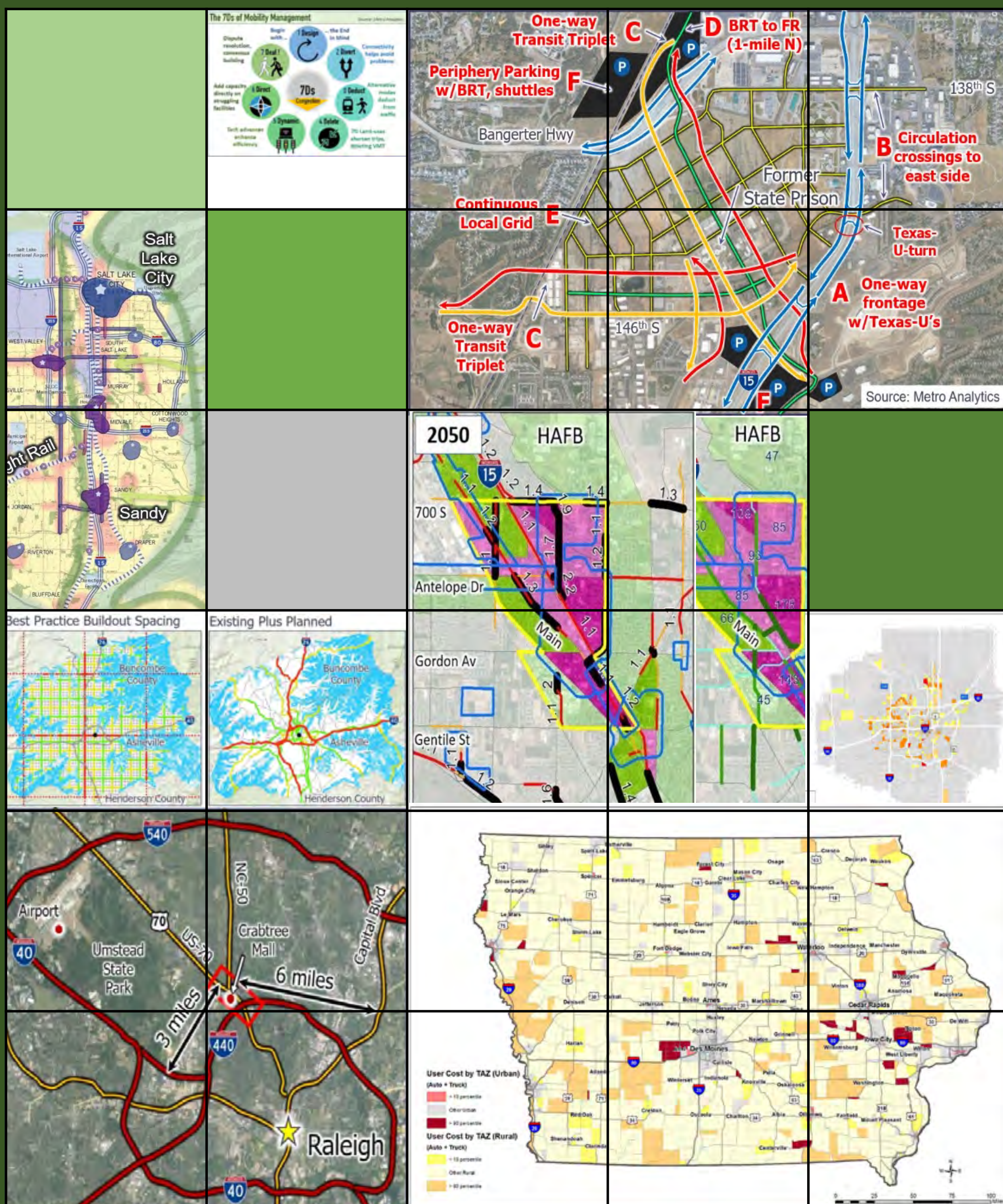
NCHRP 20-44 (22)

Right Sizing Transportation Investments

Methods for Planning and Programming

IMPLEMENTATION PLAYBOOK



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Introduction

A Changing World Requires a Changing Transportation System

Past generations have left a legacy of transportation assets for today's society. This legacy carries both tremendous value along with responsibility to adapt the transportation system in response to evolving economic, societal, and environmental awareness. Agencies and stakeholders are increasingly aware that the arrangement of resources, land, cash flows, and infrastructure inherited from the past often require "right-sizing" to free up resources, improve performance and enable progress to occur. *NCHRP 917: Right-Sizing Transportation Investments: A Guidebook for Planning and Programming (2019)* offers practical ways that transportation agencies can embrace right-sizing as a paradigm for investing, planning, and prioritizing their choices.

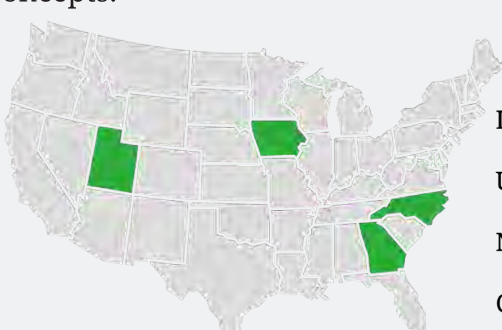
> Right-sizing can be understood as repurposing, reusing, or fundamentally resizing (either larger or smaller) an existing asset (or in some cases, plans for a future asset) for a newly understood economic function or purpose.
>
> NCHRP 917: Right-Sizing Transportation Investments: A Guidebook for Planning and programming (2019)

What Does it Mean to Right-Size a Transportation System?

Traditionally, transportation infrastructure investments have been based on a need to respond to a current or projected deficiency. If potholes are emerging, investment is made to prevent or repair them. If bottlenecks appear, investment is made to expand capacity. If crashes occur, investment is made to improve designs. But what if a perfectly sufficient asset simply costs too much to maintain in its current state due to changes in utilization? What if the location or characteristics of an existing facility prevents a better and higher use of land, development capital, or community quality of life? What if changes in technology, trade, and demographics raise questions about what the real need for a transportation asset or program will be in the future?

Right-sizing is the transportation planning practice of identifying and addressing situations where the understanding impacts of technology, the economy, and society can result in more efficient transportation investment choices. A right-sized system or program is one where dollars spent not only minimize deficiencies but also align with the best and highest use of resources for all the stakeholders involved.

In 2019-2021 the states of Utah, Iowa, Georgia, and North Carolina undertook pilot studies to implement the right-sizing principles given in NCHRP 917. Their practical experiences serve as a playbook for other agencies seeking to implement right-sizing concepts.



Iowa: Right Sizing for trade and technical uncertainty

Utah: Livable Centers as Right-Sizing

North Carolina: Right-Sizing networks and corridors

Georgia: Right-Sizing a right-of-way program

Why a Playbook?

Because right-sizing is a far-reaching paradigm for changing how agencies use and invest in transportation system, it can be difficult to understand where to begin. While the approaches offered in NCHRP 917 - Right-Sizing Transportation Investments: A Guidebook for Planning and Programming cover a wide range of policies and techniques, - this Playbook is intended to provide easy-to-use first-steps for agencies to implement. The Playbook features early right-sizing efforts from four-states presented in ways that others can replicate and adapt for right-sizing success. At its heart, the playbook is offered to enable planners and decision makers to understand in a brief sitting some of the core principles of right-sizing and how others have applied them, with the chance to probe more deeply into how the techniques have been applied and why.

What the Playbook is About

Who Can Apply Right Sizing Techniques? Different Right-Sizing Roles

While not every role in right-sizing solutions is covered in the experiences of four states, the experiences of Utah, Georgia, North Carolina, and Iowa in the NCHRP 20-44(22) pilot studies demonstrate how a wide range of professionals can apply right-sizing in different roles. A key characteristic of right-sizing is the breadth of the concept as a planning and investment paradigm that can be implemented in one part of an agency and incrementally spread to other programs. The plays offer practical examples of how diverse roles such as a state DOT right-of-way office (Play 1), an MPO planner coordinating with local municipalities on new infrastructure (Play 4), a statewide modeler (Play 3), an MPO planner coordinating livable centers in a unified planning process (Play 5), a planner assessing long-range transportation needs under changing technologies (Play 3), or an MPO planner managing a complex multimodal corridor (Play 2) have implemented the guidance of NCHRP 917.

The NCHRP 917 guidebook identifies roles for private developers, municipal planners, community groups, as well as other stakeholders not featured in the four states of the NCHRP 20-44(22) pilots. However, the examples in the playbook offer a starting point for how some practitioners can leverage their roles in ways that may inform and engage others in more widely realizing right-sizing intelligence and decisions.

How can I Implement Rightsizing in Existing Planning Processes?

Right-sizing is best understood not as a new or stand-alone process, but as a new way of engaging in existing planning and decision-making processes. The experiences of states and MPOs piloting right-sizing techniques demonstrate how right-sizing can readily be incorporated into processes like statewide right-of-way management, corridor management, statewide forecasting, metropolitan level-of-service analysis, long-range transportation planning (LRTP), and livable centers initiatives. The experiences of the four states are also instructive regarding how right-sizing alternatives explored for a corridor or a network raise both challenges and opportunities to pinpoint appropriate junctures in more systemic processes, such as integrated program delivery or comprehensive transportation planning, where right-sizing assessments can make consistent contributions.

Setting Up the Play Field: Practical Advice for Right-Sizing Assessments

While Chapter 4 of the NCHRP 917 guidebook offers a host of practical methods for diagnosing and evaluating right-sizing opportunities, the real-world implementations provide more detail on the challenges and results that can be expected. The experiences of the four implementing states are accompanied by practical documentation of the general steps taken to diagnose where right-sizing opportunities could be found, how the opportunities are evaluated, visualized, and communicated, and how this information is used in decision making. Within each of the plays, there are links to primers that can show not only the principles applied in the implementing states but also transferable steps that others can try and customize for their own unique policy and planning environments.

How to Use the Plays

The plays that follow provide helpful tips and guiding principles based on the real-world applications from four states and their MPO partners' application of the body of research provided in NCHRP 917. Like any application of principles, the experiences of these agencies are distinct, and each organization and community will have its own right-sizing experience. The techniques applied in these pilot cases are not all-inclusive of the full body of right-sizing opportunities available through NCHRP 917 and may not be transferable to every peer organization. While some plays may be implemented together in the same organization, agencies may find it helpful (as in these examples) to implement right-sizing first to one area, program, or system as a basis for introducing the concept which then can inform other agency groups and stakeholders.

When using this playbook, feel free to change up the plays to suit local needs. The research offers practical applied examples of right-sizing techniques and innovative methods for identifying the best and highest uses of transportation resources. It is offered to facilitate a new generation of planning and decision-making initiatives that focus resources on the improvement of the human condition through a more dynamic understanding of transportation needs and opportunities. The hope is that this playbook will be a starting point for more innovative practices and tools to be developed from these basic plays. As the plays are executed and new ones are developed, practitioners are encouraged to share their success through collaboration in the American Association of State Highway Transportation Officials (AASHTO), the Transportation Research Board (TRB), and other associations.

Contents

PLAY 1 – Know One's Assets and Seek Their Best and Highest Use

A key to right-sizing a transportation portfolio is understanding its assets and their best and highest use. For many agencies, the portfolio includes both land and capital infrastructure. A starting place for right-sizing can be taking inventory of what a transportation agency owns, what it needs to own, and whether there could be either better owners, or better uses of infrastructure, land parcels, or other resources the agency currently retains. Chapter 2.1 of the recently published NCHRP 917: Right-Sizing Transportation Investments: A Guidebook for Planning and Programming (2019) provides four high-level goal areas for a right-sizing policy. These include (1) reducing or managing life-cycle costs, (2) achieving best and highest uses of assets and revenues, (3) aligning funding and decision making with intended beneficiaries of an asset, and (4) arriving at a cost-effective understanding of needs and solutions.

Because it can be difficult for agencies to evaluate which actions best satisfy right-sizing policy goals, NCHRP 917 policy guidance also recommends a "three-part test" (Figure 1.2) to evaluate changes in transportation infrastructure or policy. Chapter 2.4 of the NCHRP policy guidance also recommends the use of decision clinics to engage stakeholders in creating partnerships to ensure that the right-sized value of every resource is properly envisioned and realized through right-sizing efforts.

CASE STUDY – Right-Sizing Georgia DOT's Land Parcels:

Like most transportation agencies, the Georgia Department of Transportation (GDOT) owns many parcels of land acquired over years of highway construction and maintenance that are no longer needed for transportation purposes, but still belong to the state. These are called "remnant parcels" (R-parcels) and are prime targets for right-sizing. GDOT has applied right-sizing principles to better manage its inventory of remnant parcels, reduce the number of new parcels added to this inventory, and dispose of or utilize remnant parcels in the inventory more proactively. GDOT sought a process to right-size a growing inventory of over 8,000 parcels of which the administrative and maintenance burdens are unsustainable. They requested assistance to identify and implement specific right-sizing techniques statewide. It has been the experience with DOTs throughout the country that implementation efforts are not likely to succeed unless it can be demonstrated that they are aligned with the agency's strategic plan. This is particularly important to this effort given the GDOT Strategic Goal to: "utilize performance-based management, innovation, & P3 to deliver GDOT's mission responsibly and more efficiently." This implementation effort has consciously worked to align with this principle and to take a function that is, and will remain, a function of the Office of Right-of-Way, and elevate it by creating involvement by multiple GDOT offices and bureaus.

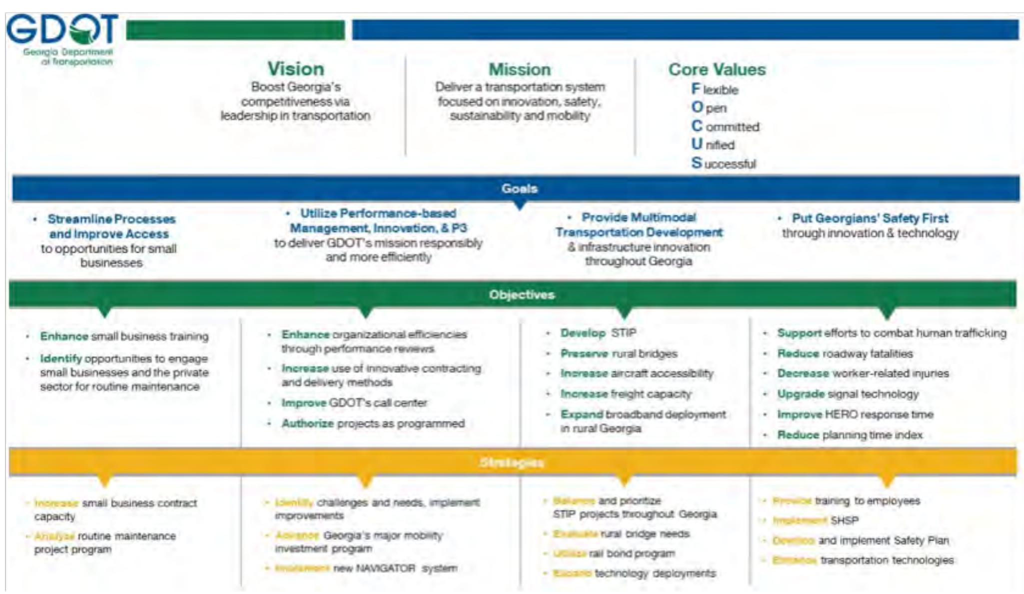


Figure-1 GDOT Strategic Goals

Select a Right-Sizing "Starting Point" Where There Are Clear Objectives

Because right-sizing is a new paradigm for state transportation departments, NCHRP 917 recommends incremental implementation of right-sizing principles. It is helpful to begin by identifying a program or asset where there is a widely understood need to improve efficiency or achieve alignment between outlays and sources of value in transportation assets. Georgia chose the right-of-way program as a natural right-sizing starting place due to the well-established understanding that a process was needed to achieve greater efficiency.

GDOT's R-parcel inventory is created through normal right-of-way acquisition activities when severance, good-faith negotiation, or other purchases create an uneconomic remnant that is not needed for the project but is of no value to the owner(s). GDOT is committed to protecting the rights of impacted property owners, and so the uneconomic remnant is purchased even though it is not needed for transportation purposes. This creates an inventory of R-parcels that are not needed for direct transportation use, are not on local tax rolls, and create an overhead burden in terms of property management and maintenance costs. Because this inventory is growing it is an appropriate candidate for a right-sizing evaluation and implementation effort. It is obvious that these R-parcels are not in their best and highest use, and so there are reasons to believe there are sources of value that can be leveraged.

Use Decision Trees and Decision Clinics to Consider Right-Sizing Options for Assets

The Georgia experience shows that a decision tree can be a helpful construct for evaluating assets in a program and applying the three-part test working through right-sizing decisions about assets. Using a decision tree to categorize R-parcels, GDOT arrived at a process for creating an inventory of R-parcels that are not needed for direct transportation use, are not on local tax rolls, and create an overhead burden in terms of property management needs. Because this inventory is growing, it is an appropriate candidate for a right-sizing evaluation and pilot implementation effort. An application of the NCHRP 917 3-part test (Figure 3) readily shows that these R-parcels are not in their highest-and-best use, and there are reasons to believe there are sources of value that can be leveraged. In discussing possibilities with representatives of GDOT Right-of-Way Services, four distinct groups of R-parcels were identified:

Group 1	Group 2	Group 3	Group 4
R-parcels that have a marketable highest-and-best use of their own and can be transacted arm's length in an open market. We understand that GDOT ROW has engaged Vaughn and Melton to assist them with these R-parcels, and so while Group 1 is not a primary focus of this effort, it is incorporated for the sake of completeness.	R-parcels that have their own highest and best use but cannot be conveyed arm's-length because of limited potential buyers. There are multiple possibilities for conveyance for uses that could be monetary or non-monetary.	R-parcels that do not have their own highest and best use but must be conveyed non-arm's length. This may include instances of surface easement that can only be released to the underlying fee owner, or areas that have functional utility only in assemblage with an adjacent property owner.	R-parcels that do not have their own highest and best use but may be conveyed for transportation enhancement uses, or simply to return the parcel to the tax rolls.

An annual review of the inventory may reveal sufficient R-parcels in this group to make such an effort cost effective on an as-needed basis.

GDOT has applied the NCHRP 917 guidance for decision clinics to arrive at the above groupings. In applying this technique, GDOT utilized both internal and external decision clinics to consider the department's needs and uses for assets, as well as potential value to external users and outside parties. The internal decision clinics process has a strong focus on identifying and retaining parcels that are needed by GDOT or by local partners for future transportation needs. This retention does not preclude an interim, alternative use of the parcel, but it will not be disposed of. The parcels that are not needed by GDOT or local partners can then kick off an external decision clinic that will actively seek the disposition of the R-parcel. The groupings are subject to change; it is intended to be a dynamic process.

The Three-Part Test for Right-Sizing

The three-part right-sizing test provided in NCHRP 917 is a practical way to apply right-sizing criteria to determine if a proposed change in an asset qualifies as a right-sizing improvement (Figure 1.2). The test may apply differently to an entire program (such as right-of-way) than it would to an individual asset (like an intersection).

As part of the R-parcel right-sizing implementation, it was beneficial for GDOT to apply the three-part test to the R-parcel inventory management application. The three parts of life-cycle cost testing, alignment testing, and best and highest use testing all support this implementation. These three parts are briefed for the R-parcel inventory application below.

Life-Cycle Cost Test: Remnant parcels on the GDOT inventory are, by definition, not required for traditional transportation uses. Simultaneously, these parcels are not on the tax rolls, and they carry overhead burdens for GDOT in the form of annual property management and maintenance costs. Therefore, retention of these parcels is a dis-benefit to GDOT unless an alternative use can be identified.

Alignment Test: As discussed above, indefinite retention of R-parcels that have no future transportation use to GDOT or a local partner does not align with GDOT's Strategic and Management Goals. The rate of growth of the inventory is also unsustainable given current constraints on resources.

Best and Highest Use: Because these parcels are unused and are not immediately needed for traditional transportation uses, they are by definition not in their best and highest use. If GDOT determines that a given parcel can be disposed, then it will transition into its best and highest use once the transfer is complete. If GDOT determines that the parcel is to be retained (or, if there is no market demand for the parcel), then alternative uses may provide an interim use.

Right-Sizing Tests	Key Questions for Determination
Life-Cycle Cost Test	• Will the proposed change reduce life-cycle costs? • How will the cost savings accrue from the right-sizing action? • Will these costs be saved or merely shifted to other agencies or to the traveling public?
Alignment Test	• How will the proposed change offer incentives to users and beneficiaries of the program or facility to participate in its costs? • How will the agency enable the proposed beneficiaries to participate in decisions regarding the future of the facility? • Do key affected partners endorse the change?
Best and Highest Use Test	• Does the choice enable an asset or program to be used differently from how it is currently being used? • What new economic opportunities are available as a result of this changed use, function, or ownership? • What indications are there that these opportunities are real and can be expected to materialize? (Examples may include analogous similar cases, commitments from developers or other governmental partners, or other contextual information). • Will the choice meet the transportation need in the most sustainable and equitable way available?

