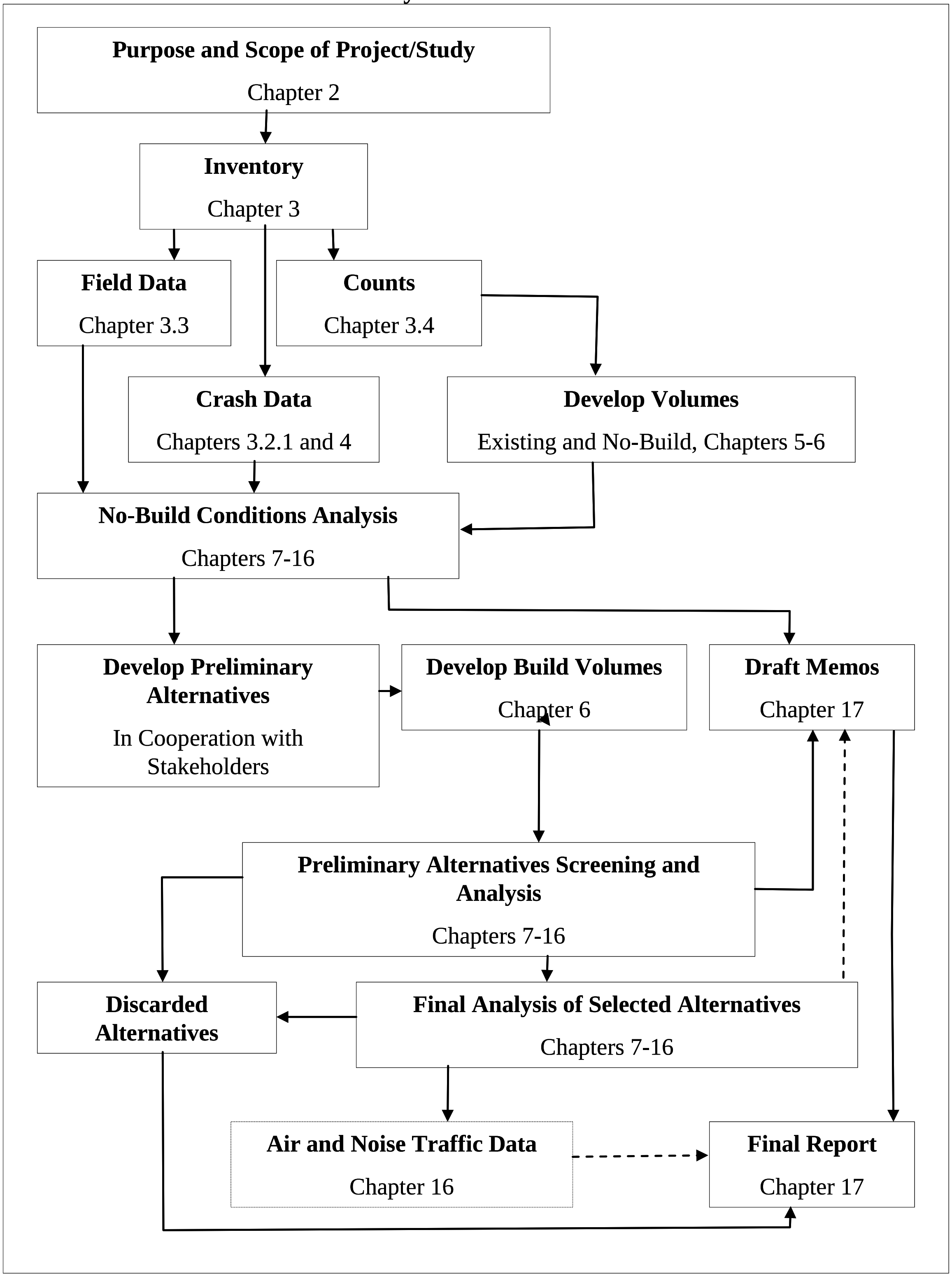
2 SCOPING PROJECTS

2.1 Purpose

The purpose of this chapter is to provide guidance to identify the various steps for scoping the analysis of a transportation study or project. The general flow of traffic analysis steps and the corresponding APM chapters are shown in Exhibit 2-1 below.

The first step is to have a thorough understanding of the work that is identified in a problem statement. The next step is to identify the appropriate level of detail and tools. The last step is to then create a scope of work for the study or project.

Exhibit 2-1: Process of Traffic Analysis



2.2 Problem Statement

2.2.1 Project Understanding

One of the most important steps in conducting analysis work is to clearly define the scope and purpose for the work. Every plan and project is unique with its own set of assumptions and applicable methodologies. There needs to be a clear understanding of what needs to be done by when and at what cost. The understanding should be conveyed through a problem statement that clearly defines the purpose and need for the work. The problem statement is the basis for either creating an analysis work plan for in-house work or for creating a scope of work for contracted work. A detailed scope of work or work plan helps to limit scope creep and lays out expectations for all parties. A problem statement template is available in Appendix 2A.

Information on geometrics, safety, volumes, past studies, prior projects, other analysis performed along with standards, guidelines, and procedures is available and should be used to gain general knowledge of the study area. There may be a project prospectus or initial planning/environmental documents available as well. The analyst should consult or coordinate with the project team to complete the problem statement. There are many useful tools and resources available on the ODOT website. Major sources are explained in Chapter 3.

2.2.2 Project Constraints

Various constraints need to be considered when the work is scoped. If any of these change during the project duration, the problem statement and scope of work should be reassessed and consequences determined. Most constraints fall into two categories. The first is project specific, given the details of what is needed. The second is the project delivery constraints related to delivery /completion date and budget for the work.

The analysis work is controlled by various project factors, issues and concerns. The following questions can focus the problem statement:

- What is the Purpose and Need for the work?
- What questions need to be answered?
- What key issues should be considered?
- What are the Goals and Objectives of the work?
- Who is the audience?
- At what level will the work need to be analyzed and evaluated?
- What types of alternatives need to be evaluated?
- What evaluation measures will be used?
- What is the overall and traffic analysis study area, if different?
- What types of useable information and tools are available and practical?

The purpose and need, goals and objectives and questions and issues typically are determined by a project team, however direction can come from statutes (ORS), rules (OAR), legislation, the Oregon Transportation Commission (OTC), ODOT management, or local jurisdiction. The level of work, types of alternatives and the evaluation measures comes from a process or project/study management team. The study area, tools and information available influence the work. For example, a study in the Portland Metro area can rely on data from "PORTAL" which has very detailed volume information on the freeways. The rest of the state must rely on physical counts or nearby data recorders to obtain volume information. This difference can be a constraint on the project. Similar to data, the choice of performance /evaluation measures can also be a constraint. Chapter 10 provides more guidance on performance measures and their data needs.

2.2.3 Schedule, Resource, and Budget Constraints

The work is driven by a need to deliver an answer in an identified time frame with an identified resource. Questions to identify these factors include:

- What is the timeframe for the analysis work?
- What are the impacts from changes to Purpose and Need?
- What are the risks from outside sources such as other jurisdictions, stakeholders, and private citizens? For example, local concerns/issues/ politics can easily add time to a projected schedule.
- Are there outside factors or time constraints that may dictate delivery of work items? For example, crash information is needed but cannot be obtained in the specified time frame.
- What resources are available? Are they internal or external?
- Are tasks dependent on resources not within analyst's control?
- Does the project funding require certain analysis tools and procedures?
- Is the budget adequate to perform the desired analysis and data collection?
- What is the availability and quality of existing data?
- Can the work be divided? Are tasks independent of each other? Are tasks sequential or concurrent?

2.2.4 Additional Details

After the problem, schedule and budget constraints are completed, additional thought needs to be given to what likely performance measures and tools will be used in the project. A project objective will have specific evaluation criteria/measures that will require a particular performance measure which then will require a certain tool to be used. Level of detail (see Section 2.3), and constraints will determine which tools (see Section 2.4) are practical for the effort. This can be somewhat iterative, so the problem statement may need to be modified as the scope of work or internal work plan is constructed.

For example, under a project goal or objective of mobility, the evaluation measure may be travel time. This might be measured by the buffer index which would require either a travel demand model or a micro-simulation depending on the level of detail needed at a particular step in the process.

Once the steps in this section and the previous sections are completed, this will give the analyst the basis to create the scope of work analysis tasks or an internal analysis work plan.

Example 2-2-1 Problem Statement

The below is an example project statement which includes a summary of the field scoping conditions and the defining statement questions and constraints.

OR193 is an older congested regional highway (not a freight route) in an urban arterial corridor within the city of River City. The highway is mostly four lanes undivided (no center turn lane) with a 35 mph posted speed and an average daily traffic load that exceeds 25,000. The corridor has dense retail/service commercial development with limited right-of-way along its length. There are numerous driveways, many closely spaced, because of past uneven growth patterns. Parking and bike lanes are spotty along the length. Sidewalks are curb-tight with many poor slopes in driveway areas and sub-standard curb ramps. In addition, a number of the intersections are high-crash locations. Congestion extends through the peak hour as a significant bottleneck exists in the study area at a bridge over a local small river. The bridge is still structurally acceptable but functionally obsolete with only two lanes, no bike lanes, narrow lanes and sidewalks. The city wants revitalize the corridor with urban renewal and thus wants to improve it for all users, not just vehicles. Efforts to improve access management in the past have met with resistance from property owners. An improvement project has been listed for this location in the City's Transportation System Plan.

The project has been scoped and meets the needs for an Environmental Assessment (EA) because of the potential impacts. A draft project Purpose and Need (P&N) has been developed: "The purpose of this project is to improve multimodal mobility, increase safety, and enhance the economic development potential of the corridor." Some draft Goals and Objectives have been formed aligning with the P&N on mobility, safety, environmental, limiting natural and built-up impacts, and economic development.

The project needs to conform to practical design objectives so that the alternatives can stay within a 25-50 million dollar range. This would keep the project reasonably likely so it could be included in the next available State Transportation Improvement Plan. A travel demand model is available for the area.

Problem Constraints

- What is the Purpose and Need for the work?
    - From the draft P&N: "The purpose of this project is to improve multimodal mobility, increase safety, and enhance the economic development potential of the corridor."
- What questions need to be answered?
    - What are the base conditions to help define the project need? What are the actual congestion and safety problems? What are the future conditions? What is the impact of access management on congestion? What are the pedestrian, bike, and transit needs in the corridor? Are there cost-effective alternatives available that can address most of the issues?
- What key issues should be considered?
    - Whether to widen or to build a new vehicle and/or ped/bike bridge
    - Balancing different modal needs
    - Access management and parking impacts to properties
- What are the Goals and Objectives (G&O) of the work?
    - From draft G&O document: Mobility, safety, environmental, limiting natural and built-up impacts, and economic development.
- Who is the audience?
    - The audience is multilevel with state and local staff and stakeholders (i.e business groups, bike community, neighborhood associations, freight users) and the general public.

