proximity to residential developments and schools, as well as its traffic volumes.

Hot-spot modeling at the Alternative B1 Antelope Drive interchange included the WDC northbound and southbound mainline, interchange ramps, and Antelope Drive.

The analysis included quantitative modeling to estimate project-specific emission rates from vehicle exhaust, brake wear, tire wear, and re-entrained road dust caused by the WDC. Model inputs for developing emission rates and dispersion modeling parameters were consistent with EPA's quantitative PM hot-spot analysis guidance (EPA 2015b) and consistent with inputs that WFRC uses for regional emissions conformity.

PM_{10} emission rates (from vehicles and re-entrained road dust) were used in the CAL3QHCR dispersion model to generate PM_{10} concentrations at specific receptor locations at the Alternative B1 Antelope Drive interchange. The PM_{10} concentrations (including a background concentration) were used to determine whether the vehicle emissions resulting from the WDC would cause the applicable NAAQS for PM_{10} to be exceeded.

The 24-hour air quality standard for PM_{10} is 150 $\mu g/m^3$ (micrograms per cubic meter).

11A.3.1.2 Analysis Approach and Years

A no-action analysis was not completed for this project. If the project were not built, there would be no PM_{10} impacts related to the project. For PM_{10}, concentrations are estimated by calculating a "design value" using 2040 emissions projections for vehicles and road dust that is then compared to the PM_{10} NAAQS.

What is a design year?

The design year is the year for which a project is engineered. Design years for infrastructure projects are typically 20 to 30 years from the year of construction in order to provide long-term benefits. The design year for the WDC is 2040.

As discussed in EPA's transportation conformity guidance (EPA 2015b, Section 3.3.2), for large projects it is appropriate to focus hot-spot analyses on locations that represent the locations that are likely to have the highest concentrations of PM_{10} and that are the most likely to create new or worsened violations of the PM_{10} NAAQS. The WDC team selected the 2040 design year for the hot-spot analyses because the WDC would be completed by then and the maximum number of vehicles would be using the WDC on a daily basis. Although vehicle emission rates are expected to be lower in 2040 (thereby improving regional air quality), VMT on the WDC would be at its highest; therefore, the projected highest project-level PM_{10} emissions would be in 2040.

11A.3.1.3 Project-Specific Data

Transportation conformity requires that the latest planning assumptions be used in the conformity and hot-spot analyses. In addition, the regulations require that the assumptions used in the hot-spot analyses be consistent with the assumptions used in the regional emissions analysis for any inputs that are required for both analyses (EPA 2015b).

WFRC provided MOVES2014a input files for the 2016 and 2040 regional conformity analyses for use in detailed project-level modeling. The regional conformity input files that were appropriate for PM_{10} hot-spot modeling (for example, inspection-maintenance coverage, fuel formulations, and vehicle-age distributions) were used in the hot-spot analyses. Project-specific data requirements such as hourly volumes, age distributions, vehicle types, and turning movements were provided by WDC Project traffic analysis or were derived from the travel demand model provided to the WDC team by WFRC.

Hourly vehicle volumes were developed for the morning (AM) peak, midday peak, evening (PM) peak, and overnight peak to represent the four time periods as required for hot-spot modeling.

A 5-year (2011 to 2015) hourly meteorological data set from the Ogden-Hinckley Municipal Airport (the most recent, closest representative source to the WDC study area) was used for the dispersion modeling with CAL3QHCR and encompasses the wide variety of weather conditions that are likely to be experienced in the WDC study area.

On-road vehicle emissions were estimated using the MOVES2014a emission model. At the project level, MOVES2014a requires link-specific data. A link file includes the vehicle volume, average speed, facility type, and grade. At the Alternative B1 Antelope Drive interchange, a detailed road-link network was developed. Network links (that is, roadway coordinates) were developed from MicroStation design files that were incorporated into ArcView GIS.