Figure 2 Three-Part Test (NCHRP 917 p 54)

Apply Decision Clinics with Both Internal and External Stakeholders

A decision clinic is a right-sizing activity in which different stakeholders are invited to offer perspectives on sources of value they can derive from an asset. Decision clinics enable right-sizing decisions to be made with a complete understanding of potential partners, as well as the complete universes of potential uses, funding sources, and business cases for the asset or programs' future. GDOT used right-sizing decision clinics as collaborative workshops in which technical staff from throughout the enterprise (internal decision clinic) and from each partner agency (external stakeholders) presented to the other the decision criteria, supporting data, and type of analysis they have conducted concerning a parcel or set of parcels. Partnerships are critical to any right-sizing effort. Since one size does not fit all, GDOT has embraced the use of internal decision clinics to categorize the R-parcel inventory and the use of external decision clinics in the form of intergovernmental agreements and public/private partnerships to help determine alternative use or disposition.

Internal Decision Clinics: The task of organizing R-parcels into the categories discussed above is a function that is entirely internal to GDOT. The primary responsibility for this internal decision clinic is, and will continue to be, the GDOT Office of Right-of-Way. With right-sizing, however, the task has been expanded enterprise-wide to also include:

- Office of Performance-Based Management and Research
- Office of Legal Services
- Office of Utilities
- Office of Maintenance, and
- Office of Environmental Services

Regular sessions of the internal decision clinic will be scheduled so that this right-sizing process becomes fully integrated into the way GDOT manages property and right-sizing is mainstreamed.

External Decision Clinics: R-parcels are categorized with one of two general possibilities resulting. Either a given parcel will be identified for disposal and external partners and stakeholders will be required to expedite the disposition, or the parcel will be identified for retention and the external partners and stakeholders are needed to help identify potential alternative uses. It is not likely that GDOT will have all of the authority, information, or resources needed to expeditiously seek alternative uses for an R-parcel. External decision clinics have been introduced to synergize the key stakeholders.

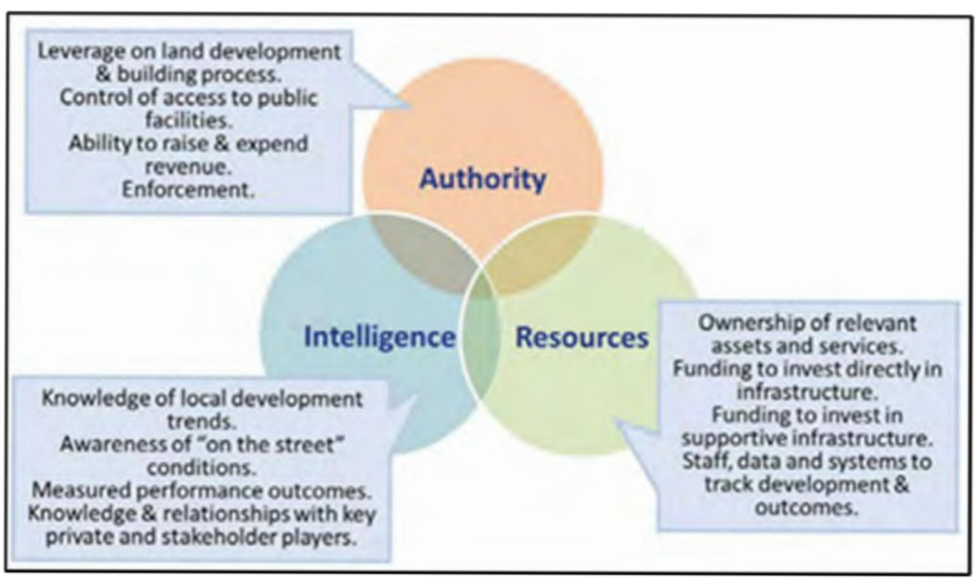


Figure 3 Synergies from External Decision Clinics (NCHRP 917 p24.)

PLAY 2 – Manage Corridors for Right-Sizing Objectives

The process of corridor management often involves different partners with conflicting ideas about the size, extent, or role a corridor should play. Chapter 3.4 of the NCHRP 917 guidebook (Table 19) notes that almost every technique of right-sizing can have some application in the corridor management process. Furthermore, NCHRP Web-Only Document 263: White Papers for Right-Sizing Transportation Investments (Chapter 4) contains a host of right-sizing design solutions that integrate travel demand management with innovative urban and infrastructure concepts to achieve right-sizing objectives.

In collaboration with the Capital Area Metropolitan Planning Organization (CAMPO), the North Carolina Department of Transportation (NCDOT) has been testing a new methodology incorporating these concepts for right-sizing arterial corridors. The ART (Arterial Right-Sizing) Tool enables practitioners to systematically review corridor features within the context of land use attributes, and offer a set of potential supply and demand-side improvements that could improve the alignment of infrastructure with the current development context. North Carolina DOT (NCDOT) selected a segment of US-70, Glenwood Avenue (the corridor), in Raleigh as the first place to test the overall ART process.

Focus on Corridor Mobility, Not Just Corridor Infrastructure

A key right-sizing principle offered in NCHRP 917 and its associated whitepapers, is the observation that better mobility can often be achieved with a tighter or more efficient infrastructure blueprint. NCDOT and CAMPO's dialogue about right-sizing corridor solutions explored ways to enhance mobility as opposed to simply ways to "fix" existing infrastructure.

North Carolina and CAMPO's right-sizing exploration followed a structure for understanding corridor needs, which may be characterized as the "7Ds of Mobility Management". The 7Ds of Mobility Management are encapsulated into the ART tool and reflect key right-sizing considerations that can be beneficial to agencies seeking to evolve from infrastructure-based corridor management to a more efficiency or supply/demand-based right-sizing paradigm for corridors. The principles built into the tool as applied in the Raleigh corridor experience include:

Principle 1: Design for build-out vision

Right-sizing a corridor entails a practical review of its design characteristics within the context of changing mobility requirements. Criteria applied in the ART process include (1) scanning community plans for walkable mixed-use development in this segment, (2) assessing lane-widths relative to the need for other activities in cross-sections, (3) checking the sufficiency of setbacks allowing flexibility for on-street parking, uniform street trees, or cycle tracks and (4) checking spatial patterns for the potential that properties can be linked through parking lots or enhanced street connectivity to reduce arterial friction.

Principle 2: Divert traffic away from overloaded or sensitive areas

The right-sizing process for a corridor also entails the consideration of optimizing the use of the corridor by making the best use of available alternative routes and modes. Criteria applied for this principle include: (1) scanning the surrounding network for parallel collectors or arterials that can be created or improved to reduce pressure on this arterial, (2) assessing the possibility to create continuous "backage" roads linking discontinuous local streets across parking lots or under-utilized property, (3) evaluating the potential for MPO or state DOT financing for small area plans to help local communities identify and vet diversion opportunities and get them onto master transportation plans.

Principle 3: Deduct traffic through opportunities for alternative modes

Because a common right-sizing problem or corridors is over-build of infrastructure without solving underlying mobility patterns – the ART process is designed to provide the occasion of seeking to mitigate over-use of the corridor infrastructure. This part of the assessment invites planners to scan for right-sizing opportunities to deduct from travel demand such as (1) the potential for bike paths to be widened to accommodate alternative new modes such as Neighborhood Electric Vehicles (NEVs), (2) the potential for paths be grade-separated at time-consuming or dangerous crossings to attract more users and, (3) the current or potential frequency and attractiveness of transit options.

Principle 4: Delete VMT through land-use efficiency

As discussed in Chapter 2.4 of NCHRP 917, urban right-sizing entails partnership with municipal land use and growth management authorities. Part of the ART application explores the potential to manage the size of the corridor infrastructure through land-use efficiency. The process entails scanning for (1) possible opportunities to redesign walkable areas to enhance walkability, (2) assessment of the feasibility for techniques like form-based zoning codes be used to encourage mixed-use, higher-density development, and (3) review of parking requirements, such as opening for consideration of whether "minimum parking capacity" could be replaced with "maximum parking allowance".

Principle 5: Dynamic technologies can help

Dynamic technologies such as Mobility as a Service (MaaS), and associated business models are understood to be an important component of right-sizing. While these models were not yet integrated enough with land-use or transit planning in Raleigh to be explicitly addressed in the ART implementation – the application is designed to allow planners to assign a factor to account for TNC or other mitigating technologies with identifying the size and scope of corridor needs.

Principle 6: Direct efficiency by routing through trips directly on the corridor

NCHRP Web-Only Document 263: White Papers for Right-Sizing Transportation Investments (Chapter 4) focuses strongly on the role of strategically placed innovative designs. A consideration in the ART process as applied in the Raleigh application entails differentiating locations that are best for pedestrian crossing and activity from those that may be suitable for innovative auto-oriented treatments like quadrant and Bowtie Intersections or one-way split intersections, Continuous Flow Intersections, and other auto-oriented designs improve throughput if pedestrian activity is not a priority.

Principle 7: Deal with and engage more stakeholders to help finance right-sizing

A final consideration is the possibility that a mobility challenge will remain, but a city will grow around it. Effectively, the arterial right-sizing process entails a scan to ascertain if a mobility challenge that defies any other right-sizing solution may be a proxy for other markets in land value or other factors which could warrant exploration of value-capture opportunities.

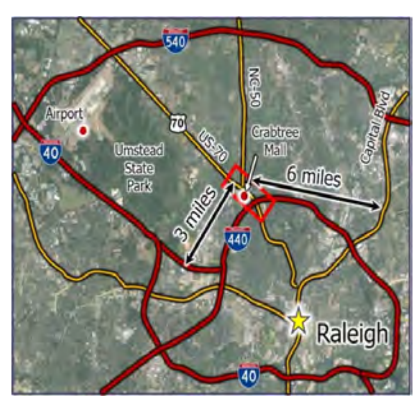


Figure 4 General Study Area

Case Study – Raleigh, NC Glenwood Avenue (US-70)

NCDOT together with the city of Raleigh has applied the right-sizing techniques of NCHRP 917 to explore innovative solutions for one of North Carolina's most dynamic and challenging corridor environments. Raleigh's Glenwood Avenue (Figure 5) faces recurring congestion, Average Annualized Daily Traffic of 75,000, a wide cross-section, increasingly complex modes and users, and significant demand for access to activities surrounding the corridor (Figure 4). Planners are confronted with the uncomfortable choice between incurring the mounting costs of performance concerns and the lack of space, dollars, or options for an expansive or high-build infrastructure solution. Right-sizing alternatives are needed to align the corridor's infrastructure with its surrounding environment to make the best and highest use of the entire area.

Figure 5 Glenwood Ave. near Crabtree Mall

In order to explore right-sizing options, the research team, in cooperation with NCDOT, developed a spreadsheet-based application of NCHRP 917 techniques called the "Arterial Right-sizing Tool" (ART), which can be found in Appendix P2.

The ART tool is quite versatile and will allow an agency to evaluate a single corridor or multiple corridors. Figure 6 shows the initial input screen of the ART Tool for Raleigh. (Please note, the input selections were informed estimations that were not widely vetted within NCDOT, Raleigh City, or stakeholders).

The gray column in Figure 6 is the user input column, the blue columns represent the points determined for a Community Development right-sizing case, and the pink columns are for points toward the case for improving vehicular mobility. There are no right-sizing points per se in this section.

The gray column in Figure 3 is the user input column, the blue columns represent the points determined for a Community Development right-sizing case, and pink columns are for points toward the case for improving vehicular mobility. There are no right-sizing points *per se* in this section.

	A	B	D	E	F	I	H	J	
1	**Arterial Right-Sizing Tool (ART)**								1
2	**Desired or Likely Future Area Type (30-yrs out)**	**Suburban-LowDen**			**Point Summary**				2
4	**Basic Attributes**	**Crabtree US-70**			**CD**	**Max**	**MB**	**Max**	4
5	City	Raleigh							5
6	Corridor Name	Crabtree, US-70							6
7	Functional Type (Principal or Minor Arterial - see note)	Expressway							7
8	Lanes: Typical GP lanes each direction	4	Grey = User Input						8
9	Bike Facilities (1=None, 2=Stripped shoulder, 3=Protected)	None	Blue = Formula						9
10	Shoulders (See list of options)	No shoulder							10
11	Median (1=TWLTL, 2=Raised hardscape, 3=planted w/trees, 4=No Med)	2	**CD = Community Development Points**						11
12	Typical Lane Width (FT)	12	**MB = Mobility Need Points**						12
13	Typical Speed Limit (Estimate if necessary)	45	**Max = Most possible points**						13
	Typical signal phases (4, 3, or 2 - see note)	4-phase							
14	**Basic Attributes, Summary of Points**				**0**	**0**	**0**	**0**	14

Figure 6 Attributes of Glenwood Ave.

- **Traffic Volume Analysis-** The objective of this section is to determine the present and future Level of Service if nothing changes about infrastructure within or parallel to the corridor. Once the tool has an estimate for both the present and future, it will render a judgment on the right-sizing case.
- **Network Spacing Analysis-** The objective of this section is to assess network density. The user inputs how far it is to an existing or planned, parallel expressway, arterial, collector, or premium transit service.
- **Land Use Analysis-** This section of the tool reveals the extent to which the corridor has changed, or is planned to change, into high-density suburban or even urban conditions.
- **Stakeholder Analysis-** This section helps identify who potential stakeholders may be, given demographic characteristics, land use types, and general knowledge of staff about the area in question.
- **Speed / Trip Length / Safety Analysis-** The purpose of this section is to identify the type of trips using a facility and the access requirements of those trips.
- **Opportunity Analysis-** This section helps to identify whether the facility is appropriate for innovative intersections and/ or corridor treatments.

Figure 7 shows the summary results from the ART Tool for its application to the Glenwood Ave corridor. The tool is intended to provide the practitioner a contextual understanding of the corridor and its potential for right-sizing. This process can be used iteratively, as a stakeholder engagement tool, to better understand what they feel is important, and thereby cultivate buy-in to the process and, ultimately, the solution set developed for the corridor.

Adjusted Points	Weight	CD	Max	Weight	MB	Max
Traffic	10%	0	0	25%	25	25
Spacing	10%	3	10	20%	11	20
Land Use	25%	13	25	5%	0	5
Stakehold	20%	3	20	20%	11	20
Speed	10%	6	10	5%	3	5
Opportun.	25%	20	25	25%	20	25
	100%	44	90	100%	70	100
Strength:	CD:	49%		MB:	70%	

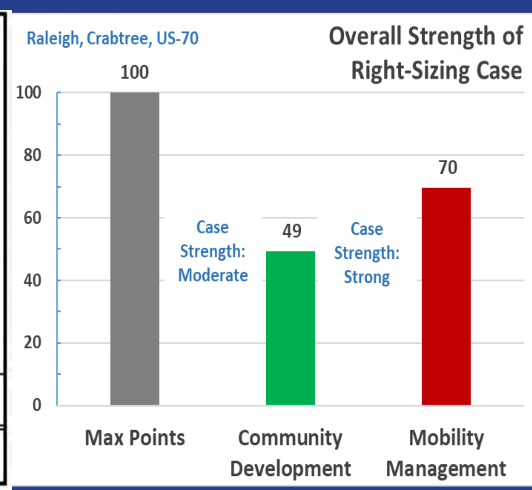


Figure 7 Summary of Right-Sizing Points

PLAY 3 - Use Models and Scenario Plans for Right-Sizing

When right-sizing a transportation system, it helps to find new ways to use models and data. Because right-sizing is about aligning resources with needs, the models that agencies use to assess demand, economic impact, and user benefits can find new uses in a right-sizing context. [The Policy Guidance of *NCHRP 917 Right-Sizing Transportation Investments: A Guidebook for Planning and Programming*] recommends using transportation and economic models to consider economic and technology growth scenarios to right-size an agency's understanding of future investment needs. Uncertainty about global trade, telecommuting, e-commerce, and other trends makes it challenging to understand where and how much investment is really warranted on a transportation network. Applying transportation, economic, and trade models to a right-sizing scenario can address this problem.

Use Models to Identify Places with Exceptional Agency or User Costs

While travel demand models have often been used to forecast Vehicle Miles of Travel (VMT) and Average Annual Daily Traffic (AADT), the models can include valuable right-sizing intelligence. For example, the Iowa Department of Transportation has developed a right-sizing application for mapping which areas of the state are the costliest to access in terms of the vehicle hours and miles required per-trip to access a place. [A place is represented as a Traffic Analysis Zone (TAZ)]. In Figure 8, the areas shaded in red represent those areas that are the costliest for users to access using the existing transportation network.

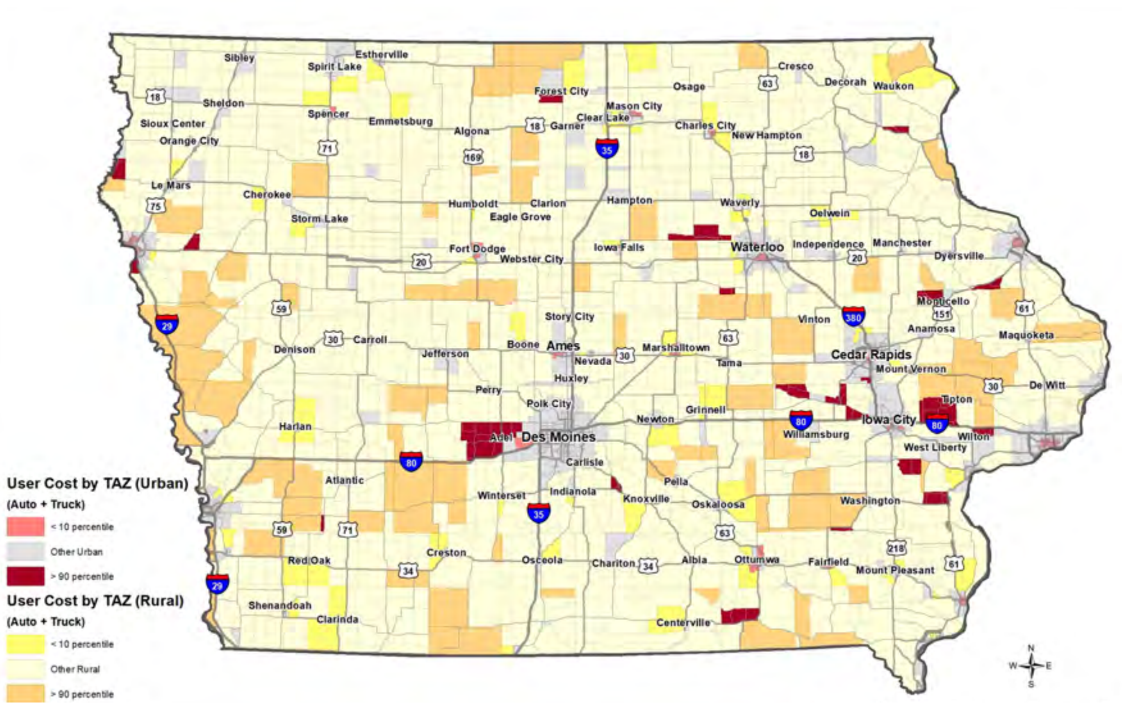


Figure 8 User Cost by TAZ

This type of analysis is done using the time and distance between zones and applying a simple dollar-per-mile or dollar-per-hour factor (of the type used in FHWA grant applications) to arrive at the cost per trip. The areas in red pinpoint urban parts of Iowa that suggest where right-sizing solutions might entail considering (1) more direct routes to serve places with fewer miles or hours, (2) better local infrastructure or development to utilize existing infrastructure more fully, and (3) consideration of routes serving areas to identify if bottlenecks may be imposing unusually high travel-time costs.

When combined with an understanding of highway and bridge preservation costs, a state can also use a model to pinpoint destinations for which the DOT is incurring the greatest expense to preserve access. Because the cost to preserve a segment of highway is a function of (1) its starting pavement condition and (2) its truck and car volumes over time, it is possible for a travel demand model to consider the "preservation cost" of routes serving any given place (or travel analysis zone). By using travel model network tools, a travel model outfitted for right-sizing can pinpoint areas in the state with the highest highway preservation cost per-trip. Figure 9 below illustrates those areas in Iowa which cost the Iowa DOT the most per-trip to preserve highway access.