- At what level will the work need to be analyzed and evaluated?
    - Alternative concepts will need to be evaluated on a screening basis.
    - Once concepts are more developed into alternatives, then the alternatives can be analyzed at key locations using deterministic tools.
    - The final set of build alternatives that go into the EA (including the no-build) are analyzed in full detail including simulation, multimodal and predictive safety tools. Air & Noise traffic data will be required for the final alternatives.
- What types of alternatives need to be evaluated?
    - No-build (this is what other alternatives are measured against)
    - Possible future land use alternatives as this drives the future improvement needs (this would need to be settled first before getting into detailed analysis).
    - Couplet (new) alignments
    - Bridge replacement
    - Road diet to better accommodate other modes
    - Wider or better utilized right-of-way to improve multimodal, parking and mobility needs including bridge widening.
    - Transportation System Management (TSM)/Safety improvements including painted/raised medians, center turn lanes, improved crosswalks, and improved access management.
    - Alternative strategies such as a new ped/bike bridge, off-street parking, transportation demand management (TDM), or TSM.
- What evaluation measures will be used?
    - Ones that are applicable to this project area include: These can include: volume-to-capacity ratio (v/c), level of service (LOS), queuing, travel time, delay, emergency response time, multimodal level of service (MMLOS), ped/bike system connectivity, accessibility, duration of congestion, percent crash reduction, expected crashes, access spacing, and conflict points.
- What is the overall and traffic analysis study area, if different?
    - Land use and bridge scenarios will require a city-wide look initially to determine if any significant negative impacts exist on areas potentially outside the project limits. If these occur, and the alternatives will still be pursued, then the project limits and/or the analysis study area may need to be modified.
    - Because this is a congested area and traffic simulation will be necessary, the study area will need to go out two signalized intersections outside of the project limits (area of potential impact). The project will at least need to go a couple of block on each side of the highway to accommodate the couplet alternatives.
- What types of useable information and tools are available and practical?
    - Inventory data, some counts, analysis and modeling work done for TSP
    - A travel demand model and local modeling staff time is available.
    - Mesoscopic methods (i.e. windowing out of a model area)
    - Highway Capacity Manual (HCM) and Highway Safety Manual (HSM) methods
    - Micro-simulation

Schedule, Resource, and Budget Constraints

- What is the timeframe for the analysis work?
  - This project is going to kickoff in July, so counts will need to be obtained immediately to capture the 30th highest hour conditions.
  - The project is one of the Region's top priorities
  - Since this is an EA, the end date is somewhat unknown but is expected to last at least 36 months.
- What are the impacts from changes to Purpose and Need?
  - Likely impacts could be additional alternatives, rework of analysis which will lead to more time required to do the work.
- What are the risks from other sources such as other jurisdictions, stakeholders, and private citizens? For example, local concerns/issues/ politics can easily add time to a projected schedule.
  - Access management and parking concerns will likely cause delay or create issues with the city council/planning commission.
  - Potential issues with internal and/or outside business groups
  - Environmental/Riparian issues along the river
  - Potential additional bridge routes/alignments
- Are there outside factors or time constraints that may dictate delivery of work items? For example, crash information is needed but cannot be obtained in the specified time frame.
  - Counts will need to be obtained between July and September in order to stay on schedule.
  - Staff time to perform analysis is limited because of other legislative high-priority work. Will likely need to have help from consultant to stay on schedule.
- What resources are available? Are they internal or external?
  - Internally, there is the project lead (manager) and at least one analyst available. The EA consultant has additional analysis staff available to help out on contingency.
- Are tasks dependent on resources not within analyst's control?
  - Yes, model applications are dependent on current workload; alternatives are dependent on region designers, alternative development process is dependent on feedback from stakeholders, public open houses and the teams themselves.
- Does the project funding require certain analysis tools and procedures?
  - The project falls under NEPA requirements so full counts and inventory data will be necessary to stay consistent with land use requirements and to support the environmental analysis. In addition, the travel demand model is required to be used.
- Is the budget adequate to perform the desired analysis and data collection?
  - The budget is adequate for the data collection, and up to three detailed alternatives in the EA document.
- What is the availability and quality of existing data?
  - State inventory data is current. The TSP analysis is still usable but more counts and data will be needed for the project analysis.
- Can the work be divided? Are tasks independent of each other? Are tasks sequential or concurrent?
  - Most work can be divided into concurrent tasks, but simulation work must be

done sequentially from a single source to avoid inconsistencies in assumptions. Generally, no-build work must precede alternative work.

Additional Details

- Given the above mentioned evaluation measures and other issues what are the likely performance measures that will be needed?
  - Volume to capacity ratio for the state highway and level of service for the local system will be required to compare with established performance targets and standards. In addition, travel time and queuing will be needed to test the overall efficiency of alternative operations. Multimodal level of service will be used to gauge the impact of mobility alternatives on the pedestrian/bike/transit operations and vice versa.
- Likely tools to be used?
  - Analysis of the no-build and the alternatives will require the use of the travel demand model to help develop the volumes and to create high-level screening measures to test any model-usable concepts (i.e. road diet, couplet and other network changes), Tools such as Highway Capacity Manual-based software (i.e. HCS and Synchro) and the multimodal tools will be needed to develop the detailed analysis. Micro-simulation will also be needed to create the travel time measures for the detailed analysis and to create the queuing data.

2.3 Level of Detail

There are many types of analysis work done for transportation related issues. The analysis ranges from high-level policy and procedures, through subject or facility plans to specific issues, locations or improvements projects. For example, a 10-mile long facility plan should have a different level of analysis than a single intersection realignment. The analysis process can have multiple levels such as single-issue or fatal flaw screening through detailed reporting like micro-simulation.

2.3.1 Types of Work

Planning Studies

These studies are generally limited to a specific geographic area or corridor or can cover multiple topics/issues. All of these can be either rural or urban and can overlap into different elements as well as varying level of detail. In some regions, the terms “corridor”, “facility”, “refinement” all mean the same level of effort. Expressway plans are similar but deal with a certain facility type and condition reports only deal with existing or future no-build needs yet the plans may not look different from a typical refinement plan.

The key difference in plans will be what are the specific questions needing answers and the detail level needed to answer them regardless of what the plan is named. For example the I-205 corridor in a dense urban area would involve use of a regional travel demand model, dynamic traffic assignment (DTA), and micro-simulation while the comparatively rural US395 corridor would only have an urban model in a couple locations, and use a higher segment-based analysis.

Examples of each can include:

- Statewide Policy / Plans - This work is generally of a statewide nature but can be topic specific; typically guidance or an overriding policy such as:
  - Greenhouse Gases (GHG)
  - Least Cost Planning (LCP)
  - Legislative Studies / ORS / OAR
  - Performance Measures like Alternative Mobility Standards
  - OTP and Modal Plans (OHP, Freight Plan, Rail Plan, Bike/Ped Plan)
- System Plans – these focus on:
  - Metropolitan (urbanized) areas –Regional Transportation Plan (RTP)
  - County/multiple jurisdictional – County TSP, Regional Transportation Plan.
  - City – City Transportation System Plans
- Corridor/Facility Plans – these focus on:
  - Specific highway corridor
  - Land Use (TPR-type zone change, UGB expansion)
- Refinement Plans – these focus on:
  - Topic (Road Diet or Conversion of Two-Way to One-Way)
  - Feature (IAMP),
  - Mode (Safe Routes to Schools)
  - Highway segment
  - Sub-Area

Projects

This operational analysis is limited to specific locations often with specific guidelines or parameters that influence the work. They include

- Modernization – this work covers large issues / needs that must be measured against specific data needs or standards. The intent is to bring the facility/project up to standards and/or formalize exceptions.
- Safety / Operations / Preservation – this work is specific in nature and may allow deviation from standards. For example on a facility with a high crash rate fitting a minimal left turn lane within the given right-of way may not have standard widths and tapers.
- Traffic Impact Analysis (TIA)/Traffic Impact Studies (TIS) – this work is driven by the development itself. The analysis is to determine facility adequacy, significant effects and required mitigation.
  - Transportation Planning Rule (TPR)/Zone Change –When a proposed development requires a change in land use and has a significant effect to the state facility, certain criteria must be met.
  - Conforming Use Development- When a proposed development does not fall in the TPR/Zone change, the analysis is dependent on local land use code and approach permitting

- Approach Permitting – These are for developments that do not require a TIA. This driveway type and location considerations such as sight distance, conflict points, influence areas.

Other Procedural / Research Studies

This is analysis work in support of a specific topic or tool, such as but not limited to trip generation studies, determination of analysis factors, procedures or calculators. These studies should conform to appropriate national methods and accepted analytical processes. This work needs to be detailed out with specific deliverables and agreed to by the parties requesting and accepting the work.

2.3.2 Level of Analysis

The questions being asked and the data available can determine the level of analysis needed. This can range from policy and systemic reporting to a very detailed specific need. Resources are limited, so the level of analysis needs to be tailored to the questions.

- Rules of Thumb – Generalization based on common conditions with very little detail. Can be in tabular or checklist format or "canned." For example, when AADT exceeds 60,000 then six lanes are needed. These need to be taken into context as a general ballpark only. They may be used to help determine a starting point. Actual decisions need to be based on more detailed analysis.
- Broad Brush (a.k.a. "30,000 or 10,000 foot view") – Big picture generalized planning analysis or a preliminary estimate of a more detailed later task. This could include using daily traffic volumes (AADT's), assumed roadway geometrics, or default values. This is typically at the system or corridor level (not intersection level). Data is typically at an aggregated level.
- Screening – A mid level analysis where some plan/project specific data is available but likely not fully developed. This process is used to whittle down large number of scenarios/concepts/alternatives/options to a more reasonable number. This can include both qualitative and quantitative elements. Measures can include items such as policy/standard compliance (a.k.a. fatal flaw analysis), natural and built environmental constraints, segment demand-to-capacity ratios, and key intersection volume to capacity ratios. Context sensitivity / practical design considerations are important at this level and below. Typically in a plan or project, multiple levels of screening are used in increasing detail.
- Detailed – This is a comprehensive look a study area or topic. This uses study-specific data where the use of defaults is limited. This analysis typically furnishes detailed numbers for establishment of standards or policies or details for a specific design (i.e. storage lengths, signal progression). Actual plan or project decisions can be made from information derived from this level.