Link speeds were assigned for accelerating and decelerating links (for example, on ramps and arterials), idle speeds at intersections, and cruise speeds on the mainline. Link vehicle volumes and turning movements were derived from the travel demand model. Vehicle speeds on interchange ramps and local arterials were based on best professional judgment consistent with EPA guidance and the availability of detailed project-level design information describing vehicle activity (EPA 2015b, Section 4.5.8, page 45).

Hourly PM_{10} emission rates for each of the 118 links in the CAL3QHCR model were calculated using MOVES2014a for each meteorological season (winter [January through March], spring [April through June], summer [July through September], and fall [October through December]) and, within each season, for four daily peak time periods (AM, midday, PM, and overnight). The 16 combinations of season and time-of-day analyses were performed at the Alternative B1 Antelope Drive interchange for the 2040 analysis year when traffic volumes would be greatest and would generate the highest emissions. A MOVES2014a post-processing script was used to generate link-specific (and speed-specific) PM_{10} emission rates.

11A.3.1.4 Emission Rates

PM_{10} emission processes in each MOVES2014a run included running exhaust, crankcase running exhaust, brake wear, and tire wear.

Re-entrained road dust factors were taken from WFRC's most recent air quality regional conformity evaluation and were added to vehicle emission rates prior to modeling with CAL3QHCR (WFRC 2016, page 15).

The WDC would not affect traffic behavior related to other emission processes such as starting or extended idling emissions; therefore, those processes were not included in the MOVES2014a runs. The road dust emissions were then added to MOVES2014a emission rates and summed to produce a total PM_{10} emission rate for each link (EPA 2015b).

Construction emissions are discussed in Chapter 20, Construction Impacts, of the Final EIS and are not included in this analysis because construction would not last more than 5 years at any individual location [40 CFR 93.123(c)(5)]. In addition, detailed construction plans and schedules are not readily available at this time, and any construction analysis would be speculative.

11A.3.1.5 CAL3QHCR Air Quality Dispersion Modeling

In addition to detailing requirements for MOVES2014a modeling, EPA's transportation conformity guidance also describes the procedures for conducting dispersion analyses with CAL3QHCR. The WDC team conducted a refined modeling analysis using EPA's CAL3QHCR dispersion model with MOVES2014a emission rates and AP-42 emission rates for re-entrained road dust to produce estimates of PM_{10} concentrations at discrete residential receptor locations near the Alternative B1 Antelope Drive interchange. Inputs to the CAL3QHCR model consisted of detailed information about the alternative alignments and additional information such as link length, roadway segment width, vehicle volume per hour, emission factors, receptor locations, and hourly meteorological data. Figure 11A-1, Antelope Drive Air Quality Model Receptors and Links, in Volume IV shows the receptors and interchange links modeled in the hot-spot analyses.

11A.3.1.6 Receptor Locations

As stated in EPA's guidance, for the purpose of a project-level conformity analysis, receptors are locations in the project area where an air quality model estimates future PM_{10} concentrations (EPA 2015b).

Receptors are locations where the maximum total concentration of a pollutant is likely to occur. For the WDC, most individual exposure to vehicle emissions would be at residential locations closest to the highway, namely the mainline and interchange ramps or ramp intersections where people would be likely to spend substantial amounts of time. Fifty-seven receptors were included in the CAL3QHCR model. Figure 11A-1, Antelope Drive Air Quality Model Receptors and Links, in Volume IV shows the receptors and interchange links modeled in the hot-spot analyses.

11A.3.2 Background Concentrations

Background PM_{10} concentrations used in developing the design value for the PM_{10} annual standard were derived from daily PM_{10} data reports from the Ogden air quality monitor (49-57-002) for the 3-year period 2013 to 2015 (UDEQ 2016a). A total of 953 daily measurements were included in this 3-year data set.

11A.3.3 Analysis Results and Design Value for the PM_{10} 24-Hour Standard

The CAL3QHCR dispersion model was used to estimate PM_{10} concentrations. A 5-year (2011 to 2015) preprocessed meteorological data set from the Ogden-Hinckley Municipal Airport was used as an input file in the dispersion model. The data set encompassed the wide variety of weather conditions that are likely to be experienced in the WDC study area.