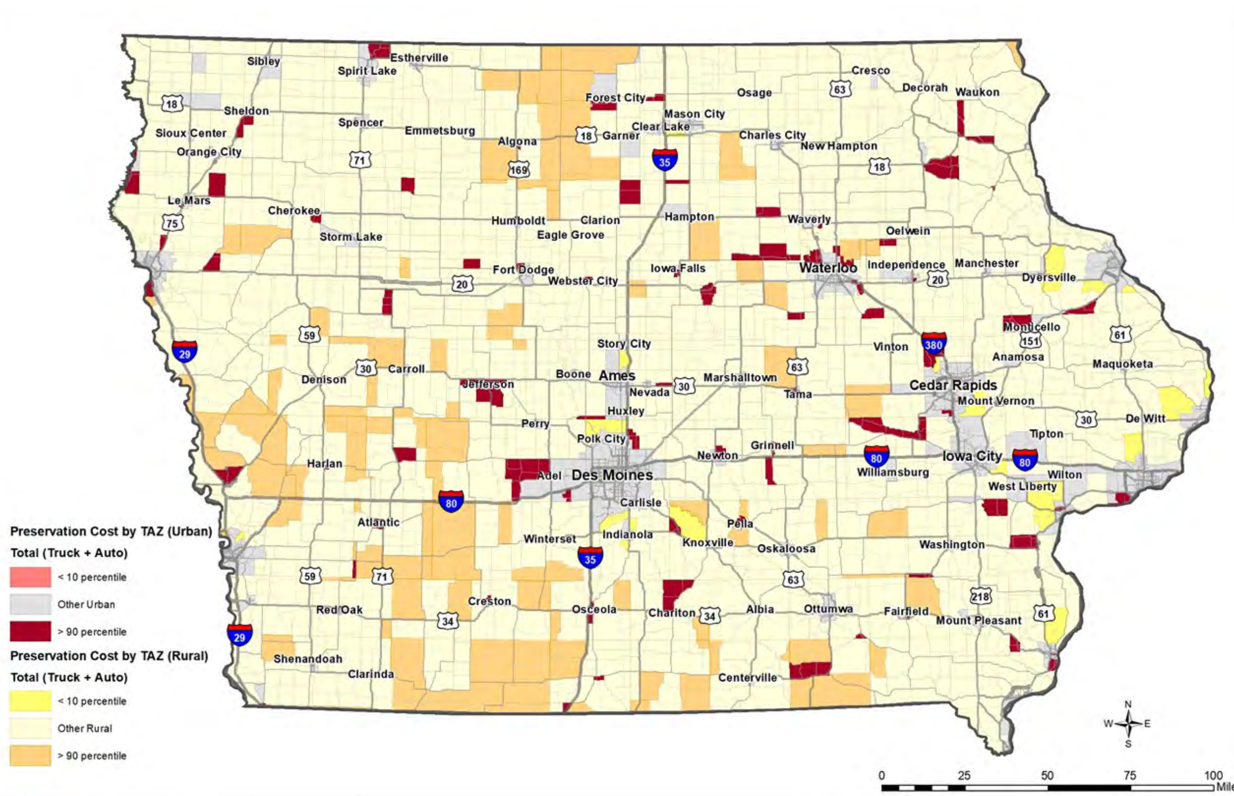


Figure 9   Preservation Cost by TAZ

Many of the areas shown in red are simply urban locations where there are very few trips, but which may be near other areas that compensate by serving higher numbers of trips. However, large areas with significantly higher than average preservation costs can help guide the DOT to look at jurisdictional issues, pavement condition standards, potential system redundancy, or opportunities to get better utilization of pavement assets in some areas of the state. This illustrative analysis relies on general assumptions about pavement conditions, but could be applied with a pavement management system where specific segment-conditions are known.

Using travel demand models to diagnose areas with exceptional user and agency preservation costs is a diagnostic tool for directing an agency's attention to areas where right-sizing plans warrant consideration. Based on the type of screening shown above, an agency is positioned to engage in right-sizing partnerships to further diagnose and evaluate right-sizing needs and alternatives as described in *NCHRP 917*.

Consider How Technology Can Shape Future Needs

While travel demand models have usually been applied to test different infrastructure build scenarios, they can also be used to right-size a traffic projection in the face of changing technology. In 2020, the COVID-19 pandemic tested the limits of how telecommuting and electronic commerce (package delivery services) can shape a region's travel market. The Des Moines Area MPO has applied a right-sizing technology scenario to consider the implications of both telecommuting and e-commerce on their projected traffic volumes and potential transportation needs. There is both an economic and transportation modeling aspect to creating a digital-economy scenario for a metropolitan area. The process entails (1) considering which types of businesses are most likely to engage in telecommuting and e-commerce, (2) associating those businesses with trip purposes and locations in a travel model, and (3) comparing different traffic forecasts to quantify the potential impacts of the digital economy on transportation demand and associated infrastructure needs. Appendix P3, Instructions for Digital Economy Scenario describes the process followed for Des Moines for applying the principles of *NCHRP 917* for technology-based right-sizing scenario.

Figure 10 illustrates the distribution of potential trips that may be saved in the Des Moines area if a moderate level of digital economy implementation occurs. (The areas shown in red-orange represent the destinations with the most savings in trips)

By applying a digital economy scenario, an MPO can identify areas where the current understanding of transportation needs is sensitive to technology assumptions. Figure 11 illustrates the segments on the Des Moines highway network where the pattern illustrated in Figure 10 in digital-economy trip making would affect the level of service and anticipated needs.

The figure shows that there are significant interstate and arterial segments on I-35, I-235, US 65, and other facilities, where the implementation of a digital economy and the indicators of telecommuting and e-commerce adoption have the potential of altering the level of service from deficient levels (D or E) to a sufficient level (C) in the AM Peak period.

While planners are not recommended to develop programs assuming implementation of technologies not consistently implemented (outside of the exceptional circumstances of COVID-19), implementing the above right-sizing technique empowers planners in Des Moines to monitor technology trends and implications over time.

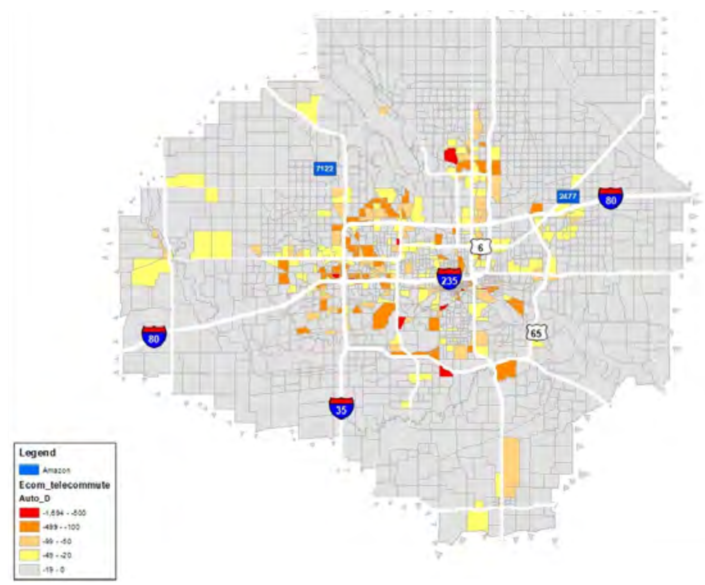


Figure 10 Potential effects of eCommerce/ Telecommuting as trips saved

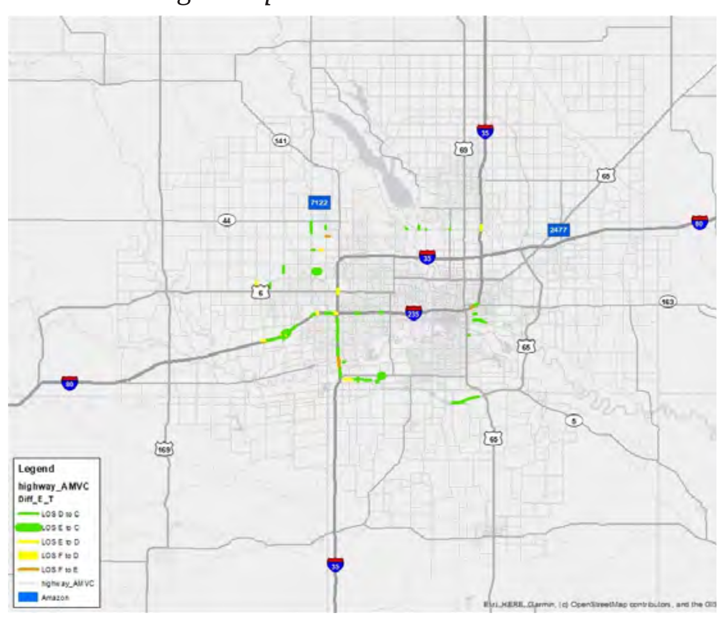


Figure 11 Potential alterations in Level-of-Service of eCommerce/Telecommuting

Consider How Trade and Economic Patterns Can Change

When right-sizing a transportation network, it is important to understand that even a relatively modest shift in heavy commercial VMT over a 20-year period can have millions of dollars of impact on the timing and extent of pavement preservation cost for an interstate highway or the life of a bridge. Likewise, a shift in global trade from one global region to another can cause one international gateway, or port of entry, to lose a significant share of its utilization while creating a seemingly overnight deficiency elsewhere. How can planners understand where and how their networks are vulnerable to such shifts? How can planners differentiate between (1) demands and needs that will occur regardless of trade shifts and (2) those that are susceptible to change in the global economy? Also, importantly, policy leaders ask how a global trade development will affect a states' transportation needs or performance – how can a planner respond? By applying right-sizing techniques with statewide and multistate models, planners can be prepared for these types of questions.

The Iowa DOT has implemented a trade scenario into the statewide Iowa Transportation Analysis Model (ITRAM). The trade scenario contemplates the impact on Iowa's highway network if US trade in agricultural commodities were to shift from Latin America to Asia. The scenario is constructed specifically to test the sensitivity of heavy commercial truck volumes on I-35 and I-80 in Iowa (key drivers in the size and magnitude of Iowa DOT's overall highway program) to trade uncertainty. Appendix P3, Instructions for Trade Scenario, describes the procedure, data, and methods for developing such a scenario using the Iowa example. Figure 12 illustrates the findings of a right-sizing scenario of agricultural trade-shift from Latin America to Asia.

In Figure 12 the orange/red shades indicate segments where future (2050) volumes will be lower because of the trade shift, whereas the green segments demonstrate where volumes will be higher. The findings show that a drop in Latin American trade will overall reduce utilization of Iowa's entire highway network, with precipitous drops on I-35 and I-80, attributable largely to a reduction of truck traffic exchanged with the Great Lakes and Mississippi riverport systems (Chicago and Milwaukee). They also show a drop in the overall north-south market for travel bound for the Gulf coast via I-35. The analysis shows that while east-west traffic does increase within Iowa and the other midwestern states (as shown by the strong increase in I-80 and I-90 traffic in the western area of the Iowa DOT model study areas), the trade shift would lead to a decline in traffic generally offsetting the increase on east-west traffic (to west-coast ports for trade with Asia).

By including an Asia-Trade right-sizing scenario, Iowa DOT's travel demand model puts the department in a position to monitor developments in global trade, and readily pivot its forecasts and associated transportation needs estimates when agricultural commodity markets or global trade conditions change.

LEARN MORE: The complete analysis from Iowa DOT demonstrates a series of user cost mapping and trade scenario findings from the Iowa DOT modeling as well as digital economy scenario findings from Des Moines.

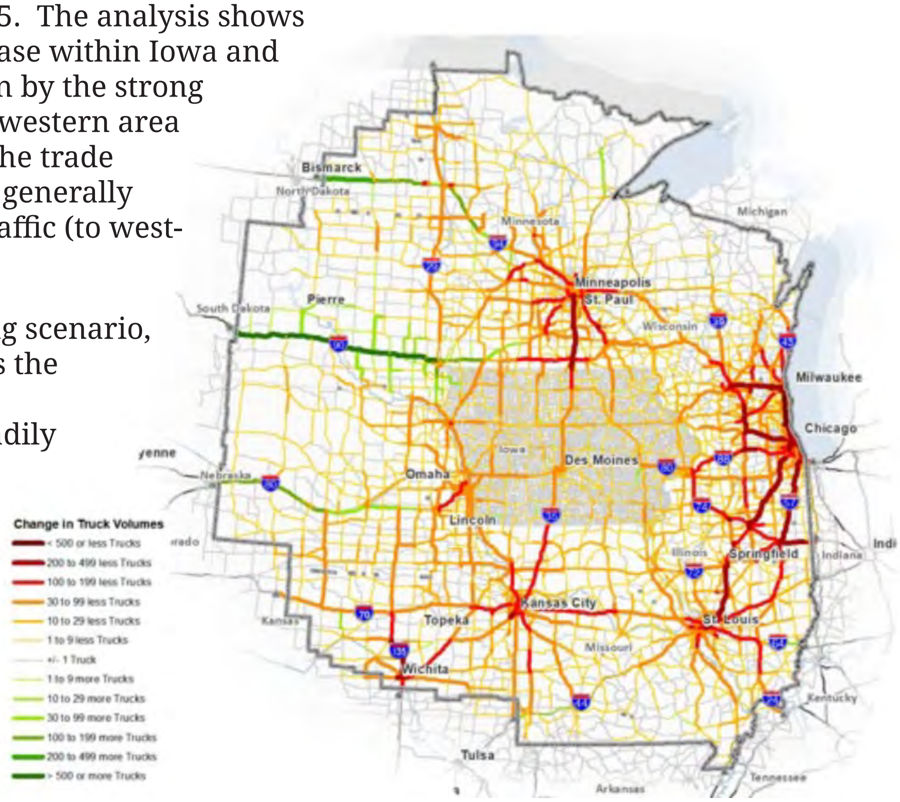


Figure 12 Trade scenario - Potential change in truck volumes

PLAY 4 – Create A Future-Proof Network

Right-sizing does not always entail re-using or adapting today's infrastructure. Right-sizing may entail building enough flexibility into today's planning to prevent a need for costly retro-fits later. Some of the greatest opportunities to right-size a transportation system occur when planners can anticipate rapid growth in development, even if they do not know the exact form that development will take. In Chapter 4.9 of NCHRP 917: Right-Sizing Transportation Investments: A Guidebook for Planning and Programming (2019) and Section 4.4 of NCHRP Web-Only Document 263: White Papers for Right-Sizing Transportation Investments, right-sizing offers opportunities for growing areas to develop transportation network master architectures that can account for future growth. This play highlights the master architecture process and includes a case study of how the process was applied in Asheville NC.

Focus on Connectivity in Growing Areas

For growing regions, the right-sizing guidebook emphasizes the benefits of connectivity. Beyond local-level connectivity, NCHRP 917 suggests that most regions can benefit from having a collector every half-mile, an arterial every mile, and an expressway every five to ten miles at buildout. The report also identifies that a best-practice design for arterials and expressways is to create nearby collector-scale "backage" roads so that local circulation can occur in the corridor without overwhelming the primary corridor (Figure 13).

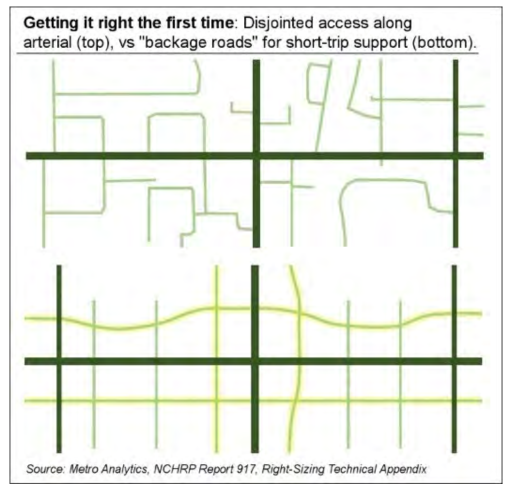


Figure 13 Master architecture concept

Apply a Master Architecture Process in Planning

Establishing a region-wide master architecture can be done by either a DOT or an MPO, however, in urbanized areas, it makes sense for the effort to be led by an MPO given their planning area responsibilities. Since the goal is to identify a network that will function (functionality to be defined locally) beyond the horizon year, it makes sense to create this architecture in conjunction with, if not prior to, the development of the long-range plan. Below are the major steps of the master architecture process. Figure 14 shows a series of maps used in Utah by the Mountain Land Association of Governments (MAG) to enhance their long-range planning process and account for post-horizon growth.

Step 1: Fishnet Pattern to Create Interagency Awareness of Need- Start by discovering if existing plus planned network will be adequate as sub-areas of the region approach buildout. To reveal this, staff can easily create a "fishnet grid" for side-by-side comparison with the existing plus planned network (Figure 2). Staff would then present these county-level graphics to their partner agencies. This allows those agencies to see any gaps in their plans and start formulating a strategy to fill in the gaps, or otherwise compensate for areas where they will not be able to create a more connected network.

Step 2: Best-Fit Paths #1, (for interagency feedback)- With general agreement among interagency staff about gaps in the network, the next step is to identify "best guess" alignments for closing those gaps. Use the fishnet grid pattern and the right-sizing strategy for "backage" roads along key arterials to help identify missing or under-sized aspects of the macro-network.

Step 3: Best-Fit Paths #2, (after interagency feedback)- Once a first iteration of the "paths of least resistance" is developed, an agency would again engage their partner agencies for feedback. It is recommended to have a through-street at least every half-mile along with an overall architecture for build-out conditions. The partner agency review should consider local sensitivities.

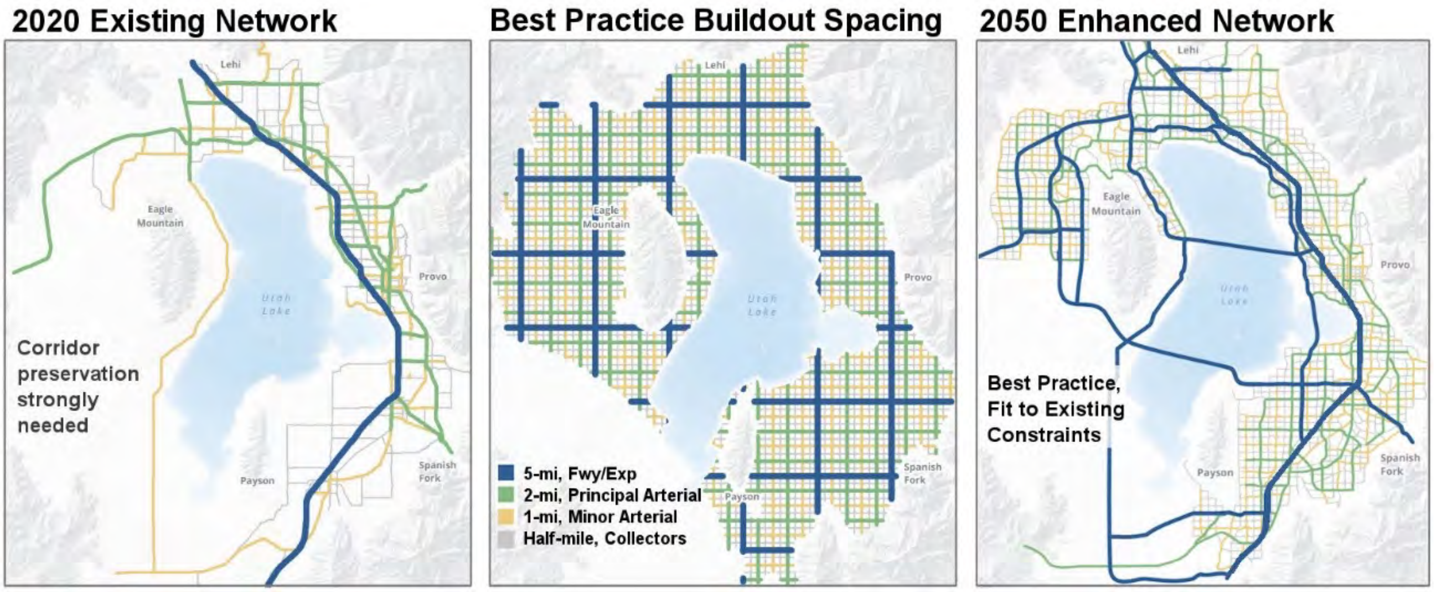


Figure 14   MAG Master architecture

Step 4: Test to Reveal Benefits of Corridor Preservation- To make the business case for corridor preservation, an agency can test an existing fiscally constrained plan against a plan that is also fiscally constrained but includes more developer-provided collectors. Additionally, a post-horizon build-out scenario with all the illustrative corridors can be tested against the fiscally constrained corridors.