2.4 Tools

There are many tools used for transportation and planning analysis. They are a mixture of commercially developed and internally created programs serving anything from analyzing the effect of a specific policy to a specific project detail. Often a particular process becomes identified as a tool and is included for discussion purposes.

2.4.1 Individual Tool Descriptions

The following tool descriptions are not exhaustive list and mainly concentrate on the ODOT-used ones. Some of these tools are discussed in more detail in following chapters. Some of these tools could be considered a process, i.e. sub-area modeling or zonal cumulative analysis. Some tools may package together multiple tools (i.e. HCM analysis and simulation) in a suite format. Other tools and methodologies not listed here or later in the APM may be acceptable if explained and documented in a methodology memorandum and approved by ODOT. For more information or availability of these tools, please contact TPAU staff. The higher model –based tools are discussed further in the Senate Bill 1059: GHG Modeling and Analysis Tools Report (i).

SWIM (StateWide Integrated Model) – This model is used for high level projects of statewide importance that involve freight movements and/or long-term economic impacts. SWIM is not designed to analyze small or isolated projects.

LUSDR (Land Use Scenario DevelopeR) – This tool is used with a travel demand model for large-scale regional planning to develop and test a range of future land-use scenarios. A single or weighted average of these scenarios can be used in system and refinement planning efforts such as TSP's and IAMP's. LUSDR can inform local jurisdictions of future land use development issues and possibilities and influence decisions on growth areas, the comprehensive plan, and the future land use patterns.

GreenSTEP (Greenhouse gas Strategic Transportation Energy Planning model) – This model is used for large-scale regional emissions planning as part of an area's Greenhouse Gas (GHG) reduction efforts. The model is used to help establish a transportation strategy for meeting greenhouse gas targets,

HERS-ST (Highway Economic Requirements System-State Version) – Typically used on a corridor-basis for determining needs (deficiencies) including capacity, geometric alignment and pavement based on identified funding thresholds. Data are available for the state highway system as the HERS-ST input datasets are created mainly from internal ODOT inventory databases and are updated yearly. Local HERS-ST data can be created if the appropriate data and resources are available. With varying levels of effort, HERS-ST can be linked to travel demand models. This produces simplified HCM segment capacities, typically in volume to capacity ratios. Like with all HCM-based tools there are no interactions between segments. Also, while some intersection data are included, HERS-ST will not produce intersection performance measures. HERS-ST can be used to produce benefit-cost ratios for different project improvements which can be used for screening alternatives or used for high-level project management decisions. It also can be used as the primary tool for determining existing and future year v/c's and needs in corridor and facility plans.

Urban Models (4-Step Travel Demand Models) – Travel Demand Models are generally built as system-level tools so detail is limited at a facility level; including basic characteristics such as number of lanes and speed limits. These models can be used as a screening tool using district travel patterns (origin-destination), demand-to-capacity ratios, percent volume differences, and high level estimates of travel times. Travel Demand Models are also used to develop future volumes for plans and projects through post-processing methods. See the available TPAU and

MPO urban model map on TPAU's website at:
https://www.oregon.gov/ODOT/Planning/Pages/Technical-Tools.aspx

IDAS – (ITS Deployment Analysis System) - This is used for integrating ITS (Intelligent Transportation System) operations into a travel demand model assignment. IDAS allows global settings of traffic signal timing, variable messaging and ramp meters in order to modify imported model assignments. IDAS is only for ITS applications only on a system basis rather than a corridor or point basis. For smaller areas, IDAS can be applied to a cut-out (window) model network. IDAS can compare multiple ITS scenarios including on a benefit-cost basis.

Dynamic Traffic Assignment (DTA) - DTA is an alternative mesoscopic method that assigns traffic across time periods so that adjacent time periods and congestion affect each other. DTA is useful when the typical peak hour traffic spreads across multiple hours. The assignment is more detailed as it incorporates basic signal timing and platoons of vehicles which allow for queuing to be modeled. DTA is a further level of effort and refinement of the model assignment between the typical travel demand model and micro-simulation. Common DTA software tools are Dynus-T and Dynameq.

Subarea modeling – This is a mesoscopic technique by cutting out a portion of a travel demand model (also called windowing) to be used separately or adding detail to a portion of a model (also called focusing). Both methods involve adding detail to the model (signal timing, smaller zones, additional centroid connectors, better refined capacities, etc). This additional detail will improve calibration between the model and field counts, possibly to the point that post-processing is very limited. Typical software for the windowing method would be VISUM.

HCS (HCM) – Highway Capacity Software is a faithful implementation of the Highway Capacity Manual methodology. These methods are point/segment based and are isolated so adjacent sections do not affect each other. This is the only source of deterministic analysis tools for freeway operations (segment, merge, diverge, and weave). HCS/HCM also considers pedestrian, bike and transit multimodal analyses. The HCS/HCM is mostly operational (high detail level) based but there are some planning-level methodologies available using mostly default values and average daily traffic volumes.

Synchro – Synchro is mainly for the operation and system optimization of signalized study area networks. Synchro is mainly focused on the analysis of signalized intersections, but can do unsignalized intersections, roundabouts, and intersection-level multimodal analysis following current HCM methodologies.

SimTraffic – SimTraffic is a micro-simulation based on the arterial portion of CORSIM and thus is best suited for simulating arterial networks. This allows system-level analysis of a study area network for queuing impacts, travel time, delay of individual vehicles as well as network wide.

VISSIM – VISSIM is a complex but comprehensive micro-simulation which can be used to model virtually any road network. VISSIM also has the capability to handle DTA and multiple modes. The software is extremely customizable but requires significant effort to calibrate and report out useable data.

Trip Generation - This process implements the ITE Trip Generation Manual procedures based on land uses and other site size and type characteristics.

SigCap – SigCap is currently used as a quick sketch-type analysis and is mainly used to develop signalized intersection LOS C values for the environmental traffic data process.

Unsig – Unsig is currently used as a quick sketch-type analysis and is mainly used to develop unsignalized intersection LOS C values for the environmental traffic data process.

EISBase – EISBase is database tool used to calculate the resulting speeds of traffic flows, based on volumes of auto and trucks, for the environmental traffic data process.

Zonal Cumulative – The Zonal Cumulative volume development process is mainly a manual three-step (generation, distribution and assignment) analysis. This involves creation of zones, uses ITE Trip Generation methodologies, external trip origin-destinations, and gravity-based distribution. Calibration is also required. The VISUM modeling software is used to streamline the assignment process.

Future Volume Tables – These show the future annual average daily traffic volumes for state highway segments based on either 20 years of historical traffic counts or travel demand model based growth trends depending on the location. These are updated annually.

Other Planning Analysis Tools – There are a number of less complex tools that can be used to evaluate a system at a relatively high level. These also can be used as part of a more detailed plan or project analysis as an alternative screening tool. Most of these are based on average daily traffic. Some examples are preliminary signal warrants (PSW), other PSW-based tools, and the capacity nomographs.

IHSDM – The IHSDM (Interactive Highway Safety Design Model) implements the HSM Part C predictive method for rural and urban highway segments. The IHSDM evaluates the effects of geometric changes on safety. The IHSDM has a very high input detail level as it requires full geometric design data (curves, grader, stationing, super-elevation, etc). This is best suited for evaluating final design alternatives.

PlanSafe – This is for comparing relative safety levels on a transportation analysis zone or district basis within a travel demand model. PlanSafe does not use HSM methods.

NCHRP Spreadsheets – These are a free download implementing the Highway Safety Manual Part C predictive safety analysis methods. These are not technically supported and may not reflect current changes/fixes in HSM procedures

HiSafe – HiSafe is a software application implementing the Highway Safety Manual Part C predictive safety analysis methods.

Crash Decoder Tool – This macro-based spreadsheet tool converts the extensive numerical codes in the typical “long-form” comprehensive PRC crash listing to words. This eliminates the need for the analyst to be familiar with the crash coding manual. The tool will also summarize and graph the crash characteristics.

Crash Graph Tool – This Excel macro based spreadsheet uses input from the Vehicle Direction report to create a standard set of crash graphs and table by year, severity, collision type, time of day, day of week, surface condition, light condition, on and off-roadway crashes, and MP.

2.4.2 Tool Evaluation/Selection

The second step for scoping is to determine what tools are available and can be used at particular stages in the analysis effort. Selection of the appropriate analysis procedures from this manual will often be determined by project-specific characteristics such as the type of project, the surrounding environment and land uses, availability of data and the type of traffic controls present in the field. Generally, similar types of projects will use the same analysis procedures to varying degrees. Depending on the study and the project's purpose and need, additional data may be required. For further information on project scoping and selection of traffic analysis procedures, refer to the Federal Highway Administration's (FHWA) website for the Traffic Analysis Toolbox: https://ops.fhwa.dot.gov/trafficanalysistools/

In this manual, tools are broken into two basic categories: deterministic and stochastic and two sub-categories: systemic and specific. Considering the project needs and constraints, the tool selection can greatly impact the resources and time necessary to do the analysis.

- Deterministic – These tools use a set of fixed inputs and result in a single set of outputs. These include, for example, Highway Capacity Manual procedures and the 3- or 4-Step travel demand models.
- Stochastic – These tools use a set of inputs and create multiple sets of outputs. These include, for example, micro-simulation and dynamic traffic, land use and economic assignment models. These tools are much more time-intensive for inputs, process, and analysis of outputs.
- Systemic – These tools often cover multiple points that interact / influence with each other
- Specific – These tools analyze a single location

In the sections that follow, the tools are grouped first by study type and then by analysis type, however, the tables are not exhaustive. Studies likely require more than one type and related tools over their duration. Even within these tools there is a range of uses from high-level planning to project specific. Some tools can be used for widely varying efforts depending on the questions asked. An "X" indicates the tool type in the following exhibits.

> *The following discussion assumes that these tools have been created, tested, and operational. If a tool is not fully updated and useable, additional time or special considerations may be needed in tool selection.*

For each tool, the general data needs, staffing requirements, and time required are shown. Many tools may have a range depending on the task at hand which may be "high" for a simulation model, to "medium" for facility analysis, and to "low" for individual intersection analysis. The following exhibits attempt to reflect a relative difference between the tools and may not capture every specific circumstance.