Following EPA guidelines for project-level PM_{10} quantitative analyses, the WDC team developed vehicle emission rates for the 2040 analysis year for the following months (and hours of the day):

- January (AM, midday, PM, and overnight)
- April (AM, midday, PM, and overnight)
- July (AM, midday, PM, and overnight)
- October (AM, midday, PM, and overnight)

Re-entrained road dust emissions were added to the vehicle emission rates to generate a total emission rate for each season and for each time period.

As described in EPA's guidance, the 24-hour PM_{10} design value is calculated by adding the modeled receptor value to the background monitor value (EPA 2015b, Exhibit 9-6). The resulting PM_{10} design value concentration (that is, the modeled receptor value plus background monitor value) was then rounded to the nearest 10 $\mu g/m^3$ (EPA 2015b).

The modeled receptor value is the 6th-highest modeled 24-hour PM_{10} concentration for any of the 57 receptors that comes out of the CAL3QHCR modeling using the 5-year meteorological data set. The 6th-highest modeled receptor concentration across all receptors from CAL3QHCR modeling over the 5-year data set is 2.4 μg/m^3.

The background monitor value was identified using data from the Ogden air quality monitor. Based on 953 background concentrations from the Ogden monitor from 2013 to 2015, the monitor value is the 3rd-highest value over that 3-year period (92 μg/m^3) as specified in EPA's 2015 PM hot-spot modeling guidance (EPA 2015b).

Table 11A-1 shows the results of the analysis for the 24-hour PM_{10} standard.

Table 11A-1. Alternative B1 Antelope Drive Interchange Design Values in 2040 for the 24-Hour PM_{10} Standard

in μg/m^3

Location	Modeled Value 6th-Highest CAL3QHCR PM_{10} Value[a,b]	Background Monitor Value for PM_{10}	Total Design Value (unrounded)[c]	Total Design Value (rounded to the nearest 10 μg/m^3)
Alternative B1 Antelope Drive interchange	2.4	92	94.4	90

[a] Sixth-highest PM_{10} concentration over 5 years of meteorological data.

[b] Design value computations are included with model files in Attachment 1, Model Input and Output Files.

[c] The PM10 24-Hour NAAQS is 150 μg/m^3.

Table 11A-1 above shows the PM_{10} design value (that is, the 6th-highest modeled receptor concentration over the 5-year modeling period added to the background monitor value) at the analysis location for the purpose of determining transportation conformity. As shown in Table 11A-1, the PM_{10} design value of 90 μg/m^3 at the Alternative B1 Antelope Drive interchange would be less than the 24-hour NAAQS (150 μg/m^3).

The WDC study area is in a PM_{10} attainment area.

The PM_{10} hot-spot analysis described above demonstrates that the WDC Project would not contribute to any new local violations, increase the frequency or severity of any existing violation, or delay timely attainment of the PM_{10} NAAQS.

Therefore, based on the PM_{10} analyses conducted for the Alternative B1 Antelope Drive interchange, it has been demonstrated that the WDC Project is consistent with SIP control measures and would not cause an exceedance of the PM_{10} NAAQS.

11A.4 Analysis Results and Design Values for the $PM_{2.5}$ Annual and 24-Hour Standards

Similar to the process described in Section 11A.3, Particulate Matter (PM_{10}) 24-hour Project-Level (Hot-Spot) Analysis, for evaluating the 24-hour PM_{10} standard, the CAL3QHCR dispersion model was used to estimate $PM_{2.5}$ concentrations for the annual and 24-hour standard. The same 5-year (2011 to 2015) meteorological data set from the Ogden-Hinckley Municipal Airport was used as an input file in the dispersion model. In addition, vehicle emission rates were developed for the same months and hours as for PM_{10}.