Step 5: Level of Urgency- Regional gap-filling maps are helpful for raising awareness of the need and opportunity for more resilient networks, but they can also be overwhelming in the sheer volume of new corridors. At this point, NCHRP Report 917 suggests that practitioners focus on hot spots where choke points and fast-paced development could make it impossible to create connective links.

Step 6: Imply Flexibility on Public Maps- Once a reasonable, or viable buildout macro-network has been developed, it makes sense to start using the analyses and network maps with agency boards, emphasizing that they are just concepts, with opportunities for refinement at the local level.

Step 7: Illustrative Corridors on MPO Regional Plan- With general interagency agreement on which links make sense spatially for a build-out environment, evaluate these links in the regular long-range planning process to see whether they make sense to include in the fiscally constrained plan by phase. It is possible that a number of links may not show a need within the planning horizon of the long-range plan. However, this does not mean that these links should be abandoned, given the point of a master architecture is to preserve options for post-horizon growth. If the new links cannot be placed in the fiscally constrained long-range plan, they can be added to an illustrative phase of the plan to show that, in fact, they are needed. If sub-area growth proves much faster than anticipated, illustrative corridors can be amended, as appropriate, into the constrained phases of the long-range plan.

Step 8: Encourage Inclusion on County and Municipal Plans- With the regional plan established, it will be easier for sub-regional plans to point to the regional plan to justify why they intend to add new links to their own plans.

Step 9: Urgent Hot-Spot Studies- If there is fast growth and there are potential land use conflicts within needed corridors, use corridor planning processes to establish comprehensive solution sets established with stakeholder input.

Communicating “Fishnet Maps” to the Public

Relating the need for grid connectivity to stakeholders is an essential benefit of a network right-sizing mater-architecture analysis. When stakeholders understand the costs and risks of developing with a discontiguous network, and the possibility that development may overtake their opportunity to achieve an adaptable and right-size system – it is easier to protect right-of-way and frame both land use and transportation choices.

However, it is vital to communicate the results of a right-sizing grid analysis in ways that are educational and establish buy-in to the need for a network, and do not confuse the public or stakeholders about how the network will be achieved. Specifically, it is important to articulate the high-level needs for network connectivity in key areas without giving the appearance of presuming how such connectivity will be developed. If illustrative grid densities are shown with graphics using too many “lines on a map” it can run the risk of appearing to suggest “projects” that do not yet exist, without the rigor of alternatives development and analysis processes such as NEPA, PEL, and state/regional project development protocols. For this reason, using polygons, desire lines, and more general illustrations is often the key to the successful use of this right-sizing technique.

There are several potential approaches for helping the community appreciate the value of preserving through streets every half-mile and the overall benefits of spatial network planning and preservation, followed by demand planning.

1) Ignore unthreatened areas
2) Focus on chokepoints and fast-changing areas
3) Demonstrate general areas where connectivity is needed instead of controversial “lines on maps”
4) Educate about the need for a network, without suggesting specific projects not yet developed
5) More corridors mean each will maintain a rural feel for longer
6) Emphasize that corridor planning does not affect the rate of change

Case Study – A Master Architecture for Asheville, North Carolina

Asheville is a fast-growing community in the Blue Ridge Mountains of western North Carolina. Given the number of geographic chokepoints, it was important for NCDOT and Broad River MPO to future-proof their network by preserving corridors for vehicular and multimodal demand at buildout (Appendix P4).

Figure 15 compares their existing plus planned network to a hypothetical fishnet grid at buildout. The fishnet has a collector every half-mile, arterial every 1.5 miles, and an expressway every 10-miles rather than every 5-miles. Ten was chosen because the mountains are not developable, so expressway-level demand will be less frequent. The message is: Someday the region will need far more roadways and multimodal paths than are presently being actively preserved.

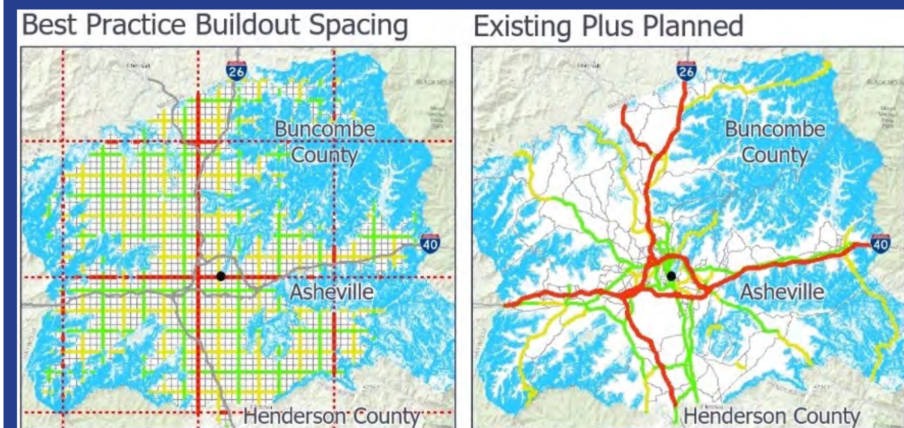


Figure 15 Asheville fishnet grid

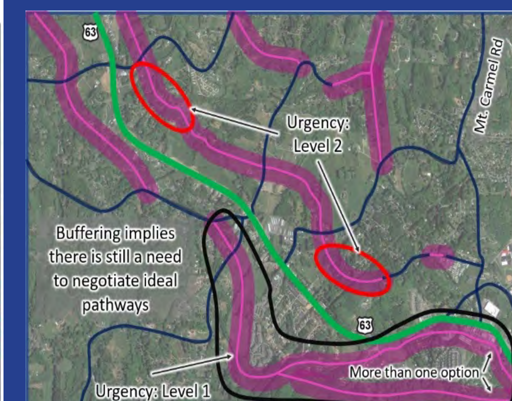


Figure 16 Asheville inset

Paths of Least Resistance

The fishnet comparison is valuable in communicating how future growth can overwhelm a buildout network that was developed using traditional planning methods. Figure 16 shows the fringes around Asheville and was used to find network gaps and assess potential paths of least resistance. As a word of caution, discretion should be exercised with this type of network planning, especially if unvetted ideas were released to the public. In the case of Asheville, they decided that buffering around candidate alignments would communicate that the alignment shown is just a starting point for discussion.

PLAY 5 – Consider Centers as a Transportation Performance Investment

At its heart, right-sizing is an investment strategy that realizes transportation performance benefits without the public and societal cost of costly infrastructure and service expansions. Increasingly metropolitan areas are looking to Livable Centers or Livable Center Initiatives (LCI's) as a way to reduce vehicle miles of travel, increase accessibility, reduce emissions and enhance safety while enabling the same economic activity to occur using less infrastructure cost.

Utah's largest MPO, the Wasatch Front Regional Council (WFRC), is tasked with leveraging transportation policy and infrastructure development to accelerate market adoption of walkable, mixed-use development patterns. Its primary tool is the Wasatch Choice Regional Vision (Figure 17). This vision underpins WFRC's 2050 Regional Transportation Plan (RTP) land use assumptions, population and employment distributions, and the assessment of transportation system needs. WFRC developed the vision in cooperation with its local government partners, the Utah Department of Transportation (UDOT), and the Utah Transit Authority.

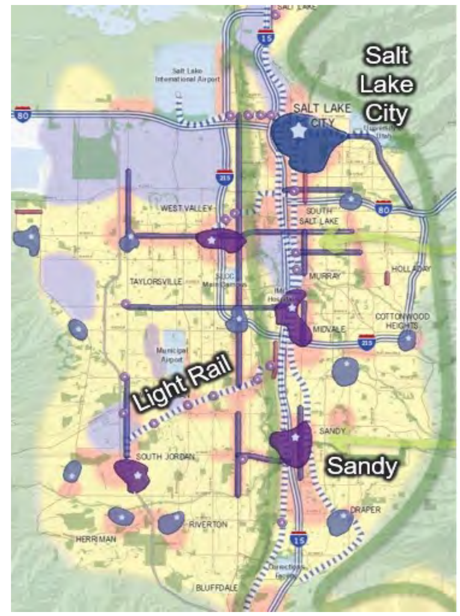


Figure 17   Wasatch Choice Regional Vision Salt Lake City

Both WFRC and UDOT participated in the right-sizing implementation effort illustrated in this play. The tools and methods used in the effort were derived from the toolkit that can be found in Chapter 3 of NCHRP 917: Right-Sizing Transportation Investments: A Guidebook for Planning and Programming (2019). WFRC and UDOT both felt that right-sizing techniques would enhance their long-range planning process by providing new ways to assess transportation network interactions between internal activity center trips and longer trips traveling through the activity centers. The partners also felt that the tools and methods would improve communication with their stakeholders during the development of the RTP by highlighting these interactions. They assessed that right-sizing tools would also assist in exploring ways to enhance the transportation network to improve localized non-auto trips and reduce localized congestion. The following sections highlight the value of right-sizing techniques to inform the development of activity centers, the technical approach used in the effort, and the results of the approach for one activity center located in Draper Utah.

Demonstrate the Transportation Performance Value of Activity Centers

The right-sizing paradigm invites planners to evaluate the performance benefits (including VMT and VHT reduction, crash and emissions, and other benefits) of livable centers in an apples-to-apples comparison to more costly infrastructure expansion initiatives. The development of compact, mixed-use activity centers is motivated by several factors, not the least of which is to reduce single-occupant vehicle (SOV) use along the Wasatch Front. Ewing, Cerverot et. al explain in the article, "Travel and the Built Environment: A Synthesis," how compact, mixed-use developments do decrease SOV use within those development types.

Another significant issue is the region's air quality. Despite its pristine setting in a valley between two mountain ranges, the Wasatch Front area has a winter-season air quality problem (PM2.5). The sources of the PM 2.5 are from both mobile and point source emissions, and those emissions become trapped in the airshed by temperature inversions. Reducing SOV use is part of the region's long-term solution to improving air quality. Other factors include the continued consumption of prime farmland by sprawl development, improving public health, and the desire to enhance the resiliency of the area's economy, its communities, and that of the transportation network itself.

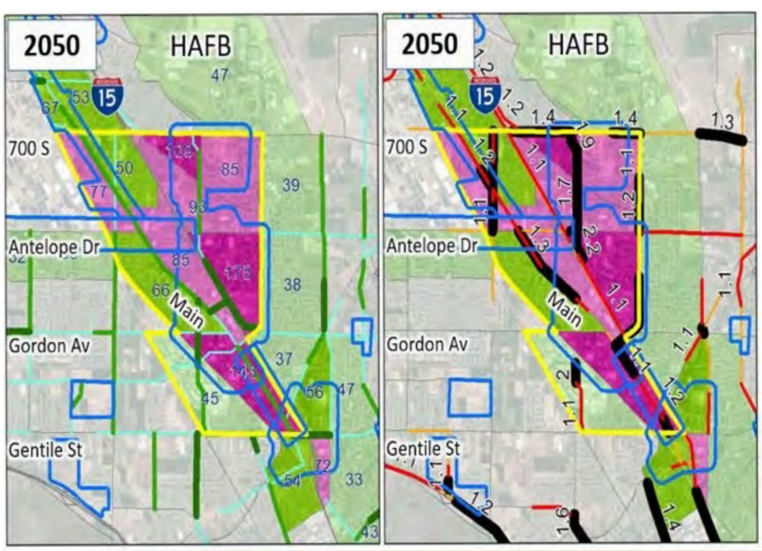
UDOT manages most of the arterials presently serving planned activity centers and is committed to implementing the policy objectives of the 2050 land use vision. As an example, UDOT's overall transportation vision and its recently adopted project prioritization process both acknowledge the importance of sustainable land-uses to improve community connections and improve the quality of life of the region's population.

Right-Sizing Utah Activity Centers- A Technical Approach

How did right-sizing techniques address perceived challenges to planned activity centers? Primarily by helping UDOT and WFRC better understand how long-distance, through trips and increased short trips generated by the activity center might compound localized congestion. The Utah analysis helped inform the type of land uses and the types of transportation improvements within the activity centers that would increase the likelihood that short trips would use transit or active transportation modes.

So, what type of right-sizing tools and methods were used in the Utah right-sizing implementation effort and how did they support WFRC's RTP development process? WFRC has developed a "Real Estate Market Model" (REMM), which is a land use forecasting model that is integrated with their travel demand model. REMM considers vehicle and transit accessibility, community land use plans, and a host of other variables to determine the likelihood of future types on greenfield land as well as the redevelopment of existing land uses.

Using land-use projections from REMM and the associated traffic projections from the travel demand model, the research team selected locations across the region where the growth potential of planned activity centers might be limited because of localized congestion. Figure 18 shows the two kinds of analysis that were featured in the Utah right-sizing analysis. The blue polygon represents the activity center, and the yellow polygons illustrate trip density: trips per acre generated by residential, commercial, and delivery activity. In the left image, posted values are also trips per acre. White, unposted areas will build out at less than 30 trips per acre by 2050. Green areas have 30-70 trips/acre. Pink areas have 70+ trips/acre. The research team then used trip scale analysis, trip length analyses, volume to capacity analyses, and a series of checklists to help the agencies identify issues that could hinder the future development of an activity center.



Layton	2019	2050	Total Acres	3,100
HH / Acre	3	7	Trip increase since 2019	62%
Jobs / Acre	10	14	Compared to SL-19 suburbs	3.1
Trips / Acre	57	93	2050 Trips vs SL-19 CBD	63%

Yellow outline increases 62% over present, with 3.1x more trips/acre than SL's 2019 suburban average. Density is 63% of SL-19 CBD, and same acres.

Figure 18 Overview of activity center analysis

CASE STUDY - Arterial Right-Sizing Tool City of Draper

The research team used the Arterial Right-Sizing Tool (ART) checklist at a location in the City of Draper, located at the south end of Salt Lake County. The partners chose this site because the State of Utah recently decided to relocate its largest state prison facility from this location, which opens over 600 acres for redevelopment. The area is one of the last large undeveloped areas between two converging Metropolitan Statistical Areas and is in the heart of the area's booming technology district (Figure 19).

Using the ART checklist and right-sizing design guidance, the research team developed the conceptual site plan shown in Figure 18. Its features include:

Figure 19 Right Size Draper prison site

- One-way frontage roads along I-15, to improve connection with cross-streets and thereby distributing freeway traffic across many cross-streets rather than overwhelming just a few
- New cross-streets connected to the frontage system, with Texas-U-turns
- Walkable one-way boulevards that pass through the 600 acres (orange and red)
- Two-way pedestrian and parking plaza served by regional bus rapid transit and micro transit circulators (green)
- Well-connected local streets, forming block-sizes no larger than 5-acres
- Periphery surface parking on less-valuable land, connected to the center via BRT and micro transit shuttles for 5-minute frequency, reducing the need to park in the center

Trend vs Potential

Each activity center in the 2050 land-use vision has its own set of complexities that affect its potential for right-sizing. Limiting factors include the receptiveness of key stakeholders to these opportunities and funding. In the Draper example, the potential for right-sizing is significant, as shown in Figure 20. This is because much of the existing area is greenfield, and existing uses like the state prison will be removed. As mentioned above, whether the development reaches its full potential is dependent on communication and collaboration with key stakeholders, and funding. Right-sizing tools and strategies can help further that process by help building support and making the business for increased investment.

Figure 20 Draper activity center right sizing potential

APPENDIX PLAY 1

Understand Transportation Assets and Seek Their Best and Highest Use

APPENDIX P1

Metro Analytics, Situation Report – Georgia DOT Implementation Update, Sep. 18, 2020, p1.

The Georgia Department of Transportation (GDOT) is one of four State DOT's selected for implementation of *NCHRP Report 917 – Right-Sizing Transportation Investments: A Guidebook for Planning and Programming*. The implementation effort for GDOT initially focused upon the Ponce-Memorial corridor in the Atlanta metro area, but discussions with GDOT revealed an opportunity to include the remnant parcel (R-parcel) inventory managed by GDOT Right-of-Way. We have agreed to develop implementation efforts for both applications. We have participated in multiple online meetings with GDOT Offices of Planning and Right-of-Way, but most recently have found it beneficial to loop in the GDOT Office of Performance Measurement. It has been our experience with DOT's throughout the country that implementation efforts are not likely to succeed unless it can be demonstrated that they are aligned with the agency's strategic plan. This is particularly important to this effort given the GDOT Strategic Goal to: "utilize performance-based management, innovation, & P3 to deliver GDOT's mission responsibly and more efficiently".

In the case of the Ponce-Memorial Corridor, effective management of a transportation corridor requires balancing of the governing dynamics of transportation (supply) and land-use (demand) just as with any economic system, and this requires sustained collaboration over a long period by multiple partners:

- *GDOT* – As the state transportation authority in Georgia, GDOT is committed to the Strategic Plan Goals to: "provide multimodal transportation development & infrastructure innovation" and to "put Georgians' safety first through innovation & technology". The pursuit of these Strategic Goals combined with authority and responsibility for the state transportation system makes GDOT an important partner.
- *Atlanta Regional Council (ARC)* – Regional partners such as metropolitan planning organizations (MPO's) and various councils of governments (COG's) are often clearinghouses for information for member jurisdictions and are responsible for the administration of some federal funding mechanisms. Amendment of corridor plans into transportation improvement plans (TIP's) is one of the duties that

ensures eligibility for potential funding streams. Regional partners are important partners.

- *Political Subdivisions of the State*– County, city, village, and other local partners typically have the legal authority over land-use decisions. Because land-use authority is vital to the demand side of the economic relationship between transportation and property development, these partners are best suited to aid in preservation and coordination with private property developers. These partners may also be best positioned to guide public investments that will, in turn, best leverage private equity investment.
- *Private Property Investors* – Private equity investors in a corridor are vitally important partners because they are in the best position to preserve needed public areas, they may "front" the investments required to construct certain public improvements, and they are most capable of positioning improvements to take advantage of future infrastructure improvements rather than fall victim to those improvements.

(NCHRP 917) National Academies of Sciences, Engineering, and Medicine. 2019. Right-Sizing Transportation Investments: A Guidebook for Planning and Programming. Washington, DC: The National Academies Press, p54. https://doi.org/10.17226/25680

1. **Specify right-sizing procedures incrementally.** While right-sizing may well change the culture of an agency and enable paradigm shifts to occur, it is important to specify which policies, procedures, criteria, or rules will be changing as an agency implements right-sizing. For example, an agency may specifically define:

– An internal and external right-sizing initiation and evaluation process; – Right-sizing procedures for developing the STIP (or transportation improvement program in the case of an MPO);
– Right-sizing procedures for implementing asset management; and
– Right-sizing scope items in LRTPs and TAMP.

By defining specific business processes in which right-sizing is to be implemented and training staff on how the right-sizing approach differs from the prior approach, an agency can gradually instill a learned understanding of what right-sizing is and what it is not. Furthermore, leadership and agency staff will not feel pressured to connect everything they do to "right-sizing" but instead will understand right-sizing as a specific type of decision with a specific purpose.

Metro Analytics, *Situation Report – GDOT ROW*, Sep. 18, 2020, p1.

The Right-of-Way Services department of the Georgia Department of Transportation (GDOT) is responsible for many things, including the management of an inventory of over 8,000 remnant parcels (R-parcels). This inventory is created through normal right-of-way acquisition activities when severance, good-faith negotiation, or other purchases create an uneconomic remnant that is not needed for the project but is of no value to the owner(s). GDOT is committed to protecting the rights of impacted property owners, and so the uneconomic remnant is purchased even though it is not needed for transportation purposes. This creates an inventory of R-parcels that are not needed for direct transportation use, are not on local tax rolls, and create an overhead burden in terms of property management needs. Because this inventory is growing it is an appropriate candidate for a right-sizing evaluation and pilot implementation effort. It is obvious that these R-parcels are not in their highest-and-best use, and so there are reasons to believe there are sources of value that can be leveraged. In discussing possibilities with representatives of GDOT Right-of-Way Services, four distinct groups of R-parcels were identified:

- *Group 1* – R-parcels that have a marketable highest-and-best use of their own and can be transacted arm's length in an open market. We understand that GDOT ROW has engaged Vaughn and Melton to assist them with these R-parcels, and so while Group 1 is not a primary focus of this effort, it is incorporated for the sake of completeness. An annual review of the inventory may reveal sufficient R-parcels in this group to make such an effort cost effective on an as-needed basis.

- *Group 2* – R-parcels that have their own highest and best use but cannot be conveyed arm's-length because of limited potential buyers. There are multiple possibilities for conveyance for uses that could be monetary or non-monetary.

- *Group 3* – R-parcels that do not have their own highest and best use but must be conveyed non-arm's length. This may include instances of surface easement that can only be released to the underlying fee owner, or areas that have functional utility only in assemblage with an adjacent property owner.

- *Group 4* – R-parcels that do not have their own highest and best use but may be conveyed for transportation enhancement uses, or simply to return the parcel to the tax rolls.