- “High” (H) generally means obtaining large quantities of data, confidential data, data not readily available, or in the correct format. Long times to collect data or the cost of collection is also considered. These tools can require a special separate project effort to collect and clean the data or to customize the tool to the location. Use of default values is very limited. Some tools may require many staff members such as updating a travel demand model or may require many hours from a single person, such as micro-simulation. Processes may take months or years in some cases.
- “Medium” (M) generally means data obtainable in the field or from available information/databases although it might still need conversion or cleaning. Staffing requirements will be a single to a few staff members. Time requirements are generally on the order of weeks.
- “Low” (L) generally means published data or available data in correct formats and can be immediately used. The tool may have a high use of default values. Overall data requirements are limited in total amount or elements. These tools can be used by a single staff member and time requirements are on the order of days.

Tools Grouped by Study Type

<u>Policy Tools</u>

Used for answering policy level questions such as for the Oregon Transportation Plan or Oregon Highway Plan. These questions can be from the legislature or upper management. Questions can be very complex, in order to determine the effects of potential policy decisions involving many diverse factors in broad areas including economics, land use and transportation. SWIM and HERS-ST are the primary tools used for this purpose.

Exhibit 2-2: Policy and Statewide Planning Tools

Tools	**Category**				**Applications**		
	Deterministic	**Stochastic**	**Systemic**	**Specific**	**Data Needs**	**Staffing**	**Time**
SWIM		X	X		H	H	H
HERS-ST	X			X	L	M	M

<u>Statewide Planning Tools</u>

Used for statewide or multiregional analysis studies such as the Bridge Limitation Strategy. These studies usually involve the highway network or elements such as freight movement, congestion, economic impacts of delay/detours, etc. SWIM is used for general flows including freight movements and economic impacts while HERS-ST is a segment-based tool for prioritizing/analyzing highway needs (deficiencies) and overall benefit/costs across the statewide network.

System Planning Tools

Used for regional, county or city planning studies such as Regional Transportation Plans (RTP) and Transportation System Plans (TSP). The tools cover a wide range of uses. GreenSTEP is used for greenhouse gas emissions in urbanized areas. LUSDR is used to help determine future land use allocations when there are too many unknowns to use the normal processes. The urbanized area, county and small city travel demand models are used to determine system travel patterns or behavior, to compare multiple land use and network scenarios, or can be used to develop post-processed volumes for more detailed analysis for specific locations.

PlanSafe is used on a transportation analysis zone (TAZ) or district basis to compare between network scenarios to determine relative safety levels. Historic crash analysis using the Crash Decoder Tool is needed to identify current issues as well as support the PlanSafe model if a travel demand model is available. IDAS can be used to refine vehicle assignments from travel demand models to help incorporate effects of transportation system management (TSM) and intelligent transportation systems (ITS) such as ramp metering and variable message signs. HERS-ST and IDAS can both calculate benefit/costs for alternatives. If no travel demand models exist, then a zonal cumulative or a traditional historic volume growth process may be used.

Other tools cover specific routes, segments, or locations. Multimodal analysis would be typically done for major facilities across all applicable modes using HCM methods. HERS-ST can be used for determining operational results of state highway segments or across an entire area if the data are available. Highway Capacity Manual operational or planning analysis techniques can be used to determine operational results of roadway segments for all modes. Other planning analysis tools include daily-traffic based intersection tools for determining needs or general traffic control types.

Exhibit 2-3: System Planning Tools

Tools	**Deterministic**	**Stochastic**	**Systemic**	**Specific**	**Data Needs**	**Staffing**	**Time**
	Category				**Applications**		
LUSDR		X	X		H	H	H
GreenSTEP		X	X		H	H	H
Urban Models	X		X		M	M	M
PlanSafe	X		X		M	M	M
HERS-ST	X			X	L	M	M
IDAS	X		X		M	M	L
HCS (HCM)	X			X	M	L	L
HCM Planning Analysis	X			X	L	L	L
Other Planning Analysis	X			X	L	L	L

Corridor Planning Tools

Used for specific highway segments, either over an entire highway or a smaller section within or between cities. Corridor plans have more detail than system plans yet lack the specific details of project refinement plans and are limited to the specific roadway in question. These tools form the full range from systemic travel demand model-based tools to intersection operational analysis to micro-simulation. Travel demand model based tools are used to compare scenarios or help screen alternatives. Some tools like dynamic traffic assignment (DTA) or IDAS are used to incorporate shifting demand or TSM/ITS into the model assignments to better match the field conditions and limit the amount of post-processing needed. If no travel demand models exist, then a zonal cumulative or a traditional historic volume growth process may be used.

Historic crash analysis is needed at the corridor planning level. Predictive crash analysis may be used on the final solutions for urban arterials and rural non-freeways. The NCHRP HSM spreadsheets and HiSafe are used to do the predictive analysis while the Crash Decoder Tool is used to simplify the historic crash analysis.

Analysis would be typically done across all applicable modes at varying levels of detail from HCM-based analysis to micro-simulation. HERS-ST or HCM planning analysis can be used for determining operational results of state highway segments along the corridor. Both HERS-ST and IDAS can be used help determine benefit/costs of alternatives. If intersection analysis is needed then any of the HCM-based methods and tools (such as HCS or Synchro) can be used. Typically, micro-simulation will not be needed in corridor plans other than in metropolitan areas. VISSIM is typically used for freeway operations, complex configurations, and/or including multimodal issues and SimTraffic is used for signalized arterial corridors.

Exhibit 2-4 shows this group.

Refinement Planning Tools

Refinement plans are more detailed than system or corridor plans, but they are limited to a specific area or highway segment. Refinement plans generally arise from system or corridor plans which identify need for more detailed analysis. Travel demand model based tools are used to compare scenarios or help screen alternatives. Some tools like dynamic traffic assignment (DTA) or IDAS are used to incorporate shifting demand or TSM/ITS into the model assignments to better match the field conditions and limit the amount of post-processing needed. The smaller scope of these plans allows sub-area (window) modeling to be done which will further reduce the post-processing need. If no travel demand models exist, then a zonal cumulative or a traditional historic volume growth process may be used.

Historic and/or predictive crash analysis is needed at the refinement planning level. The NCHRP HSM spreadsheets and HiSafe are used to do the predictive analysis on urban arterials and rural non-freeways while the Crash Decoder Tool is used to simplify the historic crash analysis. Analysis would be typically done across all applicable modes at varying levels of detail from HCM-based analysis to micro-simulation. HERS-ST or HCM/other planning analysis tools are mainly used for alternative scoping or screening. Both HERS-ST and IDAS can be used help determine benefit/costs of alternatives. Intersection-level analysis is typically needed so any of the HCM-based methods and tools (such as HCS, or Synchro) can be used. Micro-simulation (will generally be used, especially in urban or congested areas. VISSIM is typically used for freeway operations, complex configurations, and/or including multi-modal issues and SimTraffic is used for signalized arterial corridors.

Exhibit 2-4: Corridor & Refinement Planning Tools

Tools	**Deterministic**	**Stochastic**	**Systemic**	**Specific**	**Data Needs**	**Staffing**	**Time**
	Category				**Applications**		
VISSIM		X		X	H	H	H
Urban Models	X		X		M	M	M
Dynamic Traffic Assignment		X	X		M	M	M
Subarea modeling	X			X	M	M	M
SimTraffic		X		X	M	M	M
NCHRP HSM Spreadsheets	X			X	M	L	M
HERS-ST	X			X	L	M	M
IDAS	X		X		M	M	L
Synchro	X			X	M	M	L
HiSafe	X			X	M	L	L
HCS (HCM)	X			X	M	L	L
Crash Decoder Tool	X			X	L	L	L
HCM Planning Analysis	X			X	L	L	L

Project Tools

Project analysis is the most detailed of all analysis types. Project analysis can involve the full range of tools from the travel demand model to micro-simulation and may involve specialized areas such as environmental analysis. Travel demand model based tools are used to compare scenarios or help screen alternatives and are used to create post-processed design hour volumes to be used by other tools. Some tools like dynamic traffic assignment (DTA) or IDAS are used to incorporate shifting demand or TSM/ITS into the model assignments to better match the field conditions and limit the amount of post-processing needed. The smaller scope of these plans allows sub-area (window) modeling to be done which will further reduce the post-processing need. If no travel demand models exist, then a zonal cumulative or a traditional historic volume growth process may be used.

Detailed historic and/or predictive crash analysis is needed at the project level. Tools like IHSDM, the NCHRP HSM spreadsheets, and HiSafe are used to do the predictive analysis on urban arterials and rural non-freeways while the Crash Decoder Tool is used to simplify the historic crash analysis.

Analysis would be typically done across all applicable modes at varying levels of detail from HCM-based analysis to micro-simulation. HERS-ST or HCM/other planning analysis tools are mainly used for alternative scoping or screening. Both HERS-ST and IDAS can be used help determine benefit/costs of alternatives. Intersection-level analysis is usually needed so any of the HCM-based methods and tools (such as HCS or Synchro) can be used. In congested areas or where the HCM methods no longer apply then micro-simulation is required. VISSIM is typically used for freeway operations, complex configurations, and/or including multimodal issues, and SimTraffic is used for signalized arterial corridors. Some projects may involve environmental traffic analysis for noise, air quality and energy impacts which normally requires the use of (or the equivalent of) Synchro, SigCap, Unsig, and EISbase.

Exhibit 2-5: Project Tools

Tools	**Category**				**Applications**		
	Deterministic	**Stochastic**	**Systemic**	**Specific**	**Data Needs**	**Staffing**	**Time**
VISSIM		X		X	H	H	H
IHSDM	X			X	H	M	H
Urban Models	X		X		M	M	M
Dynamic Traffic Assignment		X	X		M	M	M
Subarea modeling	X			X	M	M	M
SimTraffic		X		X	M	M	M
HERS-ST	X			X	L	M	M
IDAS	X		X		M	M	L
Synchro	X			X	M	M	L
EISBase	X			X	M	L	M
NCHRP HSM Spreadsheets	X			X	M	L	M
HCS (HCM)	X			X	M	L	L
HiSafe	X			X	M	L	L
Crash Decoder Tool	X			X	L	L	L
Trip Generation	X			X	L	L	L
HCM Planning Analysis	X			X	L	L	L
MUTCD Signal Warrant Analysis Worksheet	X			X	L	L	L
Other Planning Analysis	X			X	L	L	L
Sigcap	X			X	L	L	L
Unsig	X			X	L	L	L

Specific Analysis Elements

<u>Volume Development Tools</u>

These tools are used to help develop volumes to be used in the analysis at various levels of detail as warranted by the individual study. Where a travel demand model is available, model assignments can be created to help in screening and post-processing. Dynamic traffic assignment and subarea modeling techniques can be used to refine the assignment. Zonal cumulative analysis is used where a travel demand model is not available. Trip Generation is used in cumulative analysis using rates from the ITE Trip Generation manual.