Re-entrained road dust emissions for $PM_{2.5}$ on freeways, ramps, and arterials were added to the vehicle emission rates to generate a total emission rate for each season and for each time period.

11A.4.1 Analysis Results and Design Value for the $PM_{2.5}$ Annual Standard

Calculation of the design value for the $PM_{2.5}$ annual standard followed EPA guidelines (EPA 2015b). As described in EPA's guidance, the $PM_{2.5}$ annual design value is calculated by adding the modeled receptor value to the background monitor value. The resulting $PM_{2.5}$ annual design value concentration (that is, the modeled value plus background monitor value) was then rounded to the nearest 0.1 $\mu g/m^3$.

For each of the 57 receptors included in the CAL3QHCR model (see Figure 11A-1, Antelope Drive Air Quality Model Receptors and Links, in Volume IV), the average annual concentration for each quarter (January, April, July, and October) and year (2011 to 2015) was determined from CAL3QHCR modeling results (EPA 2015b, pages 133–134). From that data set, the receptor with the highest modeled annual average $PM_{2.5}$ concentration (0.736 $\mu g/m^3$) was identified as the $PM_{2.5}$ annual modeled receptor value (EPA 2015b, page 134).

The background monitor value for annual $PM_{2.5}$ was calculated using the weighted 3-year average annual $PM_{2.5}$ concentration (2013 to 2015) at the Ogden monitor, which is 8.64 $\mu g/m^3$ (UDEQ 2017b).

The total $PM_{2.5}$ annual design value concentration was calculated by adding the modeled receptor value $PM_{2.5}$ annual concentration at the highest receptor (0.736 $\mu g/m^3$) to the background monitor value $PM_{2.5}$ average annual concentration (8.64 $\mu g/m^3$), resulting in a total design value $PM_{2.5}$ annual concentration of 9.376 $\mu g/m^3$, which was then rounded to the nearest 0.1 $\mu g/m^3$ (9.4 $\mu g/m^3$).

Table 11A-2 below shows the results of the analysis for the annual $PM_{2.5}$ standard. The annual $PM_{2.5}$ concentration is less than the annual $PM_{2.5}$ NAAQS of 12 $\mu g/m^3$.

Table 11A-2. Alternative B1 Antelope Drive Interchange Design Values in 2040 for the Annual $PM_{2.5}$ Standard

in µg/m^3

Location	Highest Modeled Annual Average $PM_{2.5}$ Value[a,b]	Average Annual Background $PM_{2.5}$	Total Design Value Concentration $PM_{2.5}$ annual (unrounded)[c]	Total Design Value Concentration $PM_{2.5}$ Annual (rounded to the nearest 0.1)[c]
Alternative B1 Antelope Drive interchange	0.736	8.64	9.376	9.4

[a] Receptor with the highest modeled average annual concentration over 5 years of meteorological data.

[b] Design value computations are included with model files in Attachment 1, Model Input and Output Files.

[c] The PM2.5 Annual NAAQS is 12 µg/m^3.

The WDC study area is in a $PM_{2.5}$ non-attainment area.

The $PM_{2.5}$ hot-spot analysis for the $PM_{2.5}$ annual standard described above demonstrates that the WDC Project would not contribute to any new local violations, increase the frequency or severity of any existing violation, or delay timely attainment of the NAAQS for the $PM_{2.5}$ annual standard.

Therefore, based on the $PM_{2.5}$ analysis for the $PM_{2.5}$ annual standard conducted for the Alternative B1 Antelope Drive interchange, it has been demonstrated that the WDC Project would not cause an exceedance of the $PM_{2.5}$ annual NAAQS.

11A.4.2 Analysis Results and Design Value for the $PM_{2.5}$ 24-Hour Standard

Calculation of the design value for the $PM_{2.5}$ 24-hour standard followed EPA's guidelines for 1st-tier evaluations when conducting the analysis with CAL3QHCR (EPA 2015b).