In consultation with the GDOT Performance-based Management & Research Office, the need to align this effort with GDOT Strategic Plan is clear.

(NCHRP 917) National Academies of Sciences, Engineering, and Medicine. 2019. *Right-Sizing Transportation Investments: A Guidebook for Planning and Programming.* Washington, DC: The National Academies Press, p28. https://doi.org/10.17226/25680.

Decision Clinics.

One approach to sharing data in right-sizing partnerships is the use of “decision clinics.” A *decision clinic* is a collaborative workshop in which technical staff from each partner agency presents to the other the decision criteria, supporting data, and type of analysis they have conducted in relation to a facility or asset in which the two agencies have differed about the role of the transportation infrastructure and its appropriate size, extent, or composition. Engaging in this way enables partner agencies to bring both data and context to conversations that data analysis might not otherwise elicit on its own. One agency may not be aware of the historical background behind another agency’s decision making about a certain asset and which qualitative circumstances may have influenced a specific decision or series of decisions. Examples could range from political decisions, to targeted community investment, to inclusion in a strategic plan (i.e., statewide planning or city master plan). Ultimately, shared expertise allows right-sizing partners to help each other put all data in context to understand current or anticipated performance. With this understanding, partners can work to define rightsizing objectives that benefit all parties. Creating a shared data framework, with a holistic set of indicators, data sources, and methods for assessing the status of existing assets relative to a right-size vision is essential to arriving at the efficiency and economic vitality aims that right-sizing seeks to accomplish. Such frameworks can be vital for establishing right-sizing objectives and for sustaining and monitoring rightsizing progress over time in long-term and permanent right-sizing efforts (as described in the section on Duration of Right-Sizing).

(NCHRP 917) National Academies of Sciences, Engineering, and Medicine. 2019. *Right-Sizing Transportation Investments: A Guidebook for Planning and Programming*. Washington, DC: The National Academies Press, p54. https://doi.org/10.17226/25680.

Remedies and Safeguards. The following recommendations are offered to safeguard rightsizing policies and outcomes when an agency may be seeking to institutionalize right-sizing practices as a permanent matter of policy:

1. **Specify right-sizing procedures incrementally.** While right-sizing may well change the culture of an agency and enable paradigm shifts to occur, it is important to specify which policies, procedures, criteria, or rules will be changing as an agency implements right-sizing. For example, an agency may specifically define

- An internal and external right-sizing initiation and evaluation process;
- Right-sizing procedures for developing the STIP (or transportation improvement program in the case of an MPO);
- Right-sizing procedures for implementing asset management; and
- Right-sizing scope items in LRTPs and TAMP.

By defining specific business processes in which right-sizing is to be implemented and training staff on how the right-sizing approach differs from the prior approach, an agency can gradually instill a learned understanding of what right-sizing is and what it is not. Furthermore, leadership and agency staff will not feel pressured to connect everything they do to "right-sizing" but instead will understand right-sizing as a specific type of decision with a specific purpose.

2. **Three-part testing.** As part of an agency's right-sizing policy, it may be beneficial for an agency to have a three-part test to apply to any investment or decision justified based on right-sizing, consistent with the three types of objectives shown in the template for near term right-sizing (see Table 10). A project, choice, or policy change (not otherwise justified by other agency policies or standards) must meet at least one of the three parts of the test to be justified on the basis of right-sizing. The three-part test is summarized in Table 13.

3. **Independent review and oversight of right-sizing choices.** A final recommendation for success in permanent or institutionalized right-sizing is the appointment of an independent agency-wide right-sizing review board or task force. Such a board may consist of experienced agency leaders from different business units and disciplines, such that knowledge of all aspects of the agency's business process are represented, as is a diversity of districts or major geographic units. The board may also include outside partners representing MPOs, the developer community, and other related entities. The board may meet periodically to review recent decisions made on the basis of right-sizing that have been questioned by either internal or external stakeholders and to review proposed decisions from managers within the agency to determine if a potential project, policy change, or decision can be justified as part of a right-sizing policy. The board can provide peer review, applying the three-part test previously described. If a choice, project, or initiative does not qualify as a valid right-sizing change, then it still may be justifiable under other agency policies, but such reviews can serve as an educational opportunity to raise awareness of how right-sizing decisions can be identified, justified, and implemented.

APPENDIX PLAY 2

Manage Corridors for Right-Sizing Objectives

APPENDIX P2

(NCHRP 917) National Academies of Sciences, Engineering, and Medicine. 2019. *Right-Sizing Transportation Investments: A Guidebook for Planning and Programming*. Washington, DC: The National Academies Press, p69. https://doi.org/10.17226/25680.

Table 19. Right-sizing methods and typical DOT business processes.

Right-Sizing Tools and Methods	DOT Activities					
	State/MPO LRTP (Planning)	State/MPO STIP/TIP (Programming)	Modal Plans	Asset Management (Ongoing)	TAMP/Asset Management Plan	Corridor Study
Trip Length Analysis to Assess Modal Balance						
Roadway Utilization/ Cost Screening						
Development-Sensitive Safety Analysis						
Stratified ROI Calculator						
Funding and Development Awareness Method						
Congestion Threshold Testing						
Asset Deficiency Mapping Method						
Project Scoping Method						
Roadway Spacing Analysis						
Performance-Based Practical Design Checklist						

Metro Analytics, *White Paper - The Arterial Right-Sizing Tool (ART), 2021.*

Introduction

The National Cooperative Highway Research Program recently published *NCHRP Report 917, Right-sizing Transportation Investments: A Guidebook for Planning and Programming* to underlying or emerging economic and community needs. Recognizing that few state DOTs will have experience with right-sizing, NCHRP funded a follow-up implementation effort with these primary purposes: 1) better define how to implement the guidebook in real-world settings, 2) provide practical examples, tools, and methods other states can follow, and 3) influence target agencies to adopt right-sizing techniques into their business processes. The "Arterial Right-sizing Tool," or ART, was developed to help analyze arterial corridors and emerging Activity Centers, and rapidly changing corridors, and to offer ideas for right-sizing. The tool enables practitioners to identify where and how the features of a corridor or location may be misaligned with surrounding land-uses – and suggest potential urban design or infrastructure features consistent with *NCHRP Web-Only Document 263: White Papers for Right-Sizing Transportation Investments* (Chapter 4).

Overview of the Arterial Right-Sizing Tool

ART's Traffic Volume Analysis

The Arterial Right-sizing Tool (ART) starts with an analysis of whether right-sizing is warranted from either increasing or decreasing traffic volumes. First, enter basic attributes used throughout the tool such as the corridor name, city, area type, functional class, total lanes, lane widths, and speed limit. Traffic analysis allows users to enter both existing and long-range daily volumes and compares those with an estimated daily capacity based on a Highway Capacity Manual methodology. The result is a probable present and future Level of Service.

Alternatively, a user can simply enter a present and future LOS if they have outside analysis or if they simply want to "guesstimate" for sketch planning. If an urban arterial with 4+ lanes has LOS C or less, and the future is also C or less, there may be a case for reducing the number of lanes or otherwise relaxing design standards required for managing high volumes. Light loads can occur if the road was once very busy but has since died down due to economic struggles. Alternatively, if today's LOS is C or higher, and future LOS is D or higher, the case becomes increasingly strong for a mobility-based right-sizing effort.

ART's Network Spacing Analysis

How far is it to parallel collectors, arterials, and expressways on either side? If the corridor connects to a freeway, how far is it to the next interchanges on either side? Is the area mainly built-out, or is there still considerable development left to occur? Areas with too few corridors face political pressure to super-size the few corridors they have – including for alternative modes as there may be little opportunity to accommodate such elsewhere. The spacing recommendations in the tool vary by the scale of development anticipated at buildout.

There are four categories of spacing analysis: Expressway, Arterial, Collector, and Premium Transit spacing, which all vary by buildout area type. If some categories are already ideal, there is a weaker case for right-sizing based on this attribute. Since weakness in a functional class will likely create pressure in a buildout environment, the case for mobility management increases as pressure increases. How to accomplish this mobility is another question. An obvious place to start is to try and create new corridors for relief-valve connectivity. Whatever gap cannot be accomplished this way creates opportunities to right-size in other ways.

While the mobility right-sizing case is strengthened if the spacing is *not* ideal, the community development case is strengthened if a functional class *is* ideal. This is because it is easier to consider actions that might calm traffic or reduce overall capacity if one can credibly diffuse spillover traffic to somewhere else. It is important to note that if the spacing is not ideal, this does not mean there will not be a strong case for community-focused right-sizing. It just means a strong case will come from other factors.

ART's Land Use Analysis

This part of the tool was created specifically to address the negative effects of traditional arterial design on land uses. The calculator asks the user to assess the scale of languishing properties. It then asks questions associated with aspects of land use known to reduce VMT. The tool asks about both present conditions and trends. Trends can be either actual evidence that the market is already demonstrating land-use change, or that key stakeholders are ambitiously trying to catalyze a change in development patterns. So, if land use density is already relatively high, or if communities are creating form-based land use codes to encourage higher density and more diverse mixed uses, the tool will increase the strength of the Community Development right-sizing argument. Other factors in the Art methodology that reduce VMT per capita:

1. **Land Density:** If the density is already relatively high, or if the community and market aim to increase density, there will be a stronger case for right-sizing with a community development focus.
2. **Prevalence of Mixed-Use:** If the area already has or is trending toward a strong blend of commercial and residential within the area, then designing for active modes and transit will help since short trips are likely to increase.
3. **Urban Design Features:** Design includes things like block sizes and street trees. If blocks are large, this may hinder the market's ability to create walkable development in response to Complete Street investments. Uniform trees on both sides of a corridor can be a key component of the ambiance necessary for catalyzing walkable development.
4. **Destinations:** The extent to which the corridor already has or is likely to have significant regional destinations.
5. **Availability of Transit:** If the present or future has passenger rail, BRT, or a bus every 15-minutes or less on or within say ¼ mile of this arterial, then there is stronger reason to invest in walkability.

6. **Demographics:** If the present or future has an unusually high share of those who want or need alternative modes, points are awarded. While today may not have many in this category, if the community is rezoning to encourage affordable housing, or to attract the elderly or environmentally motivated, then the future can be considered to have demographics that will value community-oriented right-sizing.
7. **Parking and other Demand Management Levers:** This focuses mainly on parking. Communities that are eliminating minimum parking requirements are more likely to need alternative mode investments so that people can get around without needing to park.

While this land-use analysis has a large number of questions and hence a large number of points available, it is possible to weight each question differently. It is also possible to weight the entire category so that categories with few questions will not dominate over those with many unless the user intends it to be so.

ART's Stakeholder Analysis

The more enthusiastic that stakeholders are about a need to do something with present infrastructure, or the more unhappy they are with the first roll-out of potential changes, the stronger the case for going to the right-sizing drawing board (or back to the drawing board). However, care should be taken that right-sizing is not skewed heavily toward "enthusiastic stakeholders" because project activism is often correlated with inequity – those who are better connected are more likely to engage the system to advance their concerns.

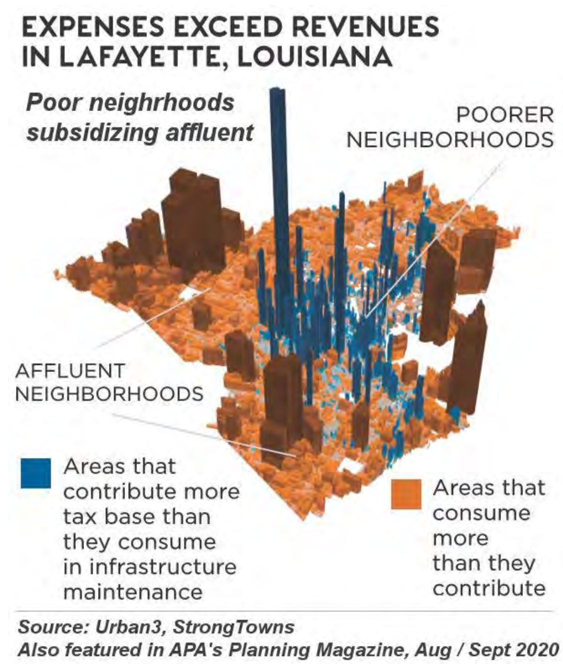


Figure 3: Systemic inequity revealed by right-sizing methods

Therefore, this tool also has questions dedicated to discerning the magnitude of lower-income residents and those who may have been inadvertently neglected over decades of systemic underrepresentation. The tool also gives credit to situations where communities can raise their own funds to help right-size, either through direct contributions or through public-private partnerships – value capture opportunities where private interests may be willing to route a portion of their potential profits to construct and/or maintain right-sized elements with a strong nexus to their interests (i.e., Stratified Return on Investment process).

Uncovering systemic inequities: Figure 3 was featured in the right-sizing guidebook *NCHRP 917*. It shows lifecycle expenses overwhelming revenues in general (more red than blue), but it also shows the net-positive areas also happen to be poorer neighborhoods. This is possible because an apartment unit generates less in property taxes than a large single-family home, one may also have 100 apartments on the same length of street as 10 homes.

Taxes collected from lower-income neighborhoods are not entirely consumed by those neighborhoods, so the excess “fills potholes” in affluent neighborhoods. Arterials may function well for traffic but might also repel investment and reinvestment on adjacent land. The cost of duplicative infrastructure can easily outpace the costs of stabilizing adjacent uses. Once stabilized, these uses can potentially start to contribute more than they consume.

ART's Speed / Trip Length / Safety Analysis

A major factor in right-sizing is to determine the extent to which it is critical to attain or maintain a certain average speed (which is different than an operational design speed). If the corridor supports a high number of long-distance trips, both now and in the future, and there are few options to accommodate those trips on a different corridor, then right-sizing could easily include designing to achieve higher average speeds for those trips or at least ensuring speeds do not get substantially slower.

A corridor, now or in the future, may have a significant share of <u>both</u> long-distance and short-distance trips. Design, in this case, may aim to serve both higher speeds <u>and</u> lower speeds, perhaps with a multiway boulevard or a separation of multimodal corridors.

There are also cases where a corridor once had a strong argument for higher speeds, but long-distance trips have since moved elsewhere (a bypass, etc.). Where a corridor has a much higher incidence of short trips than long trips, it may be reasonable to relax speed objectives if that helps improve safety and community development/livability objectives. It may also be true that signalized corridors with a reasonably high share of long trips can tolerate a few blocks of walkable speed limits and traffic calming. Right-sizing looks specifically for opportunities where it may be possible to reduce delay caused by 4-phase signals (often double-left-lane intersections) so that one can afford to reduce speed limits to walkable levels without actually delaying traffic, a phenomenon described best as driving slower through sensitive areas but traveling faster despite the intentional slow-downs.

ART's Opportunity Analysis

A case for right-sizing depends significantly on the opportunities for right-sizing. In a high-level review of the corridor, what appears possible to actually do? How cost-effective are these opportunities? Would potential actions create "Economics of Place" value that can be captured to finance the project? Will the economics of place be worthwhile even if not directly captured to help finance the effort?

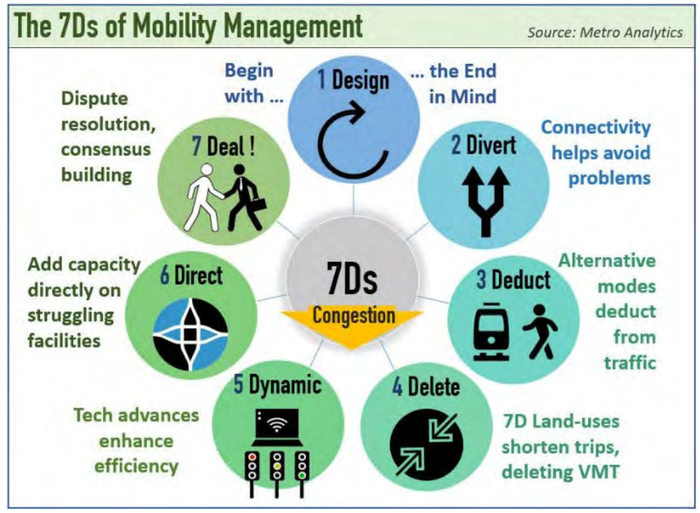


Figure 4: 7Ds of Right-Sizing for Mobility

In this process, the tool builds on a different set of 7Ds best described as the "7Ds of Mobility Management," see Figure 4, which were noted in the guidebook:

1. Design: Look for under-utilized right-of-way or how to better utilize any property setbacks

2. Divert: Includes network spacing already discussed, but also looks for "backage road" opportunities, frontage, and where freeways are involved, opportunities to connect relief valves to the freeway--most likely via one-way frontage roads.

3. Deduct: Identify regional plans for premium transit that can attract a significant ridership (likely 15-minute buses, BRT, and passenger rail). If there are no significant plans, could there be? Is this a potentially attractive corridor for significant transit? Deduct also includes exploring the ability to create active mode paths, grade-separating such paths (enhancing speed and safety, which in turn attracts far more users), or adding 2-ft to bike paths so they can be useful for low-speed electric vehicles of all types, including small low-speed 4-wheel electrics.

4. Delete: Connected closely to the 7Ds of Place, this seeks to manage mobility, not by better connections between far away origins and destinations, which inadvertently *encourages* further trip spreading (i.e., induced demand), but instead by bringing O&D much closer together over time through density, diversity, and the other 7Ds of Place. Regarding what specifically DOT managers can do with right-of-way toward that end, traffic calming and a serious effort to plant uniform street trees on both sides of the corridor may prove more cost-effective than other options.

5. Dynamic: This factor includes a focus to improve corridor efficiency through ITS and supporting Mobility-as-a-Service in conjunction with Transportation Network Companies (TNCs).

6. Direct: This is mainly about looking directly at the present uses of the right-of-way in question and hunting for opportunities. Is there a strong need for more capacity? Are the other Ds unlikely to handle the entire emerging need? If so, the traditional way of handling this is to "add more lanes." That is still an option in this calculator, but it also asks whether those lanes could be HOV and/or BRT lanes. It also guides the user to explore Alternative Intersections, or AIs, which achieve 3-phase or 2-phase signals and thereby offer more green time (higher capacity) than 4-phase signals that typify most suburban arterials.

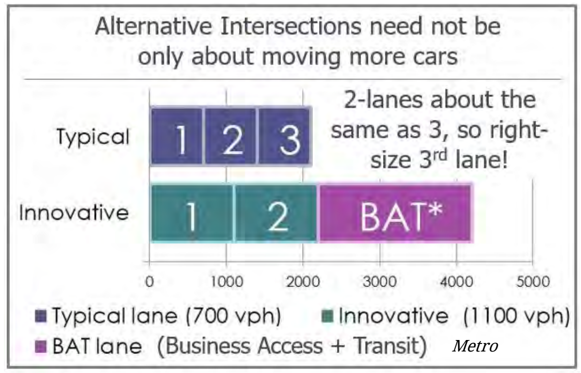


Figure 5: Fitting 3-lanes of traffic into just two

But while alternative intersections (AI) offer higher capacity, this need not be interpreted as useful only for increasing vehicle throughput. Suppose one has a fully loaded corridor with 3-lanes in each direction and there are calls to either convert the third lane to BRT or claim more right-of-way for BRT. Since AIs increase throughput per lane via more green time, Figure 5 shows it may be possible to fit today's 3-lanes of traffic into just two, thereby freeing up the last lane for the BRT.

(NCHRP 917) National Academies of Sciences, Engineering, and Medicine. 2019. Right-Sizing Transportation Investments: A Guidebook for Planning and Programming, p35-37. Washington, DC: The National Academies Press. https://doi.org/10.17226/25680.

Suggested Tactics for Urban Right-Sizing

Account for Effects on Urban Land, Labor, and Consumer Markets. Because there are morecompeting uses for urban land and more economic activities concentrated in an urban environment, there can potentially be more right-sizing opportunities. There are more entities in the urban environment that may put forward proposals (or resources) for how a transportation asset can create more value, and inefficiencies are more likely to be noticed by stakeholders and brought to the agency’s attention sooner than in other contexts. The concentration of urban land, labor, and consumer markets in the urban setting, however, also poses challenges with respect to obtaining consensus, and these markets represent sensitive and complex relationships that a significant change in transportation infrastructure or services can either disrupt or enhance. Table 9 shows some recommended techniques for considering urban land, labor, and consumer markets when developing right-sizing objectives and considering options in urban areas.

Seek Ways to Leverage Municipal and Private Resources. The urban environment offers unique opportunities to combine a new or modified infrastructure design with the authority and resources of both municipal governments and private developers to devise and implement a right-sizing solution. Recommended techniques for consideration include the following.