Exhibit 2-6: Volume Development Tools

Tools	Deterministic	Stochastic	Systemic	Specific	Data Needs	Staffing	Time
	Category				**Applications**		
Zonal Cumulative	X			X	H	M	M
Urban Models	X		X		M	M	M
Dynamic Traffic Assignment		X	X		M	M	M
Subarea modeling	X			X	M	M	M
Future Volume Tables	X			X	L	L	L
Trip Generation	X			X	L	L	L

Screening Analysis Tools

Screening analysis is typically a high-level analysis used to reduce the number of scenarios/concepts/alternatives to a manageable level. Most studies will have multiple levels of screening at increasing detail levels. At the top end, travel demand model-based tools are typically used for the system impacts. Middle and lower screening levels are more detailed at the intersection level which may be using key intersection volume-to-capacity ratios, or multimodal level of services. Screening analysis in a project –level analysis will be more complex than in a system plan.

Exhibit 2-7: Screening Analysis Tools

Tools	Deterministic	Stochastic	Systemic	Specific	Data Needs	Staffing	Time
	Category				**Applications**		
Urban Models	X		X		M	M	M
Dynamic Traffic Assignment		X	X		M	M	M
Subarea modeling	X			X	M	M	M
HERS-ST	X			X	L	M	M
Synchro	X			X	M	M	L
HCS (HCM)	X			X	M	L	L
HCM Planning Analysis	X			X	L	L	L
Preliminary Signal Warrant Analysis Worksheet	X			X	L	L	L
Other Planning Analysis	X			X	L	L	L

Multimodal Analysis Tools

For a complete analysis of a system or a project area, a multimodal analysis is needed. Urban MPO (Metropolitan Planning Organization) models can be used to determine mode share for the base case as well as alternatives. The HCM-based multimodal level of service (MMLOS) is used to create qualitative comparisons across the auto, pedestrian, bicycle, and transit modes. HCS has all the modes and does intersections and segments while Synchro does not include transit and does only intersections. In congested areas or in areas where non-auto modes are very common mixing with vehicular traffic such as light rail, streetcar, and buses, VISSIM micro-simulation will be needed to judge the impacts of these modes on each other. VISSIM, and in some cases SimTraffic, is also needed where heavy rail modes cross roadways. Analysis of the actual modal operations requires different resources not covered in this manual, such as the Transit Capacity Quality of Service Manual (TCQSM).

Exhibit 2-8: Multimodal Analysis Tools

Tools	**Category**				**Applications**		
	Deterministic	**Stochastic**	**Systemic**	**Specific**	**Data Needs**	**Staffing**	**Time**
VISSIM		X		X	H	H	H
Urban Models	X		X		M	M	M
Synchro	X			X	M	M	L
HCS (HCM)	X			X	M	L	L

Safety Tools

Most studies will require some sort of safety analysis. At a minimum, a historic crash analysis is needed. The Crash Graphing and Crash Decoder tools simplify the processing and analysis of individual crash records. Historic crash data are also needed to support more-detailed predictive analysis. Plans and projects can use Highway Safety Manual (HSM)-based screening methods for establishing critical crash rates within a community or predicting the number of crashes associated with changes to roadway segments or intersections. Tools for screening include the ODOT critical rate calculator, excess proportion of crash types calculator, and the Visum Safety Add-In. Additional HSM-based tools are available to conduct predictive analyses methods, such as the free NCHRP spreadsheets or ISATe for freeways and interchanges. Interactive Highway Safety Design Manual (IHSDM) software allows for very detailed evaluation of safety effects of geometric design decisions and requires a project-level data collection effort to be used appropriately. See Chapter 4 for more information on safety analysis tools and methods.

Exhibit 2-9: Safety Tools

Tools	Deterministic	Stochastic	Systemic	Specific	Data Needs	Staffing	Time
	Category				Applications		
IHSDM	X			X	H	M	H
ISATe	X			X	M	M	M
Visum ODOT Safety Add-In	X			X	M	M	M
NCHRP HSM Spreadsheets	X			X	M	L	M
Excess Proportion of Crash Types Calculator	X			X	L	L	L
Critical Rate Calculator	X			X	M	L	L
Crash Decoder Tool	X			X	L	L	L
Crash Graphing Tool	X			X	L	L	L

<u>Environmental Traffic Data Tools</u>

Sometimes, plans and projects will require some sort of environmental analysis. This can range from high level travel demand model based efforts to very detailed traffic volume development. GreenSTEP is a model based tool that estimates greenhouse gas emissions across a metropolitan region and thus will be mainly used in the development of regional transportation plans (RTP). Development of RTP's requires an air quality conformity determination. Also some metropolitan and smaller urban areas have been (none currently are) non-attainment areas for air quality. The urban models feed data into the air quality model (MOVES) which is the tool for determining air quality conformance. Project analyses will generally involve at least a noise study with many larger projects needing air quality or energy studies. Tools such as Synchro, SigCap, Unsig, and EISbase support the creation of the environmental traffic data to be later used for environmental analysis. Simulation tools can be used to create simple system-wide deterministic measures such as fuel used and pollutant levels.

Exhibit 2-10: Environmental Traffic Data Tools

Tools	Deterministic	Stochastic	Systemic	Specific	Data Needs	Staffing	Time
	Category				Applications		
GreenSTEP		X	X		H	H	H
VISSIM		X		X	H	H	H
Urban Models	X		X		M	M	M
SimTraffic		X		X	M	M	M
Synchro	X			X	M	M	L
EISBase	X			X	M	L	M
Sigcap	X			X	L	L	L
Unsig	X			X	L	L	L

2.5 Creating a Scope of Work (SOW)

The third step for scoping is to determine the specifics for the scope of work (SOW). SOWs can be written for TSPs, Corridor/Facility Plans, Refinement Plans, IAMPs and projects. Traffic Impact Analyses/Statements (TIAs/TISs) also have a SOW, but specific criteria should be consistent with Chapter 3 of ODOT's Development Review Guidelines.

The purpose of establishing a SOW for a transportation study is to define critical parameters such as the study area boundaries, analysis requirements, data needs and the identification of specific concerns to be addressed. An effective SOW should always produce a completed study that satisfies the needs of the corresponding project.

Common elements for most types of transportation studies include:

- Background or Purpose Statement
- Objectives of the Study
- List of Work Tasks
- Identification of Deliverables
- Project Schedule
- Project Budget

It is important that the work tasks and corresponding deliverables be clearly defined and that the party responsible for completing them is identified. The distribution list for deliverables should generally include all the pertinent teams/groups and specific ODOT sections needed for review.

All ODOT analyses must have a discussion on methodologies and assumptions used. For SOWs there must be a requirement for a Methodology Memorandum clearly shown. This memorandum details out the methodologies and assumptions that are to be used in the existing and future volume development and analysis. It should include the range of analysis methodologies from identifying count locations through simulation, including any safety and multimodal analysis.

This memorandum should be provided to and approved by ODOT before any analysis work is conducted. This helps to significantly reduce the amount of review by ODOT and potential re-work by the Contractor.

The SOW must require that the methodology memorandum is completed by the Contractor and reviewed by and agreed to by ODOT prior to the Contractor starting any volume development and/or analysis tasks. In the absence of a SOW requirement, the APM requires use of the same methodology memorandum. Appendix 2C contains an annotated example methodology memorandum. This example does not necessarily include all methodologies that may be applicable in a given context.

2.5.1 Traffic Scoping Considerations

Each SOW likely has specific individual issues; however, there are many common needs such as professional engineer licensing requirements and specific requirements for the state highway system. Some typical SOW traffic analysis statements are shown below.

The following lists are typical of suggested statements used in SOW's for the traffic analysis tasks and are not exhaustive. Not all of these statements will apply to a single study. These tasks may be modified as desired to fit a study's particular needs.

General

- Final versions of the Contractor's transportation analysis must be stamped by an Oregon-registered Professional Engineer (P.E.) with license being current and in good standing, with expertise in civil or traffic engineering.
- Traffic analysis must follow the Highway Capacity Manual (HCM) 6 procedures and comply with ODOT's Analysis Procedures Manual available at https://www.oregon.gov/ODOT/Planning/Pages/APM.aspx. HCM 6 Signalized intersection v/c shall be computed manually unless software-calculated.
- Contractor shall coordinate all traffic analysis with ODOT's Transportation Planning Analysis Unit (TPAU) and Region [1-5] Traffic Section. [Coordination with local jurisdictions or groups such as MPO's , may be necessary.]
- Consultant shall obtain approval of existing and future analysis methodology from TPAU and Region [1-5] Traffic via a methodology memorandum prior to beginning analysis.
- All documents will be readable and usable in black and white [Exceptions can be specified for certain deliverables.]
- All documents must be written in plain language and use an easily understood format.
- Contractor shall review all applicable plan/past project documents to the study area
- Contractor shall allow two weeks for review of written and analysis deliverables or as agreed to by the contract administrator.
- Contractor shall furnish written and electronic documentation for all assumptions, data, calculations, and results. This includes paper and computer files (i.e. spreadsheets and analysis software files).

Inventory

- Counts should be broken down by type and duration as suggested in the Analysis Procedure Manual Chapter 3. For clarity, the count locations, types, durations should be identified on a map as follows:
    - Contractor (or ODOT/Agency) will provide 16-hr intersection classification traffic counts with 15-minute intervals at the morning and afternoon peak hours at the following locations:
    - Specific locations in list
    - [Note: Similar language is needed for any peak period counts or any road tube counts]
    - All counts must have at least 15-minute breakdowns from 2- 6 PM. All counts must include bicycles, pedestrians, and turning movements.
    - State highway volumes and classification information is available here: https://highway.odot.state.or.us/cf/highwayreports/traffic_parms.cfm
- Field inventory information – lane configurations, traffic controls, speeds, operational issues (queuing, unique driving behaviors, etc) will need to be obtained by the Contractor.
- If micro-simulation is desired, then Contractor shall obtain necessary calibration data.
- Note: Five (5) years of crash data shall be obtained from ODOT's Crash Analysis & Reporting Unit for state highways and any local roadways desired in the study area.

Volumes

- All traffic volumes must be adjusted to reflect the 30th highest hour [Note: use the alternative standard (i.e. average volumes) if it applies to the study area].
- Areas that are covered by a travel demand model must use the model to develop future no-build and build alternative volumes.
- Contractor must submit a model request to ODOT's Transportation Planning Analysis Unit (TPAU) at least three weeks before the data are needed. The model request form is available at: http://www.oregon.gov/ODOT/Planning/Documents/ModelRunRequestForm.pdf [Note: This is only for travel demand models that TPAU has developed.]
- All raw model numbers must be post-processed or used only in relative (percentage) comparisons.