As described in EPA's guidance (EPA 2015b), the $PM_{2.5}$ 24-hour design value is calculated by adding the modeled receptor value to the background monitor value. The resulting $PM_{2.5}$ 24-hour design value concentration (that is, the modeled receptor value plus the background monitor value) is then rounded to the nearest 1 µg/m^3.

As discussed in EPA's guidance, the CAL3QHCR model output was first separated by quarter into each year of meteorological data (2011 to 2015). Then, for each of the 57 receptors included in the model (see Figure 11A-1, Antelope Drive Air Quality Model Receptors and Links, in Volume IV), the highest 24-hour quarterly concentrations from each year were averaged over the 5-year period, and the receptor with the highest average $PM_{2.5}$ concentration was identified. Modeled receptor values for $PM_{2.5}$ 24-hour concentrations at the 57 receptors ranged from 0.113 µg/m^3 to 0.939 µg/m^3. The $PM_{2.5}$ 24-hour modeled receptor value for this analysis is the highest modeled concentration at any of the receptors. This receptor is a receptor adjacent to the northbound on ramp to the WDC from Antelope Drive. The higher concentration at this location was due to accelerating traffic on the ramp before it merges with the WDC.

The $PM_{2.5}$ 24-hour background monitor value is the 98th-percentile $PM_{2.5}$ 24-hour concentration from 3 years of 24-hour monitoring data from the Ogden air quality monitor (UDEQ 2016b). The $PM_{2.5}$ 24-hour background monitor value was determined to be 33.69 μg/m^3 using the 2013, 2014 and 2015 data from the Ogden air quality monitor. For context, the 2013 98th-percentile $PM_{2.5}$ 24-hour value was 47.7 μg/m^3, the 2014 98th-percentile $PM_{2.5}$ 24-hour value was 25.7 μg/m^3, and the 2015 98th-percentile $PM_{2.5}$ 24-hour value was 27.7 μg/m^3. The rolling 3-year 2013 to 2015 average was 33.69 μg/m^3.

The $PM_{2.5}$ 24-hour design value was calculated by adding the model value of 0.939 μg/m^3 to the background monitor value of 33.69 μg/m^3. The design value $PM_{2.5}$ 24-hour concentration was calculated to be 34.63 μg/m^3, which was then rounded to the nearest whole μg/m^3 (35 μg/m^3).

Table 11A-3 shows the results of the analysis for the $PM_{2.5}$ 24-hour standard.

Table 11A-3. Alternative B1 Antelope Drive Interchange Design Values in 2040 for the 24-hour $PM_{2.5}$ Standard

in μg/m^3

Location	Highest Modeled 24-hour Average $PM_{2.5}$ Value[a,b]	98th-Percentile 24-hour Background $PM_{2.5}$ (2013 to 2015)	Design Value $PM_{2.5}$ 24-hour Concentration (unrounded)[c]	Design Value $PM_{2.5}$ 24-hour Concentration (rounded to the nearest whole μg/m^3)[c]
Alternative B1 Antelope Drive interchange	0.939	33.69	34.63	35

[a] Receptor with the highest modeled average 24-hour concentration over 5 years of meteorological data.

[b] Design value computations are included with model files in Attachment 1, Model Input and Output Files.

[c] The 24-hour PM2.5 NAAQS is 35 μg/m^3.

The WDC study area is in a $PM_{2.5}$ non-attainment area for the 24-hour $PM_{2.5}$ NAAQS.

The $PM_{2.5}$ hot-spot analysis for the 24-hour $PM_{2.5}$ standard described above demonstrates that the 24-hour $PM_{2.5}$ concentrations from the WDC Project would be less than or equal to the 35 μg/m^3 standard and would not contribute to any new local violations of the 24-hour $PM_{2.5}$ standard. Of the 57 receptors included in the model, only one receptor (when rounded) was at the 35 μg/m^3 standard. The other 56 receptors rounded to 34 μg/m^3.