• **Explore the Use of Business Improvement Districts (BIDs).** Explore the use of BIDs in funding or owning enhancements to the infrastructure. BIDs provide a mechanism for businesses to participate collectively in both providing funding for improvements and making decisions about how infrastructure will be used. Atlanta's community improvement districts (CIDs) and their role in the region's Freight Cluster initiative are examples of this (see https://atlantaregional.org/transportation-mobility/freight/transportation-mobility-freight-freightcluster-plans/). CIDs (or BIDs) can be scoped to provide amenities like enhanced curb access for on-demand transportation, charging stations for electric vehicles, and even autonomous commuting and delivery shuttles as they become viable in the future.

Table 9. Urban right-sizing market considerations.

Complex Urban Markets	Urban Right-Sizing Sensitivity to Consider	Potential Data/ Information Sources
Land Markets	• Will the right-sizing change, enhance, or diminish the value of abutting and surrounding properties? • Do trends in property value and changes in land use since the last improvement support the case for a better and higher market use of the facility? • Have specific businesses, developments, or communities come to disproportionately use the facility and, if so, are there ways they can participate in improvement costs (through business improvement districts, impact fees, or other mechanisms)? • Has utilization of the facility declined or been superseded by other ways in which users are now accessing places and activities in the area? • Is there unutilized or underutilized parking or curb access surrounding the project? How has utilization of parking and curb space changed since the last improvement?	• Assessor Data • Zoning Maps • Building Permit Trends
Labor and Consumer Markets	• Has the nature of the commuting workforce surrounding the facility changed in terms of modes or work hours? • Has the facility or service to be right-sized had significant changes in the timing of daily peaks or shifted from primarily supporting commuting versus non-commuting purposes? • Are there right-sizing alternatives that can bring households and jobs closer together through co-location instead of additional infrastructure capacity?	• Census Bureau (Census Transportation Planning Package, Longitudinal Employer-Household Dynamics, and Public Use Microdata Sample) • Google general transit feed specification • "Big Data" on observed origin–destination patterns from new sources such as GPS or cell phones. For example, see State Smart Transportation Initiative at https://atlantaregional.org/transportation-mobility/freight/transportation-mobility-freight-freight-cluster-plans/.

They can also be used for collectively negotiating special mobility packages with transportation network companies (TNCs) to enable car-free living or commuting, thereby managing travel demand and freeing space previously used for parking. When a transportation asset is understood within a bundle of services provided in a BID or CID context, significant savings, and higher value can be derived from the resulting use.

• **Consider Packaging Infrastructure into Brownfield Development or Urban Revitalization Concepts.** This is a growing model for potential repurposing and right-sizing of urban transportation assets. Such approaches also address increased interest in the diversification of funding sources. In redevelopment areas, private developers may view innovative transportation offerings as critical amenities for making a new land development concept possible. Given this incentive, these cases may involve shared use of the facility with the developer, shared costs in reconstruction or modernization of the facility, value capture from the pursuant development, and in some cases partial or complete jurisdictional transfer or sale of right-of-way. Agencies can participate in this type of "packaging" by collaborating with developers and municipalities in the development of the business plans that developers use to seek private financing or value capture for the redevelopment of urban brownfield areas. *NCHRP Research Report 873: Guidebook to Funding Transportation Through Land Value Return and Recycling*

- Will the right-sizing change, enhance, or diminish the value of abutting and surrounding properties?
- Do trends in property value and changes in land use since the last improvement support the case for a better and higher market use of the facility?
- Have specific businesses, developments, or communities come to disproportionately use the facility, and, if so, are there ways they can participate in improvement costs (through business improvement districts, impact fees, or other mechanisms)?
- Has utilization of the facility declined or been superseded by other ways in which users are now accessing places and activities in the area?
- Is there unutilized or underutilized parking or curb access surrounding the project? How has utilization of parking and curb space changed since the last improvement?
- Assessor Data
- Zoning Maps
- Building Permit Trends
- Has the nature of the commuting workforce surrounding the facility changed in terms of modes or work hours?
- Has the facility or service to be right-sized had significant changes in the timing of daily peaks or shifted from primarily supporting commuting versus noncommuting purposes?
- Are there right-sizing alternatives that can bring households and jobs closer together through co-location instead of additional infrastructure capacity?
- Census Bureau (Census Transportation Planning Package, Longitudinal Employer-Household Dynamics, and Public Use Microdata Sample)
- Google general transit feed specification
- "Big Data" on observed origin-destination patterns from new sources such as GPS or cell phones. For example, see State Smart Transportation Initiative at https://atlantaregional.org/transportationmobility/freight/transportation-mobilityfreight-freight-cluster-plans/.

(Vadali et al. 2018) should serve as a key resource for participating in such development processes. Proactively collaborating directly with local economic development groups to become aware of brownfield development opportunities and participating in building the business case is essential for this type of right-sizing (as described in the later section on Agency Capacity Building for Right-Sizing).

APPENDIX PLAY 3

Use Models and Scenario Plans for Right-Sizing

APPENDIX P3

(NCHRP 917) National Academies of Sciences, Engineering, and Medicine. 2019. *Right-Sizing Transportation Investments: A Guidebook for Planning and Programming,* p55-57. Washington, DC: The National Academies Press. https://doi.org/10.17226/25680.

Accounting for Uncertainty

A principal reason why right-sizing is necessary is because of the rigidity of transportation infrastructure in the face of changing economic and technological realities. Even the best planned or designed infrastructure elements, based on the most rigorous models or the most brilliant insights, cannot be expected to reflect an accurate understanding of the decades of change that follow their inception. While infrastructure assets such as houses, stadiums, office buildings, and factories can be bought, sold, demolished, replaced, repurposed, and even sliced into condominiums, highways, bridges, ports, and rail lines cannot respond to market forces in the same way. As stewards of infrastructure that serve the public interest, transportation agencies generally cannot back out of risky investments, cut losses, invest elsewhere, or engage in other rational behaviors with the same freedom as private asset owners. For this reason, transportation agencies are especially vulnerable to uncertainty and inevitably must periodically follow a right-sizing process to account for changes over time.

Both the infrastructure life-cycle checklist (in Table 2) and much of the guidance in Section 2.2 identify junctures to apply right-sizing assessments to consider current needs and potential ranges of market or economic growth before reinvesting (or disinvesting) in an existing asset. Agencies can complement these recommendations with methods of risk-based asset management as documented in the 2017 FHWA report Incorporating Risk Management into Transportation Asset Management Plans (FHWA 2017) and the 2016 AASHTO Guide for Enterprise Risk Management (AASHTO 2016). These sources enable any built-in right-sizing process to account for risk in terms of understanding the potential universe of outcomes. The recommendations of Section 2.3 also build on the FHWA's 2017 report by suggesting how agencies can not only acknowledge demand risk but also establish investment scenarios and policies accounting for it. While not all forms of risk (such as the risk of a catastrophic hurricane, breakdown of agency capacity to manage infrastructure, or risk of terrorism) are germane to right-sizing, two principal forms of uncertainty are pertinent to right-sizing scenarios. These forms include economic risk (described as demand risk in the FHWA's 2017 report) and technology risk.

Economic risk or demand risk can be understood in two ways. The risk can be understood in terms of market demand either (a) outpacing the anticipated utilization of a facility (leaving a deficiency and imposing costs on system users) or (b) falling short of anticipated utilization (leaving the agency with sunken improvement and life-cycle costs into an asset that cannot generate enough societal value to justify its ongoing outlays).

Technology risk can be understood in terms of underestimating or overestimating technological advances that may obviate or antiquate a piece of infrastructure before the end of its useful life. This too can lead to either (1) an agency losing the sunk cost of an infrastructure improvement to mitigate a problem that is resolved by advanced vehicle or other technological change before the infrastructure improvement can generate its intended benefits or (2) an agency failing to invest in key infrastructure elements that will be required by newly emerging technologies. For example, hybrid and electric ultra-low emission vehicle technology (depending on its adoption curve) could erode the incremental air quality benefit of intersection improvements intended to reduce idling or carbon monoxide emissions. While less idling may have a mobility benefit, saving stop–go time for an electric vehicle has virtually no air quality benefit whatsoever. In the same way, improvements intended to simplify travel environments and reduce driver error may not have benefits nearly as competitive with other projects in an age of driverless (or even semi-driverless) technology. The prioritization of individual improvements in an STIP that is even partly based on benefit–cost or multicriteria analysis can be fundamentally altered by assumptions made about the adoption rates and effectiveness of new technologies, leaving even the best intended “right-sizing” solution misaligned with future realities.

Risk and Right-Sizing. The economic and technology dimensions of risk are of particular importance in right-sizing, because they represent some of the most likely sources of under-build or over-build, which are the opposite of right-sizing. Right-sizing cannot prevent such risk, but a right-sizing policy can enable an agency to (1) manage its over-build or under-build risk based on understood types of uncertainty, (2) articulate those risks to owners, users, and decision makers evaluating right-sizing options, and (3) monitor those assets and projects in their programs understood to face the highest levels of incremental risk.

Using Economic and Technology Scenarios to Manage Under-Build and Over-Build Risk

The type of sensitivity testing described in Section 2.3 for considering different potential levels of demand when right-sizing asset management scenarios can be carried further to create sensitivity tests pertaining to both economic growth and technology.

Economic growth and demand scenarios can be derived by adjusting traffic growth assumptions (or economic growth and housing assumptions in a travel demand model if available) to reflect modest, moderate, and aggressive economic forecasts as described in Section 2.3. These different potential ranges of demand can then generate different estimated future year traffic volumes (both with versus without any given infrastructure investment). The host of economic benefits dependent on traffic volumes, using valuation methods documented by the U.S. DOT (Benefit–Cost Analysis Guidance for Discretionary Grant Programs) and documented elsewhere (TRB Transportation Economics Committee n.d.), will then vary, based on the severity of the anticipated problem to be solved and the number of transportation system users subject to the future condition. Examples of economic benefit levels that will vary with demand forecasts include Travel time savings, Reliability savings, Crash cost (rates may not be sensitive to volume, but number of incidents is a function of volume), Emissions savings/air quality improvement, and Market access/productivity gains (as can be quantified using AASHTO's EconWorks analysis tools at https://planningtools.transportation.org/75/analysis-tools.html). Each project will have three different possible benefit levels depending on which economic trajectory is believed. Benefits will often be highest when economic growth assumptions are most aggressive, as rapid growth generates economic costs for transportation users, justifying project outlays.

Technology scenarios can be derived by identifying key technologies to be tested and reasonable assumptions about both (1) the rate of technology deployment over the life of a proposed project and (2) the likely effectiveness of technologies at changing transportation performance characteristics. For example, the emergence of advanced vehicle technologies (both electric/ hybrid as well as driverless or even semi-driverless technologies) may have significant effects on

- Crash rates (and associated safety cost savings available from infrastructure investment),
- Emissions rates (and associated emissions savings available from infrastructure investment),
- The value of time lost traveling (in driverless scenarios, time spent traveling may represent less opportunity cost), and
- The per-mile cost of operating a vehicle (advanced technologies have less fuel cost and may be calibrated to impose less wear and tear).

Organizations like the National Highway Traffic Safety Administration have been researching and documenting such effects (see https://www.nhtsa.gov/technology-innovation/automatedvehicles- safety). For driverless vehicles, the relationship between provided infrastructure capacity and system performance may itself change. In all of the preceding cases, advances in vehicle technology have the potential to solve problems that would otherwise represent societal costs, justifying infrastructure investment. The rate of increase in deployment of driverless and electric technologies may make it significantly more difficult to justify public infrastructure outlays as the new technologies may enable alternative solutions paid for by the owners and operators of the vehicles. While it is unknown how fast changes will occur or how effective the technologies will be, it is possible to consider modest, moderate, and aggressive scenarios regarding these technologies, just as in the case of economic uncertainty. By selecting modest, moderate, and aggressive adoption rates and performance effects, it is possible to add a technology dimension that reveals how sensitive the return-on-investment for any given project is to technological uncertainty.

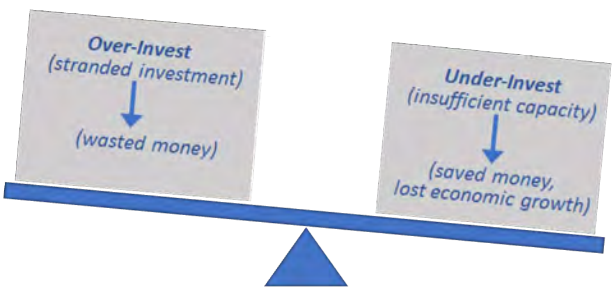
EBP, Instructions for Digital Economy Scenario, 2021.

Introduction

The goal of this primer is to outline how state DOTs or MPOs can develop right-sizing scenarios that address economic and technological uncertainty. It draws on specific development and application of a regional digital economy scenario in Iowa. The scenario analysis investigates how changes in the economy and technology can drive change in the magnitudes and spatial patterns of both passenger and freight demand, resulting in changes in traffic and transportation needs.

Right-sizing in this context is about identifying uncertainty in future economic and technological conditions and using that to understand the potential for over and under investment risk. By understanding the sensitivity of needs to different futures, transportation decision-makers can more confidently manage risk, directing resources towards assets that are critical under multiple futures, while taking a more careful look at others with more variability in need.

Figure 1 Risk and Opportunities



For each of the scenario applications, the primer follows a series of steps, as shown in *Figure 1*.

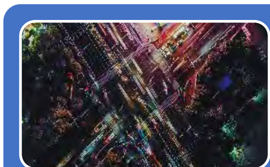
Figure 2 Right-Sizing Scenario Analysis Steps

Scenarios: *Define right-sizing scenario goals and drivers*

- Identify meaningful sources of uncertainty
- Focus on "levers" that change transportation demand or behavior

Data and Tools: *Identify data and tools to characterize scenarios*

- Identify data and tools that can help identify potential future changes in scenario drivers
- Identify the relationship between scenario drivers and "levers" within travel models



Transportation Performance: *Implement scenarios in travel models*

- Run travel demand models with alternative data or parameters developed for the scenario and for an accepted baseline
- Produce outputs such as maps and aggregate indicators of transportation performance

Sensitivity of Needs: *Explore differences between the scenario and the baseline*

- Compare scenario outcomes to the baseline, using maps, aggregate performance metrics, or examination of key corridors/locations of interest

Right-Sizing Implications: *Review investment decisions and their sensivity to scenarios*

- Explore the sensitivity of performance to the right-sizing scenarios
- Identify agency investment decisions that are sensitive to scenario drivers
- Identify strategy refinements (e.g., delay investment, conduct further analysis, focus on needs that are resilient across futures)

Digital Economy Scenario and Regional Des Moines Application

Step 1. Define Scenario Goals and Drivers

Right-sizing scenarios can help transportation agencies explore external factors that are outside an agency's control that may have direct implications for their future investment decisions. They can help agencies better understand and manage uncertainty in future investment needs.

Define scenario goals. Right-sizing scenario analysis begins by defining the big picture goals of the scenario exploration, in terms of the types of external factors and uncertainties that are of interest.

The Des Moines digital economy scenario was designed to explore the potential acceleration of digital economy trends, focusing on telecommuting and e-commerce. Through conversation with staff from Iowa DOT and the Des Moines Area MPO (DMAMPO), it was determined that this scenario is better suited to exploration at a regional rather than statewide scale, in the DMAMPO model. These digital economy drivers of changing transportation demand and performance became particularly salient during the COVID-19 pandemic, which corresponded in time to this right-sizing scenario exercise. COVID-19 caused short-term increases in reliance on telecommuting and e-commerce. The scenario provides insight into transportation needs should these changes persist in the long term.

Telecommuting has long been of interest to transportation planners for its potential to relieve congestion. The effects of the COVID-19 pandemic have brought increased attention to telecommuting potential. Relying heavily on digital infrastructure, significant levels of telecommuting could result in less travel of the workforce in favor of remote working. However, there remains significant uncertainty surrounding potential future levels of telecommuting. This scenario enables exploration of this uncertainty and the resulting potential shifts in demand on the Des Moines area road network. Similarly, the e-commerce scenario is designed to help the Des Moines region explore the shakeup of traditional distribution chains for retail sales of consumer goods. By exploring a rise in e-commerce, the scenario helps identify the transportation impact of placing less emphasis on traffic at traditional brick and mortar retail stores and instead emphasizing distribution centers offering delivery straight to customers.

Define specific scenario drivers. Both telecommuting and e-commerce could change the spatial pattern, types, and levels of trip-making in the Des Moines region. The team chose to separately develop telecommuting and e-commerce scenario characteristics to allow for a mix-and-match approach to exploring the network implications of these sources of uncertainty.

The telecommuting scenario component explores potential impacts on home-based work (HBW) trips (commuting trips), leveraging research on differences in telecommuting potential by industry and data from the DMAMPO model on the spatial pattern of economic activity. The e-commerce scenario component focuses on shifts between home-based shopping trips and truck trips at e-commerce warehouse locations.

Step 2. Identify and Apply Data and Tools to Characterize Scenarios

Once scenario goals are defined and drivers have been identified, the next step is to identify data or tools that can be used to (1) characterize the scenario in quantitative terms, and (2) connect these scenarios drivers to “levers” within travel models. This process was developed in a series of steps for telecommuting and e-commerce, respectively, as described below.

Telecommuting

> Steps to implement telecommuting:
>
> A. Stratify O-D trip tables
>   - Identify home-to-work versus work-to-home trip making
>   - Allocation of work trips by land use type
>
> B. Relate DMAMPO land use codes to industry activity
>
> C. Identify the propensity of trip makers to telecommute by industry

Telecommuting results in a reduction in home-based trip making of workers traveling to and from employment locations. However, this reduction is not uniform across industries and locations. The following steps serve to untangle the differential impact of telecommuting by industry and location in the region.

First, the origin-destination trip table representing passenger car commuting behavior is broken down into work and home components. Next, associated trip ends are decoded to understand the land use driving trip-making activity. Following that, the research team defined a linkage between certain types of land use, as encoded in the DMAMPO model, and the industries they represent. Finally, research on telecommuting potential by industry is applied to identify differential spatial impacts of telecommuting.

These steps form a flexible process to systematically construct a trip table, which can be replicated not just in the Des Moines model, but also applied to outside applications in other states. As part of this work, the research team also identified places within the process where key assumptions can be modified to add greater flexibility in testing uncertainty.

A. Stratify O-D Trip Tables

Identify home-to-work versus work-to-home trip making. The home-based work trip table represents a matrix of activity capturing commuting trips moving between an origin and destination point. However, because workers commute at different times of day depending on the types of jobs they are employed in, the movement of home-based work trips in the trip table can represent travel either from home to work, or the reverse.

To implement industry-specific telecommuting assumptions, first, the team needed to parse trips out to the industries responsible for “attracting” them. To do this, trip directionality must be defined. The team applied the directional trip-making factors from the DMAMPO model, which by period and type of trip-making activity summarize the percentage of total trips moving from production to attraction (i.e., home to work) as opposed to work to home (Table 7, Appendix P3.A). This provides the basis for estimating how many trips are going in which direction and dictates which trip ends correspond to a place of work.

Allocation of work trips by land-use type. The trip end representing the place of work then needed to be disaggregated by type of land use as a way of recognizing that certain types of industries, represented by the types of land use present in a zone, are responsible for generating differing levels of vehicular trip making activity.

To do so, the team combined the land use data by traffic analysis zone (TAZ) and the trip attraction rates by type of land use from the DMAMPO model (Table 8, Appendix P3.A). This resulted in an aggregate measure of trip attraction for each TAZ. Next, the team applied time of day distribution factors (Table 9, Appendix P3.A) to accurately relate trip attractions by land use with the distribution of trip making by the time of day. The time-of-day distribution was not income specific and so was applied in aggregate form to all HBW trips.

This effectively takes the measure for trip attraction and spreads it out across the various time periods in a day, such that now when it is normalized, it is possible to allocate trips to specific land-use types, while preserving sensitivity to land uses depending on the period of the day. This can be represented through the formula described in the box below.

Calculating the relative share of a particular land use at a particular period:

$$D_{LP} = \frac{TAZ_L * A_L * T_{LP}}{\sum_1^N TAZ_N * A_N * T_{NP}}$$

Where: D_{LP} - Share of Trip Attractions attributable to land use type L During period P is calculated as:

- TAZ_L – the land uses at the given TAZ, of a land-use type L
- A_L – the attraction rates at the TAZ for a land-use type L
- T_{LP} - Time of Day Demand Distribution for period P

Such that summing across all (N) land uses for any single time period (P) would produce an allocation vector which sums to 100% representing the weighted share of trip attractions responsible as a function of the present land use, and its relative attractions by period.

The final result of this step is a means of relating an O-D HBW flow to the land uses it serves. The next step is to associate these land uses with industries.