Analysis

- Analysis locations will include at least the traffic count locations. Exact intersection analysis locations will be determined during negotiations.
- Traffic analysis must follow methods in the Highway Capacity Manual (HCM) 6 published by the Transportation Research Board (TRB) or as agreed to by ODOT. All traffic analysis software programs used must follow Highway Capacity Manual 60 procedures. HCM 6 Signalized intersection v/c shall be computed manually unless software-calculated.
- Contractor shall prepare and submit a Methodology Memorandum documenting methodology and assumptions to be used for existing conditions (i.e. seasonal factors used), future conditions (i.e. volume development/post-processing methodology), and

alternative analysis (i.e. peak hour factors, analysis parameters, calibration, etc) to TPAU and Region [1-5] Traffic Section. Consultant shall obtain approval of methodology from TPAU and Region [1-5] Traffic Section prior to beginning analysis. Consultant shall obtain approval of analysis and conclusions from TPAU and Region [1-5] Traffic Section prior to submitting Draft Tech Memos.

- [Note: for existing conditions] Contractor shall obtain the past five years of crash data from Agency's Crash Data & Reporting Unit for both state and non-state roadways and perform crash analysis. Contractor's data for state highways shall include locations of Safety Priority Index System (SPIS). Contractor shall use the Highway Safety Manual Part B Network Screening Critical Crash Rate and Excess Proportions of Specific Crash Types methods for intersections. Each reference population used in either method must have at least 5 (five) sites. In addition, at least two sites must have at least 2 (two) crashes of the target crash type to be applicable for the excess proportion method. If this is not met, intersection crash rates need to be compared with the published 90th percentile rates (See ODOT Analysis Procedure Manual Chapter 4).
- If the local agency or region has established a critical crash rate for segments or if each segment type within the study area includes a minimum of 5 study segments, Contractor shall use the Highway Safety Manual Part B Network Screening Critical Crash Rate method for segments to compare segment crash rates to a critical rate. If fewer than 5 segments exist for a segment type, segment data must be compared with the official published crash rates (ODOT Crash Tables – Table II) for similar facilities [Does not apply to urban areas]. Segments must be homogenous in number of lanes, area type, and volume.
- For intersections that exceed the identified critical crash rate, the excess proportion of specific crash types, and/or the published 90th percentile rate, crash patterns, evaluation of causes and potential countermeasures must be identified for each site. Consultant shall map locations of these safety issue areas and the Safety Priority Index System sites. Consultant shall utilize the Crash Data and MMLOS/LTS to identify potential countermeasures and safety improvement alternatives.
- For segments that exceed the identified critical crash rate or published crash rate and intersections that exceed the identified critical crash rate, analysis of crash patterns, identification of contributing factors, and potential countermeasures need to be completed. Contractor shall map locations of these safety issue areas and the SPIS sites.
- [Add to the above before the last sentence for projects and detailed refinement plans/IAMPs]. Contractor shall perform HSM Part C predictive analysis for all screened locations exceeding segment or critical rates for the existing conditions.
- [Note: Future safety for TSP's, similar detail level plan, and project development screening] For each alternative developed to specifically address a safety concern, Contractor shall summarize safety impacts of each design. Contractor shall use the All-Roads Transportation Safety (ARTS) Crash Reduction Factor Appendix as the initial source of countermeasures. If the ARTS Appendix/List is not sufficient, then Contractor shall use the Crash Modification Factors (CMF) in the HSM Part D and/or the FHWA CMF Clearinghouse to indicate the potential crash reduction for each safety alternative or countermeasure. The ODOT CMF standard is to only use CMF's with a quality rating of 3 stars or better.
- [Note: Future safety for projects or detailed refinement plans/IAMP's] For each

alternative developed to specifically address a safety concern, Contractor shall summarize safety impacts of each design using HSM Part C predictive methods. Full predictive analysis should only be completed on and reported out on the final alternatives (including the future no-build) to be included in the [plan/project].

- Consultant shall conduct a qualitative ("Good, Fair, Poor") multimodal assessment for the Project Area collectors and above as per APM Chapter 14. The assessment analysis must include bicycle, pedestrian, and transit (if applicable) operations.
- Consultant shall conduct Level of Traffic Stress (LTS) analysis for all roadways in the Project Area as per APM Chapter 14. As much as possible, data should be obtained from current aerial photography and (TSP) roadway inventories before field data collection. Bicycle & Pedestrian LTS will be evaluated and results graphically displayed for the existing conditions.
- Contractor shall conduct a high level MMLOS analysis for [indicate roadways to be studied] in the study area. MMLOS analysis must include vehicle, transit, bicycle, and pedestrian operations. Pedestrian analysis should not include the effective width of sidewalk data and calculations but rather assume a clear sidewalk width for each side of each segment. Bike analysis should use the link-level analysis only. Transit analysis should use as much general or average data from available transit district information as possible.
- Traffic analysis at ODOT intersections must be consistent with ODOT's Analysis Procedures Manual (APM) available on the internet at http://www.oregon.gov/ODOT/TD/TP/pages/apm.aspx
- Traffic analysis at non-state intersections needs to be compatible with ODOT procedures and must follow standard engineering procedures and practices.
- ODOT may approve a different or additional intersection analysis method prior to use when the different method can be justified for local and ODOT facilities. Contractor must provide documentation fully explaining the issue and the reasons for the proposed change. Contractor must obtain approval before use.
- Operational targets for state facilities should include the volume to capacity (V/C) ratio. Existing conditions and future no-build must be compared to the Oregon Highway Plan (OHP) v/c targets. Build alternative v/c's are to be compared with ODOT's Highway Design Manual v/c's. Standards for non-state facilities can be v/c and level-of-service (LOS) or a combination of v/c and LOS, depending on the local standards.
- Other performance measures may be required which can include queuing, MMLOS, simulation-based MOE's, etc. All secondary performance measures shall be included in the methodology memorandum.
- Simulation to determine queues or other measures of effectiveness should be used if v/c's exceed 0.70 and simulation shall be used if v/c's are equal to or exceed 0.90. Simulation shall also be used if existing conditions show congested conditions, (i.e. intersection queuing backs into adjacent intersections/connections) or if Agency requires it.
- If simulation is desired to obtain 95th percentile queue lengths or other measures of effectiveness, then the simulation shall be calibrated following procedures in Chapter 15 of the Analysis Procedure Manual.
- Areas with complex freeway geometry/operations, transit operations (bus, light rail, etc), railroad pre-emption, require simulation and shall follow the VISSIM Protocol available at: https://www.oregon.gov/ODOT/Planning/Pages/APM.aspx

Traffic Data to Support HB 2017 Benefit Cost Analysis

- Following procedures in the APM, traffic data shall be prepared to support HB 2017 Benefit Cost Analysis (BCA). The analysis shall be coordinated with and prepared using assumptions and parameters provided by the Region and the economists in the ODOT Program Implementation and Analysis Unit (PIAU). Traffic data shall be provided for the No Build and Build Alternative for both the Base Year and Horizon Year.

Air/Noise/Energy Traffic Data

- Air/Noise/Energy traffic data must be obtained and reported as in the Analysis Procedure Manual Chapter 17 or as agreed upon by Agency.
- Traffic Data for Noise Analysis (Contingency)
    - Consultant shall prepare traffic data needed for noise analysis and noise technical report. This analysis shall include:
        - Existing, future build (design year), and future no-build traffic data for each roadway link in the project area, including collector and higher functionally classified cross streets, for the peak hour and the peak truck hour and in an MS Office-compatible spreadsheet in the form of:
            - Link volumes for each traffic direction
            - Percentages of the following vehicles on each link:
                - Automobiles (FHWA vehicle classes 1-3)
                - Medium trucks (FHWA vehicle classes 4-5)
                - Heavy trucks (FHWA vehicle classes 6-13)
        - Existing and future posted speeds
        - Existing 85th percentile speeds (if available)
        - For each traffic signal in the project area, the percentage of vehicles affected (expected to come to a stop).
        - Land use zoning information for properties within the project area in the form of:
            - Existing zoning
            - Future zoning or predicted changes in land use from existing use
        - Please note that the peak truck hour is typically not in the same period of the day as the peak hour, so longer duration vehicle classification counts (ideally 16+ hr) are necessary. Please refer to ODOT's Analysis Procedures Manual Version 1 Chapter 11 for details on roadway link creation, vehicle classification, and required factors and their calculation.
        - If peak hour or the peak truck hour link volumes exceed the maximum LOS C volumes (LOS C/D threshold) then the link volumes shall be capped at the maximum LOS C volume. LOS C comparative volumes for can be obtained from current Highway Capacity Manual 6th Edition methods. LOS C volumes for intersection approaches also require an iterative process to obtain the target LOS C value.
    - The methodology for creating the noise traffic data shall be documented in a methods and assumptions memorandum to be reviewed and approved by Agency Transportation Planning Analysis Unit and Region Traffic Engineer before work on creating the noise traffic data starts.

    - The completed draft noise traffic data and related documentation (calculations, notes, etc.) shall be reviewed and reviewed and approved by the Agency Transportation Planning Analysis Unit and Region Traffic Engineer. The noise traffic data shall be provided as appendix material in the draft and final Noise Technical Report.Coordination with other Work Areas
- If rail facilities are within the study area, coordination with the ODOT Rail Division is required.
- If the study area is adjacent to an airport or includes any overlay zones then coordination with the Department of Aviation is necessary.
- If studied facilities are formally recognized freight routes, then compliance with ORS 366.215 "Reduction in Capacity" may be needed if alternative concepts could potentially restrict the roadway width (i.e. curb extensions, medians, etc).

2.5.2 Developing Work Plans

Once a SOW has been determined, a detailed internal workplan that outlines the analysis tasks and timelines should be developed. This will help the analyst determine the analysis process necessary to achieve the SOW deliverables. For internal ODOT-only studies, where SOW's are not developed, then a detailed workplan is required. This is typically developed by the project analyst and should be updated as needed. The workplan tasks should be developed to line up with the Sample Analysis Process Reviewer Checklist.

Exhibit 2-1 shows the typical traffic analysis work flow.

The work plan must include the project title, highway name and number, and a purpose statement to identify the project objectives. This work plan must be consistent with the overall project schedule and should be submitted to the project leader for review of timelines. This document will help explain to the project leader/contract administrator analysis and staffing/resource needs and timelines. At the very least, this will start conversation about project expectations. Delays or additional work requests will extend the timelines. The work plan should be updated as the study proceeds especially if major changes occur. A revision date should be on the first page of the work plan. A typical analysis will include most, but not necessarily all, of the following tasks. The tasks are not necessary linear, some may be concurrent or overlap while others provide feedback to other tasks.