Therefore, based on the $PM_{2.5}$ analysis for the 24-hour $PM_{2.5}$ standard conducted for the Alternative B1 Antelope Drive interchange, it has been demonstrated that the WDC Project would not cause an exceedance of the $PM_{2.5}$ NAAQS.

As previously stated in this section, the modeled value for project-related concentrations ranged between 0.113 μg/m^3 and 0.939 μg/m^3. The total design values of 34 μg/m^3 or 35 μg/m^3 for the receptors modeled in this analysis are primarily a function of the background value of 33.69 μg/m^3, which is 97% to 99% of the design value for any of the receptors in this analysis. This analysis emphasizes that the project-level modeled contributions are a very small percentage of the design value, even with the conservative modeling assumptions, and that the primary driver of the design values that are just below or equal to the $PM_{2.5}$ 24-hour NAAQS of 35 µg/m^3 is the background value of 33.69 µg/m^3.

The WDC team recognizes that Davis and Weber Counties are $PM_{2.5}$ non-attainment areas, and the State of Utah will be preparing and submitting SIP revisions that comply with the statutory and regulatory requirements for serious $PM_{2.5}$ non-attainment areas. These SIP revisions will describe how the State will get the area to comply with the $PM_{2.5}$ 24-hour average NAAQS.

11A.5 Analysis Results for Carbon Monoxide 1-Hour and 8-Hour Standards

The WDC team conducted a project-level CO analysis at the Alternative B1 Antelope Drive interchange using the MOVES2014a model and EPA's guidelines for CO analyses (EPA 1992, 2015a). Inputs for the CO modeling included receptors, link-specific data, and meteorological data as described above for the PM_{10} and $PM_{2.5}$ analyses.

CO emission rates were generated with MOVES2014a for 2040 as described above in Section 11A.3.1, Methodology, for PM_{10}. The CAL3QHCR dispersion model was used to estimate CO concentrations because it could make use of many inputs (traffic volumes, speeds, turning movements, and receptor locations) that were the same as those used for the PM_{10} and $PM_{2.5}$ analyses described in previous sections of this document. The same 5-year meteorological data set used for the PM_{10} and $PM_{2.5}$ modeling was also used for the CO analyses.

Davis County is an attainment area for CO, so there are no CO monitors in Davis County. The nearest CO monitors are in the Ogden CO maintenance area.

Worst-case CO background concentrations near the Alternative B1 Antelope Drive interchange were calculated by averaging the highest measured 1-hour and 8-hour concentrations from the Ogden CO monitor from 2011 through 2015. As a result, the background CO concentrations used for this CO evaluation are higher than what are expected in Davis County.

The WDC would be a low-traffic road compared to other transportation facilities in Davis County (for example, I-15). In addition, the intersection ramps on both the west and east sides of the Alternative B1 Antelope Drive interchange would operate at LOS A or B in 2040. That is, there would not be heavy congestion at the intersections resulting in high numbers of idling vehicles at signalized intersections. Idling vehicles are the largest source of elevated CO concentrations.

Table 11A-4 below shows the highest modeled CO concentrations associated with the WDC. The modeled CO concentrations at all receptor locations in the vicinity of this interchange are well below the 1-hour and 8-hour CO NAAQS.

Table 11A-4. Highest Modeled Concentrations (Including Background) of CO at the Alternative B1 Antelope Drive Interchange

in parts per million (ppm)

Ramps or Lanes at Alternative B1 Antelope Drive Interchange	1-hour Concentration			8-hour Concentration		
	Existing Conditions (2015)[a]	With Alternative B1 (2040)[b]	NAAQS	Existing Conditions (2015)[a]	With Alternative B1 (2040)[c]	NAAQS
Northbound and southbound ramps	4.1	4.15[d]	35	2.0	2.02[d]	9
Mainline	4.1	4.15[d]	35	2.0	2.02[d]	9

[a] Under the existing conditions, the WDC has not been built. There are currently no vehicle emissions associated with the WDC at these locations other than emissions from local traffic on local streets. The 1-hour and 8-hour concentrations are average background concentrations from the air quality monitor in Ogden (the maximum 1-hour and 8-hour concentrations averaged from 2011 to 2015).