B. Relate DMAMPO land use codes to industry activity

Because research on telecommuting potential is industry-specific (see step C), while the DMAMPO model is organized around land-use code, the research team needed to relate the two. This association is shown in Table 1. Land-use codes with no telecommute profile (shown as "NA") are assumed to not have meaningful telecommuting potential and are excluded from the analysis. Note that this step may not be necessary for all models, as some have industry-specific employment information.

Table 1 Land Use – Industry Relationship

	Land Uses Measured in KSF	Associated Telecommute Profile
PS	DAY CARE/PRESCHOOL	**NA**
HOT	HOTEL/MOTEL	Leisure/hospitality
SFC	STREET FRONT COMMERCIAL	wholesale/retail
NSC	NEIGHBORHOOD SHOPPING CENTER	wholesale/retail
CSC	COMMUNITY SHOPPING CENTER/BIG BOX	wholesale/retail
RSC	REGIONAL SHOPPING CENTER	wholesale/retail
AUC	AUTO DEALERSHIP	wholesale/retail
SS	SERVICE STATION	Other Services
FF	FAST FOOD	Leisure/hospitality
SDR	SIT-DOWN RESTAURANT	Leisure/hospitality
ORC	OTHER COMMERCIAL	Other Services
PO	POST OFFICE/SHIPPING OFFICE	Transportation & Utilities
BNK	BANK	Financial
MFG	MANUFACTURING	Manufacturing
IPK	INDUSTRIAL PARK/LIGHT INDUSTRY	Manufacturing
WAR	WAREHOUSING	**NA**
GO	GENERAL OFFICE	Other Services
GOV	GOVERNMENT OFFICE	Public Admin
HRO	HIGH RISE OFFICE	Professional and Business
FS	FIRE/POLICE STATION	Public Admin
RF	RELIGIOUS FACILITY	Other Services
OPS	OTHER PUBLIC SERVICE	Other Services
REC	RECREATIONAL USE	**NA**
CUL	CULTURAL FACILITY	**NA**
CCEN	CONVENTION CENTER	Leisure/hospitality
PA	PUBLIC ASSEMBLY	**NA**
JAIL	Jail	**NA**
TOUR	TOURIST ATTRACTIONS	Leisure/hospitality
ORS	OTHER SCHOOL	Education and Health
LIB	LIBRARY	**NA**
HOSP	HOSPITAL	Education and Health
OHC	OTHER HEALTH CARE	Education and Health
SNF	SKILLED NURSING FAILITY/ASSISSTED LIVING	Education and Health
CAS	CASINO	Leisure/hospitality
STAD	STADIUM/ARENA	Leisure/hospitality

C. Identify the propensity of trip makers to telecommute by industry

Some industries have greater potential for telework than other industries. Each industry's ability to adapt to telecommuting is influenced by the nature of their work, as captured by the composition of occupations within their workforce. Knowledge sectors such as financial services are more able to perform their duties remotely, compared to on-location workers such as those in construction or hospitality who must be physically present to provide their services. To explore the impacts of telecommuting, the team identified the portion of workers in Des Moines that are capable of working remotely and then explored how this manifests as changes in trip-making behavior.

Research conducted by the Bureau of Labor Statistics delves deeply into this question, as part of broader research on remote work and COVID-19 employment impacts. Table 2 below shows industry-specific estimates of the share of employees within a given sector that can telework. These estimates were constructed by researchers using a combination of data on the occupational composition of the workforce and job characteristics by occupation that do or do not lend themselves to remote work.[1]

Table 2 Industry Telecommute Potential

Industry	Percent share of employed able to telework (April 2020)	Labor market outcomes		Percent change in employment (February–April 2020)			Percentage-point change in unemployment rate (February–April 2020)		
		Percent change in employment (February–April 2020)	Percentage-point change in unemployment rate (February–April 2020)	Able to telework	Not able to telework	Difference	Able to telework	Not able to telework	Difference
Financial activities	81.1	-6.1	3.7	-5.8	-7.2	1.4	2.8	7.2	-4.4
Information	80.4	-11.8	9.3	-2.1	-37.3	35.2	5.8	21.1	-15.3
Professional and business services	71.6	-9.6	5.5	-6.4	-16.8	10.4	3.5	10.0	-6.5
Public administration	57.0	-3.8	3.4	-1.5	-6.7	5.1	3.2	3.8	-0.6
Education and health services	47.9	-13.9	9.4	-12.5	-15.2	2.8	8.8	9.9	-1.1
Manufacturing	41.0	-13.7	9.2	-3.9	-19.5	15.5	4.3	12.3	-8.0
Mining, quarrying, and oil and gas extraction	40.3	-14.9	4.2	5.5	-24.8	30.3	4.2	5.1	-0.8
Other services	39.9	-27.2	19.4	-8.4	-35.9	27.5	10.6	24.3	-13.6
Transportation and utilities	32.7	-10.9	8.7	4.7	-16.9	21.6	4.9	10.4	-5.5
Wholesale and retail trade	26.5	-16.4	12.6	-9.4	-18.6	9.2	7.6	14.2	-6.6
Construction	20.7	-16.6	10.2	-11.9	-17.8	5.8	5.1	11.3	-6.2
Leisure and hospitality	20.3	-42.0	32.1	-25.5	-45.1	19.6	22.9	34.1	-11.2
Agriculture, forestry, fishing, and hunting	8.1	-1.2	-1.7	-4.3	-1.0	-3.3	-5.9	-1.3	-4.5
Total	45.8	-15.6	10.8	-7.9	-21.2	13.3	6.2	14.3	-8.1

Source: Authors' calculations based on Februrary–April 2020 Current Population Survey data and O*NET job-content data.

The research team applied these telework capacities by industry sector (second column of *Table* 2) as a theoretical maximum of what is possible in the Des Moines region. By applying the theoretical maximum, the team produced modifications to the HBW trip table that can support further exploration of telecommuting sensitivity along a frontier curve of potential response by industry. This allows for potential future testing to review the sensitivity of key links or corridors to different assumptions about telecommuting levels, relative to the defined maximum explored in the scenario.

E-commerce

Figure 3 below represents the key steps in constructing an e-commerce scenario:

Figure 3 Mechanisms for Implementing E-Commerce Scenario

[1] Drawn from Occupational Employment Statistics (OES) and the Occupational Information Network (O*NET) database.

Estimation of e-commerce shifts

- Extrapolate from national time series trends

Reduction in home-based shopping trips and combo truck trips at retail locations

- Target relevant land uses, based on land use data

Reallocation of combo truck trips to e-commerce facilities

- Assigned to specific logistics and warehousing locations

Single unit truck delivery to households

- Origins are logistics and warehousing locations, detinations are households of foregone shopping trips

Note that this process has much in common with the methodology employed in generating the telecommute scenario because it employs the similar land-use-based trip disaggregation method at the origin or destination of a trip as the basis of targeting specific types of activity. For reference, see the above section in the telecommute scenario titled A. Stratify O-D Trip Tables for the methodology of associating origin-destination trip tables with specific land uses. Where formerly the methodology focused on identifying home-based work trips, the e-commerce implementation emphasizes home-based shopping trips.

A. Adjusting Home Based Shopper Behavior

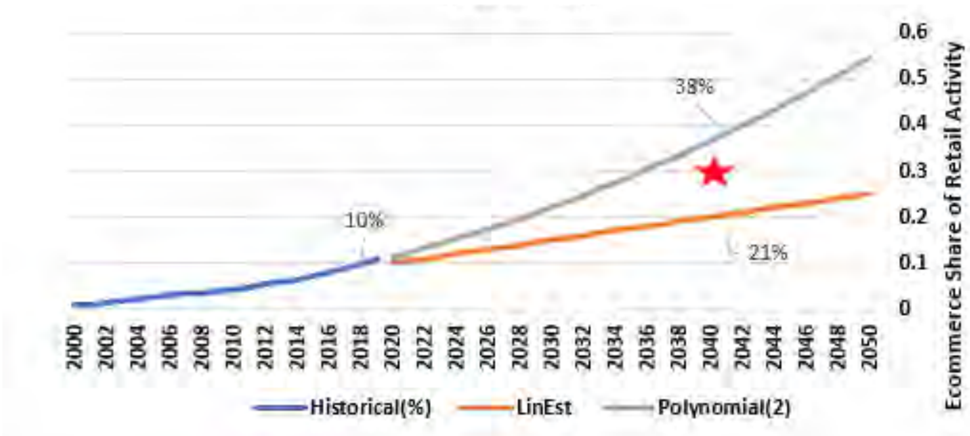
Estimating the rate of e-commerce growth in the future. To address e-commerce and its related network implications, the first step is to explore the potential growth trajectory for e-commerce in the region and how this compares to existing levels reflected in the currently calibrated travel model.

Ideally, a measure of e-commerce sales as a share of retail by a local unit of geography could be used as the basis of constructing an estimate of current e-commerce reliance. While some states mandate the collection of sales tax[2] from out-of-state businesses selling to Iowa, often the data is incomplete, and lacking in detail. In the absence of detailed local data, the research sought national data as a proxy. The US Census publishes a quarterly retail trade statistical report which provides an estimate of the value of retail trade nationally and the share that is e-commerce. This supplemental census product is constructed from the monthly retail trade survey and goes from as far back as 2015 up to a lagged present-day period (mid-2020 at the time of scenario development).[3] The historical data shows a national trend towards increase e-commerce that can be leveraged as an approximation of regional conditions.

[2] Iowa, for example, has an economic nexus tax which it collects on remote sellers who make a combined $100,000 or more in sales within the state and are not located within the region. Less information is known regarding e-commerce sales for businesses which have a physical presence within the state.
[3] Estimated Quarterly U.S. Retail Sales: Total and E-commerce. https://www.census.gov/retail/index.html

Figure 4 extrapolates from this data to the future DMAMPO model year of 2040, using two different extrapolation approaches (linear and polynomial). This enables the definition of both an aggressive and a more moderate potential rate of e-commerce adoption in the future. This approach is beneficial in that it follows from historical patterns while providing bounded expectations on the rates of adoption such that the area between the two curves represents a plausible range of growth scenarios to test.

Figure 4 Forecasting of Potential Trajectories for E-commerce Retail Activity



Source: EBP analysis using national data from https://census.gov/retail

The e-commerce scenario was developed by assuming a middle-of-the-road view between the two rates of adoptions, marked by the star in Figure 4. This rate implies that approximately 30% of retail sales by the year 2040 would be conducted and executed online, rather than in person at a store. This 30% assumption would mean that of the sum totality of home-based shoppers moving around in the model, a little less than a third of those who were making trips to and from shopping centers would be subject to the effects of this scenario.[4]

Reduction in home-based shopping trips. One key distinction between the implementation of telecommuting and e-commerce (in addition to emphasizing different types of trips being made) is that while the home-based work trip adjustments were applied based on a share of all industries, the e-commerce scenario focuses on specific types of land use in the model: Regional Shopping Centers, Neighborhood Shopping Centers, and Community shopping Centers/ Big Box Stores.

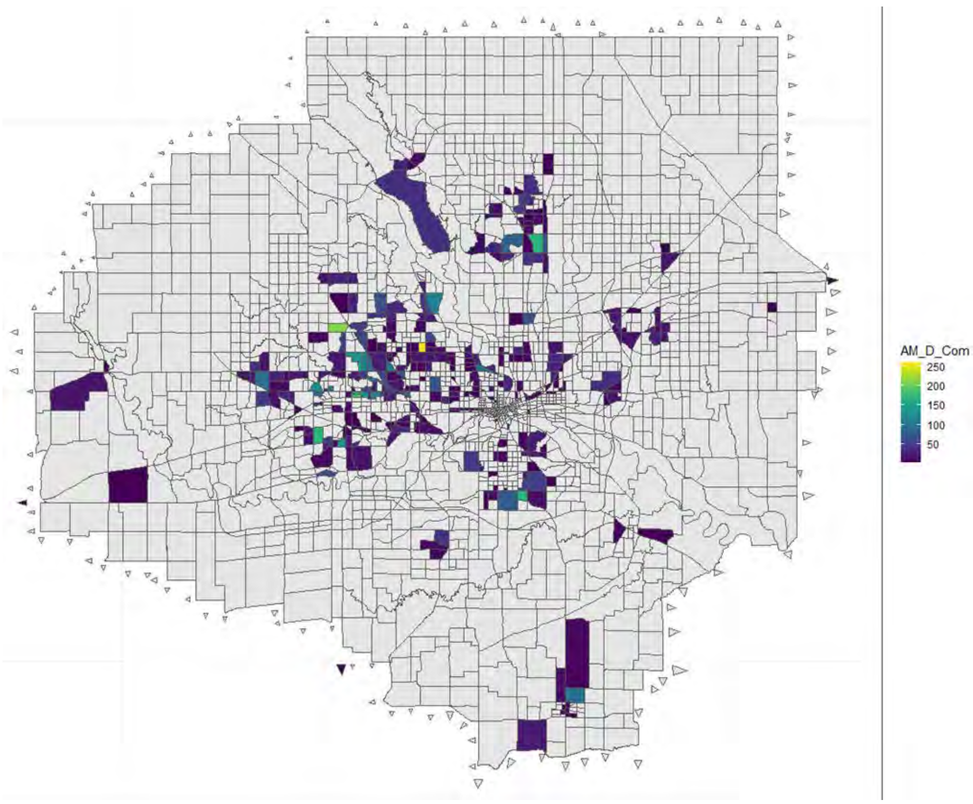
In the DMAMPO model, these are a subset of the Commercial land use types, which also include broader activities such as hotels, service stations, dealerships, street-front commercial businesses, and fast-food restaurants. The detail on the land use, and where it falls within broader classifications (industrial, commercial, public, offices) will vary from model to model.

Figure 5 depicts the destinations of home-based shopping trips targeted by the scenario, which represent just the targeted land use codes. Note that figure shows the AM peak

[4] Note that the home-based shopping purpose includes much more than retail shopping, so it is fundamentally different from saying a third of all home-based shopping trips.

time here because there is the highest correlation between origin-destination movements for travelers representing travel from home to shopping (based on the directional factors discussed earlier), even though the majority of shopping activities do not take place during the morning weekday period.

Figure 5 Destinations of Home-Based Shopping Trips Targeted by Scenario



B. Adjusting Combination Vehicles Behavior

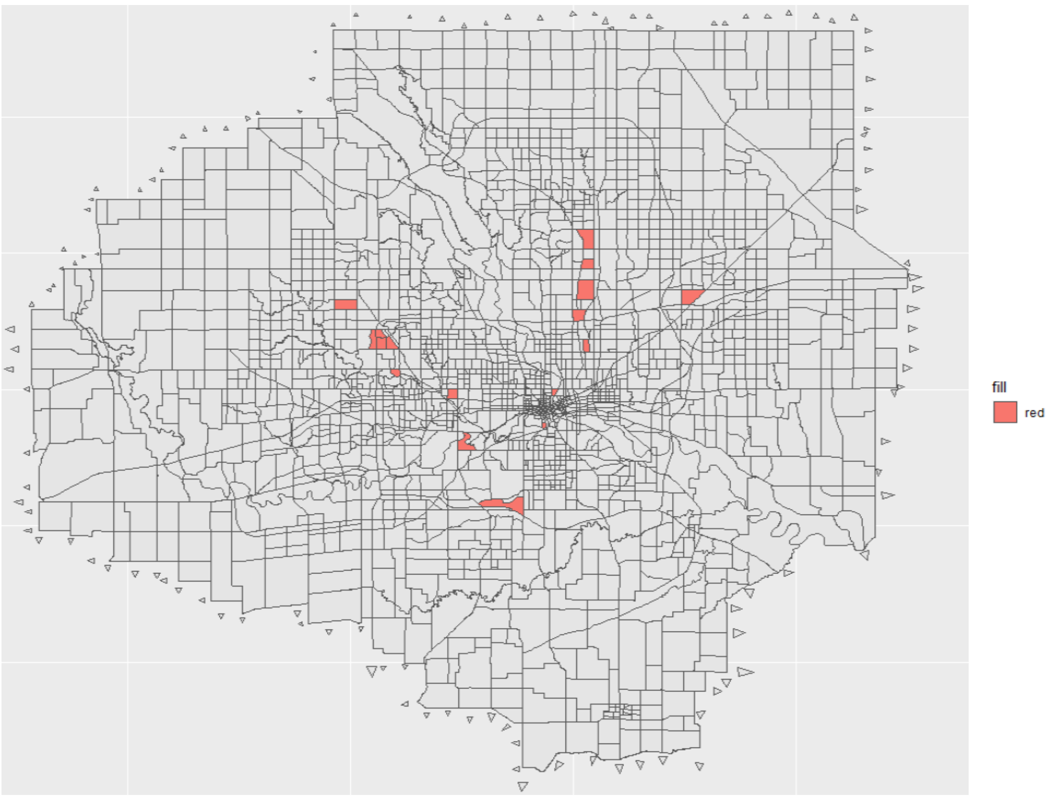
To represent the change in the pattern of truck activity which originally was responsible for stocking goods at retail stores, and that now provide goods to e-commerce distribution centers, the research team employed a four-step approach reallocating combination vehicle activity:

1. Parse out the combination vehicle O-D activity to isolate traffic involving each of the three commercial retail land-use types.
2. Apply an equivalent percent reduction from the estimated foregone home-based shopping trips to the number of combination vehicles responsible for restocking the retail outlets.
3. Work with the local DMAMPO planning staff to identify potential e-commerce facility locations which would be responsible for handling the new traffic.
4. Distribute the new trips to these facilities in place of the traditional retail locations.

The result of this sequence of steps is a substitution of combination vehicles away from the retail facilities they once stocked, towards the newly identified distribution facilities that would be responsible for generating delivery vehicle traffic to complete the order process and ship the ordered goods to customers.

Staff from DMAMPO and Iowa DOT provided a list of relevant facilities likely to handle fulfillment of e-commerce deliveries in the future scenario. These are shown in Figure 6 and serve as the destinations of the re-routed COMBO truck trips from the retail locations (shown as destinations in Figure).

Figure 6 Identified E-commerce Locations



Allocation of COMBO vehicle trips across the various distribution centers was done based on the relative volume of combination vehicles destined to the respective identified TAZs in the DMAMPO baseline trip table. Note that before implementing this scenario, DMAMPO and Iowa DOT staff worked together to encode two new Amazon facilities into the model as special generators. These facilities are expected to come online soon and play a significant role in any e-commerce future.

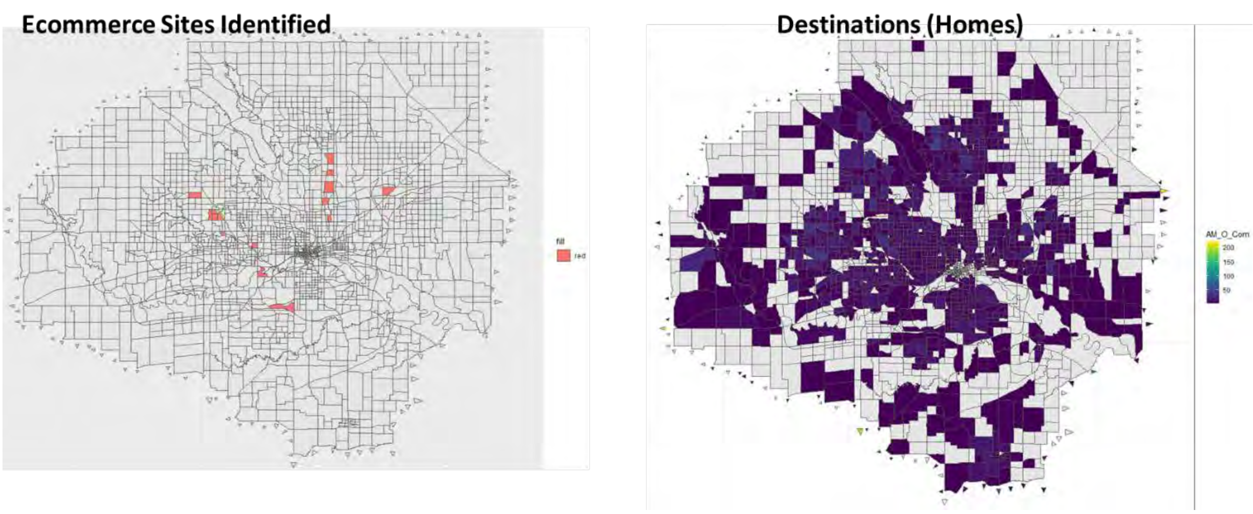
C. Adjusting Single Unit Vehicle Behavior

The following diagram (Figure 7) shows the building blocks of single unit (delivery vehicle) behavior under an e-commerce scenario. From the combination vehicle adjustments, the facilities that will serve as an origin of a delivery vehicle have already been identified (left panel). Simultaneously, the destination of the households to receive the goods are those that no longer make a physical shopping trip (right panel). The remaining question is how to represent the movement of delivery vehicles from the e-commerce sites to households (and back).