The following example tasks assume a typical plan or modernization/safety project. This would need to be modified to fit any specific study.

- **Task 1 – Project Identification and Understanding**
  The purpose of this task is for the analyst to have an understanding of purpose and need of the study, the parameters and constraints that influence it, the questions that need to be answered, and to define the level of analysis and tools to be used.

  The methodology of this task should include the following which impact the analysis:
    - Study purpose and need and goals and objectives
    - Identify any prior relevant plans (i.e. TSP's, refinement plans), analysis (i.e. prior/adjacent projects, traffic impact analyses) that need to be considered in the study area

- Identify any concurrent project or planning efforts in or adjacent to study area. This will require coordination (i.e. data, timelines, project progress etc) between these efforts.
- Identify any new data needs (such as need to update a travel demand model)
- Identify any constraints or issues that may affect the project (i.e funding, natural or built environment, politics).

Task deliverables includes a summary of any prior or current studies in or adjacent to the study area with issues, constraints, and impacts to the analysis discussed. A traffic analysis methodology memorandum may be appropriate if the work needs to be coordinated with multiple staff and or studies.

- **Task 2 – Transportation System Inventory**
  The purpose of this task is to review existing data and collect additional inventory data for the study area. Note: Allow 6-8 weeks from date of request for counts requested from ODOT.

  The methodology for this task should specify the following:
  - Count Request – This should include count locations, types and durations and any other special considerations. Refer to Chapter 3.
  - Field inventory data needed including, but not limited to the suggestions in Chapter 3.
  - Office inventory data needed including, but not limited to:
    - 3-5 Year crash information for roadways through study area
    - Available inventory data
    - Pertinent map/aerial photograph of area for figures
    - Roadway functional class, designations and planning information
    - State and local performance measures
  - If simulation, multimodal analysis, or predictive crash analysis will be needed then more extensive inventory data will be required.
  - Other optional inventory data that may be needed, depending on project.

  Task deliverables include inventory information, project area map and photo for use in the following tasks.

- **Task 3 – Develop No-Build (Existing and Future) Design Hour Volumes**
  The purpose of this task is to develop base year, build year and future year no- build design hour volumes (30th highest or other alternative standard). Occasionally, other interim years may be needed such as air quality or project phasing (short-term fixes) issues. The base year is the year of the study, or when most of the data was gathered. The build year is the year that has the day of opening of the project. Generally, the build year is one year (for small projects like intersections) to two or more years (for large projects like interchanges) from the let date shown on the project prospectus. The future (design) year is typically 20 years from the build year. For example, a 2015 interchange project with a let date in 2019 could have a base year of 2012, a build/opening year of 2021 and a future/design year of 2041.

The methodology for this task is to use the manual count data to obtain the existing/base 30th highest hour volumes (30HV) using historical and seasonal adjustments in Chapter 5. A single system peak hour must be used with volume balancing as appropriate. .

The future volume development methodology should be described, whether by historical trends, cumulative analysis, or with a transportation model (see Chapter 6).

Task deliverables include the figures/worksheets showing the traffic volume development process and the balanced base 30 HV and future no-build volumes on figures in the technical memoranda for the existing and the future no-build conditions.

- **Task 4 – Analysis of No-Build Transportation System**
  The purpose of this task is to evaluate no-build system conditions for the base, build and future years. This may help identify any deficiencies related to the study purpose and need.

  The methodology for this task should use the base year, build year and future year data developed in Task 2 along with current Highway Capacity Manual (HCM)-based analysis software to evaluate the system by performing the following:
    - Use crash data from Task 1 and perform a safety analysis following procedures in Chapter 4. This needs to include a Highway Safety Manual Part B network screening process of locations before doing more detailed safety analysis. This should cover intersections and segments and use historical and predictive methodologies as appropriate.
    - Operational analysis including preliminary signal warrants , turn lane criteria, access/street spacing, and signal progression should be covered (see Chapters)
    - Evaluate the volume to capacity (v/c) and level of service (LOS) or other performance measures as appropriate by jurisdiction for the study area for intersections, merge/diverge/weaving sections, freeway mainlines and highway segments.
    - Perform multimodal evaluation (such as HCM 6 MMLOS) across the pedestrian, bicycle and transit modes.
    - Micro-simulation modeling may be needed if there are multiple signals involved or congested conditions exist. All simulations shall be calibrated according to APM methods. Simulation outputs should at least include 95th percentile queues, travel times, speeds, and overall hours of delay. Remember to allow the additional time (least a month) to calibrate the existing condition simulation model.
    - Turn bay storage lengths will be compared to the 95th percentile no-build queues. Blocking of turn bays and upstream intersections must be noted if microsimulation is performed.

  The task deliverable is a technical memorandum which includes the safety and operational analysis including the various performance measures. If simulation is used, then a calibration report will be required.

- **Task 5 – Evaluate Preliminary Alternatives (Screening)**
  The purpose of this task is to work with the project team to develop and screen the preliminary alternatives.

  The methodology for this task is to review goals and objectives with the team considering identified needs, and evaluate each preliminary alternative by comparing operations at major intersections or other agreed upon key location(s) for the appropriate years. Travel demand models can also be used to screen alternatives effectively if the alternatives have the potential to change traffic patterns beyond the local area. Travel demand model screening can include relative volume comparisons and link demand-to-capacity (d/c) ratios. The future no-build alternative needs to be included in the analysis as the baseline that the preliminary alternatives are compared against.

  Any comparisons using HCM-based v/c's need to use the current Highway Design Manual (HDM) v/c's. Travel demand model-based link d/c's have different methodology and cannot be directly compared to the HDM v/c's. Travel demand model-based screening criteria should be based on relative comparisons. Comparisons may also need to be made to local jurisdiction operational standards which could be LOS, v/c or delay based.

  The task deliverable is a technical memorandum, with the screening criteria and results shown for each alternative. A summary comparison table that shows how the alternatives and the future no-build alternative perform against the screening-level criteria and each other must be included. Recommendations for keeping or dropping alternatives based on traffic analysis considerations should be included.

  Note: Post-memo project team decisions on alternatives should be documented in the next technical memorandum on build alternatives and need to be documented in the alternatives considered but dismissed section of the final memo/narrative.

- **Task 6 – Evaluate Build Alternatives**
  The purpose of this task is to work with the project team to develop and completely evaluate the detailed alternatives that satisfy the future transportation needs for this project. All tasks need consider timelines per alternative. Ideally, no more than three detailed alternative analyses are performed. Too many full–detail alternatives will result in excessive time or budget requirements.

  The methodology for this task is:
  - Develop build and future year Design Hour Volumes (DHVs) for each of the final alternatives. Either distribute the no-build volumes on the build alternatives, or create new build volumes for each alternative if currently diverting traffic that would return with the new alternative is sufficient to invalidate the use of the no-build volumes.
  - Operational considerations such as preliminary signal warrants, functional area, and turn lanes will be evaluated.
  - Evaluate the v/c and LOS and other performance measures for the study area for intersections, merge/diverge/weaving sections, freeway mainlines and highway segments.

- Perform a predictive safety analysis if appropriate following procedures in Chapter 4.
- Perform multimodal evaluations across the pedestrian, bicycle and transit modes.
- Microsimulation of build conditions including determining turn bay storage lengths using the 95th percentile build queues and blocking of turn bays and upstream intersections.
- The output build v/c's must be compared with the HDM design v/c's for state facilities. Non-state v/c or LOS need to be compared with the appropriate local operational performance measure standard.
- Work with TRS/Region Traffic if new signals or changes to existing signals are involved. A progression analysis for the study area is needed if more than one signal is included in the alternative.
- Determine if access, intersection and interchange spacing meets or improves over current conditions in the OHP spacing requirements.

The task deliverables include a technical memorandum with volumes, v/c, LOS, queues, safety, multimodal, and other measures of efficiency shown on diagrams for each alternative, a summary comparison of the alternatives (including a table) and how they fared against the evaluation criteria and each other. Also, the design storage lengths and other geometric details need to be forwarded onto the appropriate design staff, either ODOT or consultant.

- **Task 7 – Environmental (Air/Noise/Energy) Traffic Data (If Needed)**
The purpose of this task is to produce environmental traffic data for the no-build and build alternatives. The base year and no-build future year environmental traffic data can be started immediately after the Task 3 volumes are completed. The build alternative environmental traffic data should not be started until the final build alternatives are selected. Note: need to make sure that the data collection efforts properly support this task (i.e. ADT creation-capable classification counts).

This includes the base year, build year and future volumes. Larger projects may also require the creation of short-term future year (10 year) data. The analyst should contact the air/noise/energy specialist(s) who will be using this information before beginning this task to ensure the correct information is provided. Air quality and energy data may or may not be needed. There may be some differences in data requirements from project to project, depending on the needs of the user of the data.

The methodology for this task uses the balanced hourly volumes, the average daily traffic (ADT), and the LOS C volume thresholds. The average daily traffic volumes will need to be developed and balanced for all needed years. The LOS C volumes will also need to be developed. This volume data, in addition to truck classification data, is needed for the base, build and future years to compute the environmental traffic data. The LOS C volumes (representational of the noise hour which is the maximum number of vehicles moving at the maximum speed) are only needed for noise analysis. Use the TruckSum summary spreadsheets and the EISBase program. Work with the noise consultant to confirm years and data results requirements. In congested areas, air quality data might be needed, which involves intersection LOS and number of stopping vehicles on each approach. Energy data may be needed on large projects of regional significance (environmental impact statements) which involves vehicles miles traveled.

The task deliverables include the environmental traffic data for the base, build and future years delivered to the air/noise/energy consultant(s). Diagrams are also required as the identification/location key for the data.

- **Task 8 –Traffic Analysis Narrative/Final Technical Memorandum**
  The purpose of this task is to prepare the written documentation of the project analysis. This will assist the project team in making the preferred alternative selection. For large or complex projects a full narrative report is required. For smaller projects such as single intersection safety or operational projects can be documented with a final technical memorandum.

  The narrative/memo should draw from, summarize, and discuss information from all of the previous technical memoranda and any other analyses into a stand-alone document. Draft and final versions will need to be produced. In addition, the final narrative/memo needs to have an engineer's stamp as it is a document of record for the traffic analysis. The narrative/memo will document all of the selected and dismissed alternatives and may or may not make any recommendations.