[b] Includes 1-hour background concentration of 4.1 ppm.

[c] Includes 8-hour background concentration of 2.0 ppm.

[d] Highest modeled CO concentration shown for all scenarios.

The WDC study area is in an attainment area for CO.

The CO hot-spot analyses described above demonstrate that the WDC Project would not contribute to any new local violations, increase the frequency or severity of any existing violation, or delay timely attainment of the 1-hour and 8-hour CO NAAQS.

11A.6 Emissions Inventory for Criteria Pollutants, Mobile-Source Air Toxics, and Greenhouse Gases

In addition to the project-level hot-spot analyses described above, the WDC team developed emission inventories that estimated the amount of pollutants (that is, mass quantities in tons per year or tons per day as appropriate) in the WDC study area.

These emissions inventory evaluations included all major roads (including I-15) in the WDC study area. The WDC team obtained MOVES2014a input parameters such as VMT fractions (monthly, daily, and hourly), vehicle source types, road types, vehicle age distribution, inspection-maintenance parameters, and local fuel parameters from regional data provided by WFRC.

The traffic data used in the analyses were derived from version 8.0 of WFRC’s travel demand model, which was also used in the traffic analyses that supported the alternatives-development process for the Final EIS. The traffic data used in the MOVES2014a model included link distances and geometry, lane capacity, average daily traffic volumes for various times of the day, and travel speeds for the various roads in the WDC study area.

The results of those analyses are included in Section 11.4.2, Effects on Air Quality in the WDC Study Area, of the Final EIS and are not repeated here.

11A.7 References

Cluff, Jayson

2017 Email from Jayson Cluff, Horrocks Engineers, to Curt Overcast, HDR, regarding WDC Synchro files. March 2.

[FHWA] Federal Highway Administration

1987 Guidance for Preparing and Processing Environmental and Section 4(f) Documents.

[EPA] U.S. Environmental Protection Agency

1992 Guideline for Modeling Carbon Monoxide from Roadway Intersections. EPA-45R/R-92-005. November.

2013 Preferred/Recommended Models. http://www.epa.gov/scram001/dispersion_prefrec.htm. Accessed February 28, 2017.

2015a Using MOVES2014 in Project-Level Carbon Monoxide Analyses. EPA-420-B-15-028. March.

2015b Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas. EPA-420-B-15-040. November.

2015c Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Non-attainment and Maintenance Areas (Appendices). EPA-420-B-15-084. November.

[UDEQ] Utah Department of Environmental Quality

2013 Utah Non-attainment Areas. https://deq.utah.gov/ProgramsServices/programs/air/emissionsinventories/docs/2013/03Mar/NONATTAINMENT_MAP.pdf. Accessed March 1, 2017.

2016a PM_{10} air quality monitoring data. http://www.airmonitoring.utah.gov/dataarchive/archpm10.htm. Accessed January 3, 2017.

2016b $PM_{2.5}$ air quality monitoring data. http://www.airmonitoring.utah.gov/dataarchive/archpm25.htm. Accessed March 6, 2017.

2017a PM_{10} State Implementation Plan. https://deq.utah.gov/Pollutants/P/pm/PM10/index.htm. Accessed March 2, 2017.

2017b $PM_{2.5}$ Annual Averages for 2012–2015. http://www.airmonitoring.utah.gov/dataarchive/Y24hrt12-15Avepm25.pdf. Accessed March 6, 2017.

[WFRC] Wasatch Front Regional Council

2016 Draft Conformity Analysis for the Amended WFRC 2015–2040 Regional Transportation Plan. November 21.

WEST DAVIS CORRIDOR

Attachment 1. Model Input and Output Files

[*MOVES2014a and CAL3QHCR files provided on separate disc upon request*]

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