2.5.3 Typical Task Times

Every project is different so actual task times can be quite different depending on project complexity, actual staff time available or overall project schedule (i.e. fast-tracked) to name some of the factors involved. Timelines should be defined by number of weeks required to complete each task. Target completion dates for each task should be established but should allow for overall analyst workload. For example, the timeline may show three weeks to complete the task if 100% of time was available, but if only 25% of time is available then the target date should be 12 weeks out. The final task timelines are negotiated with the project leader depending on the resources involved. Actual task timeline totals will depend on the overall size of the project, how many different years are analyzed, and number of alternatives/options to be analyzed.

Here are some general guidelines for typical studies:

Project Understanding/Scoping

- Allow at least two weeks to develop work plan, identify issues, constraints and impacts to analysis in review of existing/current plans and projects.

Counts/Inventory

- Allow six to eight weeks for counts to be completed and processed
- Allow at least two weeks if crash data are to be requested from the Crash Analysis and Reporting Unit
- Count timing – can add many months if the data collection window is passed

Volume Development

- Allow a month to create the existing 30th highest hour volumes
- Time to update a travel demand model if needed (6 -12 months or more)
- Allow three weeks for model application requests to be completed
- Allow a month to create the future no-build volumes (including all interim years)
- Allow about two weeks to create volumes for each alternative

Analysis

- Allow at least four weeks to perform and report on alternative screening analysis. This will depend on number of alternatives and how many levels of screening to do (i.e. travel demand model relative comparisons followed by key intersection v/c's).
- Allow two weeks for analysis of each build alternative

Simulation

- Allow one to six weeks for simulation model construction/error checking (depends on software)
- Simulation calibration – SimTraffic (two weeks to a month); Vissim (one month +)?
- Allow one week per alternative for simulation results

Environmental Traffic Data

- Allow one to two weeks to setup link diagrams, spreadsheets, etc
- For smaller projects allow one to two weeks per existing, no-build future and alternatives (three to six weeks total)
- For larger projects allow four weeks per existing, no-build future and alternatives (12 weeks total).
- Allow one to two weeks for review of data (dependent on reviewer's schedule).

Documentation/Review

- Allow three weeks to write and review tech memos
- Allow a week for a reviewer to review the draft tech memos/ narrative (dependent on reviewer's schedule).
- Allow four to six weeks to write and review draft narrative; two to three weeks for final publication
- Allow one to two weeks for completed deliverable review and comment

2.5.4 Reviewing Analysis Work

Often times an analyst may be required to review work conducted by others, whether it was performed within the Department or by a consultant. All traffic analysis work (either done internally by ODOT staff or by a consultant) must be reviewed by an Oregon-registered civil or traffic engineer. At a minimum, this can be a peer review if both the analyst and reviewer are Oregon-registered civil or traffic engineers. The reviewer should be the analyst's lead worker/supervisor as they should be involved in the flow of the work. If the analyst is not registered, then the reviewer must be the lead worker/supervisor who is registered as they must be familiar with the work as the professional responsibility falls under them. Work performed by a non-registered consultant analyst must be reviewed by their registered lead worker/supervisor prior to submission to ODOT for review.

The review parameters such as who the reviewers are, what is going to be reviewed, and what level of detail the review will be must be documented before the review starts. At least one week should be allowed for the review of memos and reports. Individual review of analysis methodology, work in-progress, figures, etc should be completed in two or three days or less.

The following section provides general guidance for reviewing traffic analysis that can be applied to any type of analysis project. Specific guidance for the review of TISs can be found in ODOT's Development Review Guidelines.

2.5.5 Purpose of the Review

The reviewer should know what the purpose of the review is as this establishes what the review needs to cover. Some considerations include:

- Audience – is this only for internal, technical staff or is this to be included as part of a public document like a traffic study or guideline?
- Completeness – is this a rough draft to start a process or a discussion or is this to report analysis, discussions or decisions?
- Full Documentation – are there short-cuts taken like referring to other past memos/reports/projects? Note that report readers may not have access to the other reports. Reports should stand alone. For example, just stating that "US 101 in the project has an OHP mobility standard v/c ratio of 0.85 in Tillamook", leaves out the missing classification information which includes items like what is the highway classification; expressway, freight route, or Special Transportation Area designations, etc.
- Accuracy - need to verify things like OHP/HDM standards, speeds, lane configurations and traffic control
- Consistency - thinking "outside the box" may be good in some cases, but it should not carry through freely to documentation as readers are looking for specific types of information and having to sort through pages of data can be difficult.

2.5.6 Organization and General Format

The report should be set up for the specific (target) audience, using words and sentences (word size and sentence length) appropriately with acronyms defined and used minimally. Most readers need some sort of organization, so thoughts should be grouped linearly (i.e. time, location, or process) or grouped by topic (i.e. safety, configuration/geometrics, policies/standards, procedures, and findings/conclusions).

The report should have good readability. Color does not always copy well as graphics may just turn into multiple impossible to differentiate shades of gray. Graphics should use patterns to distinguish different features as much as possible. Typeface size for general text should be at least a 12 point (or larger) and should be limited to standard fonts with few "extras" (i.e. Times New Roman, Georgia, Arial, Verdana). Footnotes in text, tables or figures should not be any smaller than 8 point. Remember that clarity dissolves with copying and not all programs use all fonts.

The format should be appropriate, so there should be “white space” instead of continuous lines of text. Paragraphs after paragraphs of text lead to low readability. Tables are better but can be complex especially if multiple variables are involved. Tables should make data easy to read by making comparisons and failing values should be emphasized (bolded, shaded, etc).

Drawings and figures are better than long-winded description paragraphs, but some text is still needed to point out or explain to the reader the important features, issues, key locations, etc. Numbers should be noted and balanced appropriately (i.e. future volumes rounded and not to the exact amount; or not losing traffic between ramps on a freeway). Information should be limited to about three layers on a single diagram (i.e. street names, classification, and volumes).

2.5.7 Checking Information

A reviewer does not have to check every fact and figure, but should cover major sections and areas that would affect the results of the work. Some of these areas are:

- Study Area - When reviewing analysis conducted by others, knowledge of the study area is typically beneficial. The reviewer should first examine all study area mapping and photographs available and visit the physical site, if practical to do so.
- Roadway Classification and Jurisdiction - This establishes what type of road it is and who controls it. This will determine what overall performance measure to use (state or local) and the specific value.
- Analysis Methods and Processes – The document should state its purpose and need as that establishes the level of detail needed in the analysis, the answers that are needed and what the expected results are. Review the methodology memorandum to make sure that the assumptions and parameters to be used in the existing conditions, future conditions and the alternatives is appropriate for the level of detail of the work. As long as the work follows the memorandum, then the rest of the review is streamlined for both sides. Any disagreements need to be taken care of before analysis work is started to minimize rework and issues later. Keep in mind assumptions made by the analyst performing the work can have a significant effect on analysis results, even if specific analysis procedures are followed correctly.
- Data - With any type of technical analysis the proper collection and processing of data is critical to obtaining accurate results. Before reviewing the analysis itself, verify the data used is appropriate for the analysis conducted. Consider things such when was the data collected, type of data used, and whether any processing of data (e.g., volume balancing) was conducted correctly.
- Appropriate Factors – This means checking that the count data was correctly obtained and correctly seasonally adjusted to the 30th highest hour (or other applicable alternative standard). Are seasonal adjustments less than 30%? Are all the counts adjusted to a common base year? Are other analysis parameters correct such as the peak hour factor?
- Spot Checks – The reviewer should do a few quick checks by pulling the cited data and verifying correctness. With the given data, can the reviewer reproduce the seasonal and growth adjustments? Or can they follow the methodology used in a volume development or future post-processing spreadsheet? The calculations performed in the analysis should be checked for computational errors, and procedures used must be appropriate for the given situation and in compliance with accepted ODOT practices. Knowledge of the

study area, prevailing traffic conditions and accepted ODOT analysis procedures will aid the reviewer in determining which assumptions are appropriate, and which are not.

- Correct Processes – Make sure that what is reported was analyzed with the correct program. For example, queue lengths in congested systems should be from a system micro-simulation program (SimTraffic), not just the program (Synchro). Also, make sure that methodologies cited in a scope of work, workplan, or a methodology memorandum, are being followed.
- Correct Targets/Standards – Once the adequacy of the analysis has been verified, compare the results to ODOT's adopted performance measures. Check any proposed mitigation against ODOT's design standards. Often times the review process will require coordination with other units within ODOT that have specific expertise in, or authority over, certain elements of the design or approval of the mitigation proposed.
- Reasonableness - In addition to technical accuracy, the results of the analysis must be evaluated using a "reasonableness" test. The reviewer should compare the subject data, such as the traffic volume counts, lane configurations and traffic controls, and determine whether the conclusions and recommendations of the study are reasonable. This type of test often helps pinpoint sources of error in analysis, and may reveal questions likely to arise when the project is presented to the public.
- Addressing Errors - When sources of error are detected in the analysis, the reviewer should not only note the error itself, but acknowledge the significance of the error to the results of the analysis. There may be times when correcting the error would require a substantial amount of work, but the results of the corrected analysis would not be significantly different and the recommendations of the study would remain unchanged. Noting the significance of the error ahead of time will enable ODOT to determine whether correction is necessary or cost-effective.

2.5.8 Documentation

For a typical report, there should be documentation of the following:

- Study area map
- Methods and assumptions
- Applicable polices, standards, background conditions
- Local street and highway system including (pedestrian, bicycle, and transit modes)
- Data and inventory summary as well as source(s) of the information
- Traffic volumes (segments and/or intersections)
- Volume development – raw counts, system peak hour, adjustment factors, unbalanced volumes, base year, build (opening) year, future years
- Trip patterns/distributions
- Lane configurations
- Land use and zoning maps
- Circulation routes
- Existing or proposed scenarios/concepts
- Existing or proposed alignments/alternatives
- Existing & future no-build and build alternative analysis
- Summaries as appropriate
- Conclusions and recommendations
- Technical data included in appendices with electronic files available upon request

Missing sections or other errors/issues found should be addressed in a comment memo or Email, so the reviewer's comments can be documented as well. Page, section and/or line number should be identified for easy reference. Many times the team/project or planning lead will be consolidating comment from a number of reviews.

[Appendix 2A – Problem Statement Worksheet](#)

[Appendix 2B – Sample Analysis Process Reviewer Checklist](#)

[Appendix 2C – Sample Methodology Memorandum](#)

References

(i) Senate Bill 1059: GHG Modeling & Analysis Tools, Oregon Sustainable Transportation Initiative (OSTI), ODOT, January 2012