It is not realistic to simply have a delivery vehicle go out from a facility to drop off an order, and then return to the distribution center. Such an assumption would create more trips than necessary because most delivery vehicles engage in truck touring – planning out a route with multiple delivery stops. Additionally, the question of how many packages can be fit into a vehicle would need to be resolved to determine the number of delivery vehicles being created to move the goods. The DMAMPO model is not set up to account directly for trip touring behavior.

In the right-sizing scenario exploration implemented as part of this project, truck deliveries from warehouses to home locations were not implemented due to time and resource constraints. However, this could be a topic of future exploration. One approach to approximating local delivery trips in the model in a future iteration would be to develop assumptions regarding load factors and then allocate truck trips in a simplistic "there-and-back" manner between e-commerce locations and households, without accounting for touring. This could serve to identify concentrations of new traffic around the e-commerce facilities, while not meaningfully affecting local traffic in residential areas. As such, it could support the right-sizing objective of focusing on areas with the most likely transportation impact.

Figure 7 E-commerce sites and destinations of likely new home delivery trips (homes)



Step 3. Identify Transportation Performance Impacts

The next step of the scenario exploration is to implement the right-sizing scenario in the available travel model. This means, in this case, running the regional travel demand model with the modified trip tables from step 2 for the scenario and running it for an accepted future baseline.

Based on these runs, impacts on transportation performance can be examined through:

- Maps of changes in key performance such as volume and volume-to-capacity ratios
- Aggregate metrics such as changes in vehicle hours or miles traveled or the percent of travel occurring in congested conditions

The following sections present data on how trip patterns were modified in each scenario as an input to the model runs to determine resulting network performance effects.

Telecommuting Trip Patterns

Figure 8 shows the portion of average annual daily weekday home-based work trips which could theoretically be foregone in favor of working from home. Of the over 602,465 daily commute trips taking place in the DMAMPO model area, approximately 23.5% of those trips could theoretically not be made under the constructed maximum telecommute scenario.

Figure 8 Portion of Total Daily Home-Based Work Trips Sensitive to Telecommuting (2040 Weekday)

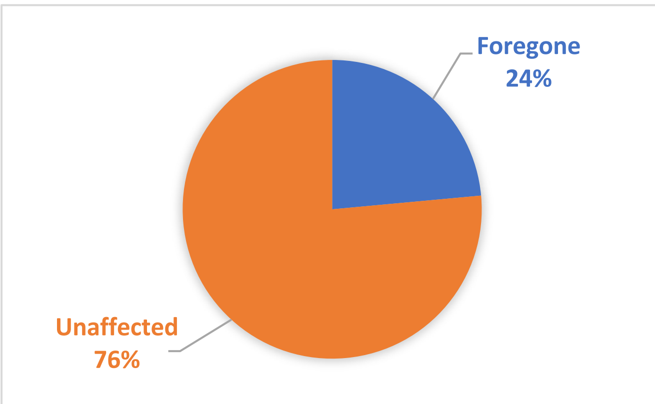
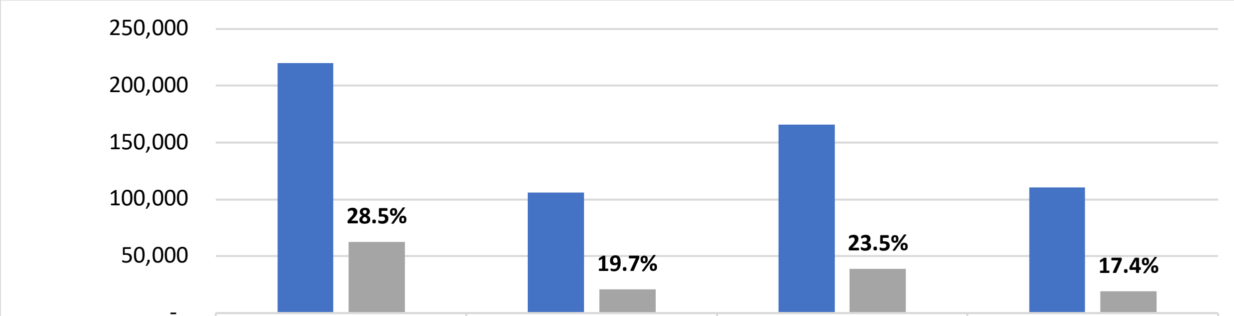


Figure 9 takes the average annual daily weekday trips by period and looks at how trip-making activity is distributed throughout the day for normal daily traffic, as well as the foregone trips that no longer have to occur due to telecommuting. While the overall volume of commuting throughout the day is expected to reduce by approximately 23.5%, there is a more concentrated effect during the AM and PM periods. Approximately 28.5% of trip making in the am peak period associated with commuting to and from work could potentially be foregone in a maximum telecommute scenario.

Figure 9 2040 Share of Affected HBW Vehicle Trips



	AM	MD	PM	OP
Base Trips	219,731	106,290	165,938	110,506
Affected Trips	62,588	20,991	39,026	19,183

Base Trips **Affected Trips**

Figure 10 shows the origins and destinations of the HBW trips affected in the AM period when the majority of commute trips move from home towards work. This spatial pattern was reviewed by staff from DMAMPO to confirm expected geographic patterns. Affected trips move from housing locations throughout the region to more concentrated and centrally located job sites. The other periods resemble a hybrid pattern of work and home locations, which spatially correlate with the directional factors (Figure 11). These were also reviewed together with DMAMPO staff to confirm spatial dynamics.

Figure 10 Origins and Destinations of Scenario Affected Home Based Work Trips – AM Period

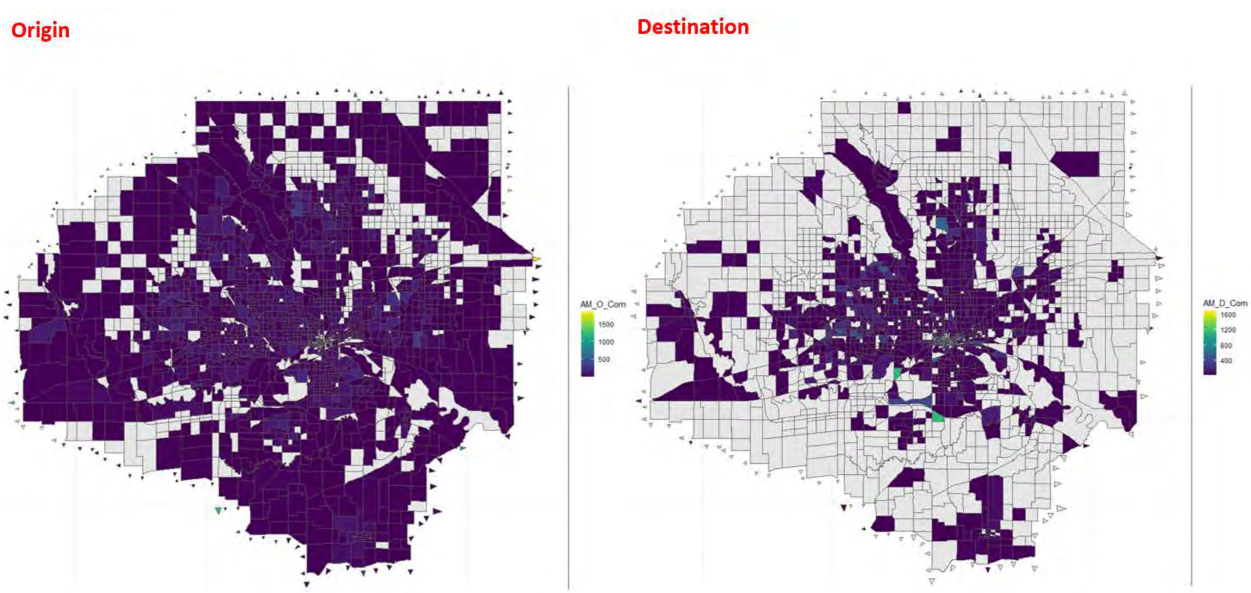
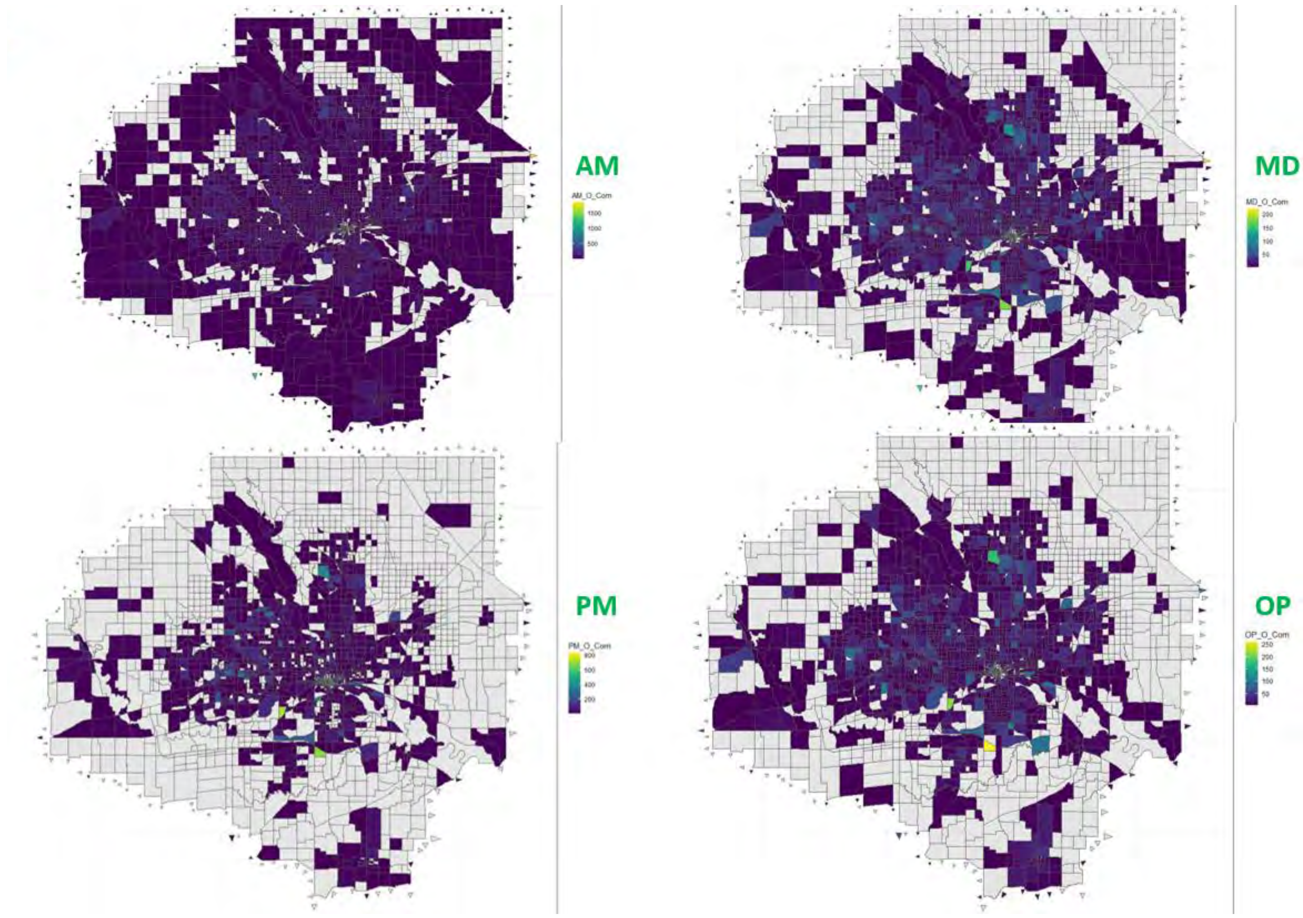


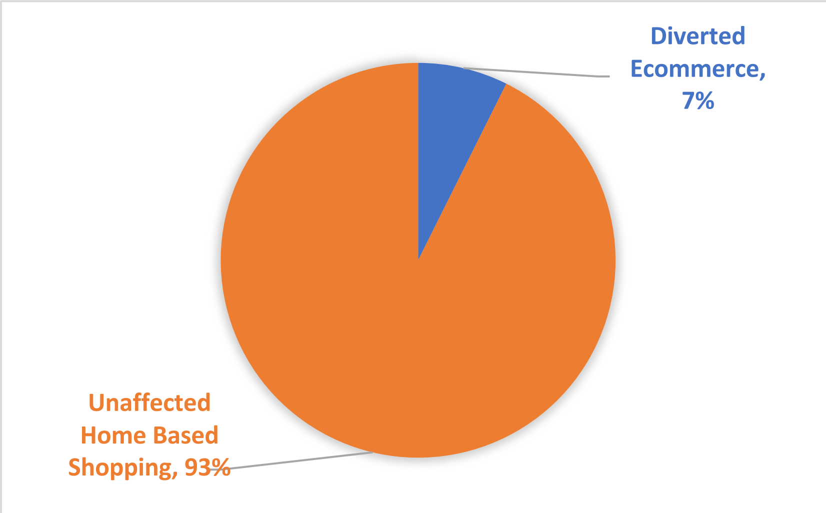
Figure 11 Origins of Scenario Affected Home Based Work Trips – All Periods



E-commerce Trip Patterns

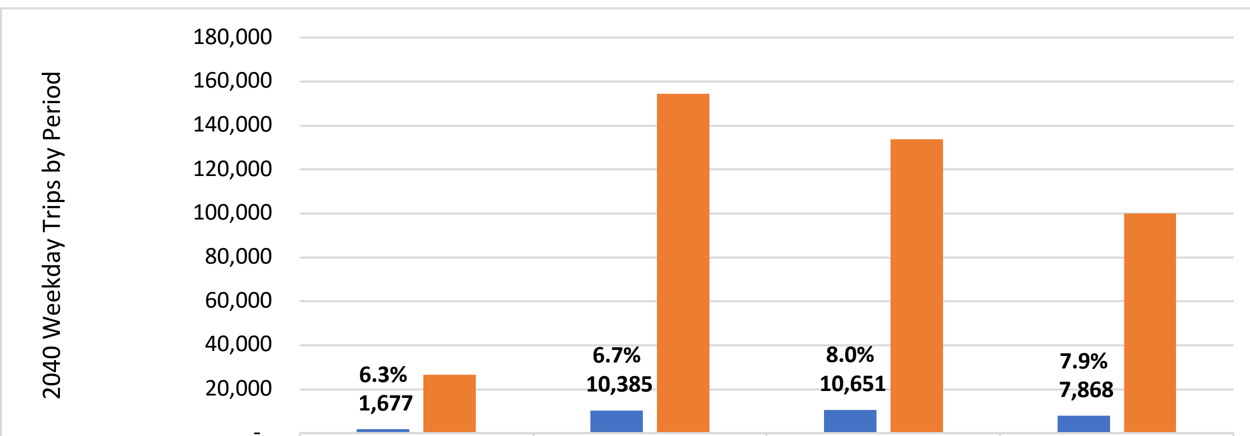
Removing 30% of home-based shopping trips for the targeted retail sectors results in a 7% reduction in weekday homebased shopping trips across all four periods of the day (Figure *1*e 12). This corresponds to 30,581 fewer daily weekday trips taking place out of the 414,669 trips occurring.

Figure 12 Affected Home Based Shopping Trips – 2040 Weekday E-commerce Scenario



The majority of these foregone trips occur during the midday and off-peak periods. Figure 13 shows the total number of home-based shopping trips taking place across the various weekday periods, along with the number of foregone trips.

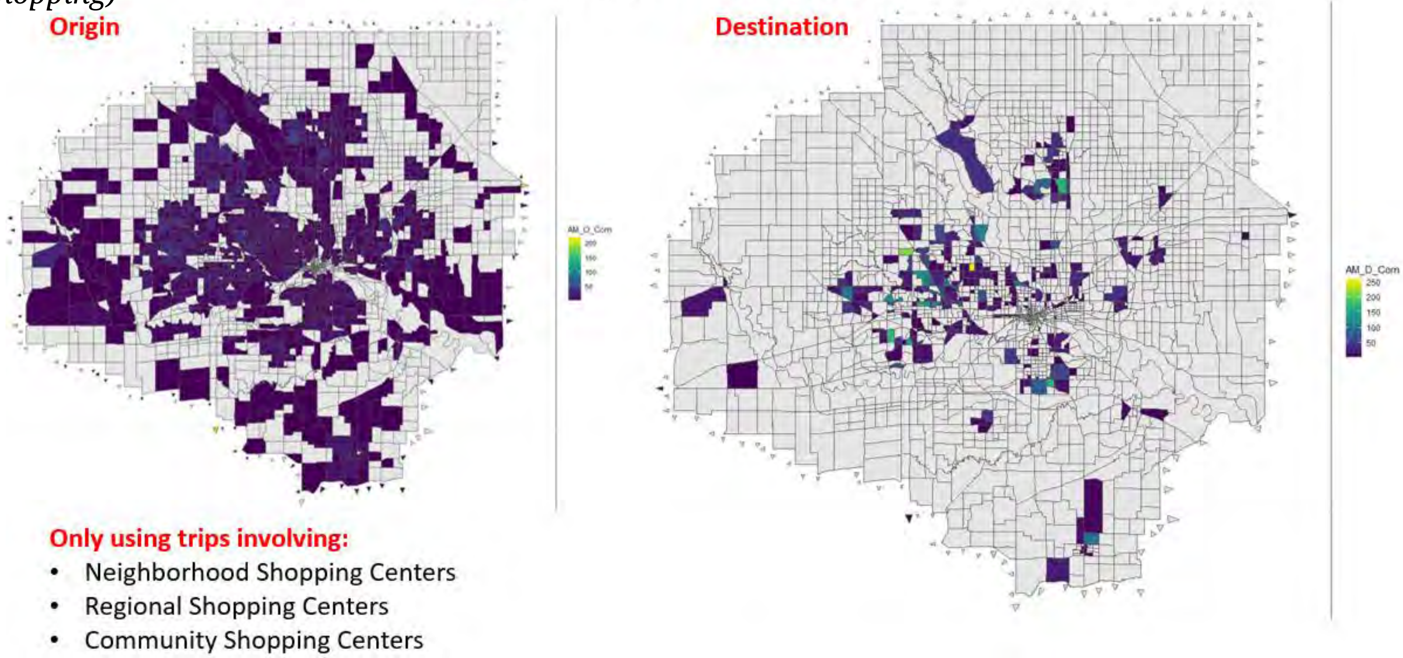
Figure 13 Diversion of Home-Based Shopping Trips Due to E-commerce (30% Assumption)



	AM	MD	OP	PM
Diverted Ecommerce	1,677	10,385	10,651	7,868
Home Based Shopping	26,445	154,381	133,834	100,009

Figure 14 shows the change in shopping trips for targeted retail shopping centers by origin and by destination. Origins are fairly distributed, corresponding to the spatial patterns of homes, while destinations are more concentrated.

Figure 14 Home Based Shopping Trip Pattern – AM (83% directionally going from home to shopping)



Combination vehicles were also redistributed from stocking retail locations to distribution centers. In total, 162 combination trucks per day are affected in the scenario. These are reflected in the changing pattern of combination vehicles at the destination shown in Figure 15. Note that a limited number of TAZs show increases and decreases associated with this redistribution effect.

Figure 15 Difference vs. Base in E-commerce: Daily Combo Trips by Destination

Step 4. Examine Sensitivity of Needs Between Scenario and Baseline

With the modeling results from Step 3, Step 4 is to examine the sensitivity of needs between the defined scenario and the baseline. This involves comparing scenario outcomes to the baseline, to determine the scale of impact on network performance and to evaluate whether future deficiencies identified in the baseline are ameliorated or exacerbated by the alternative scenario. Transportation agencies should in particular look at changes in performance along key corridors or locations of interest where significant investments are being planned or considered. This examination will help to identify whether needs identified in the baseline future forecast are sensitive to the types of exogenous changes explored in the scenario.

A comparison of the key statistics for the baseline and the three modeled scenarios at the system level is presented in this section. The scenarios included E-commerce, Telecommute, and a combination of E-commerce and Telecommute. The statistics include Vehicle Miles Traveled (VMT), Delay (difference between free-flow and congested Vehicle Hours Traveled (VHT)), and average free-flow and congested speeds, and are presented in Table 3, Table 4, Table 5, and Table 6, respectively. A daily level of service comparison between each scenario and the baseline is presented in Figure 16, Figure 17, and Figure 18, respectively.

Table 3 VMT (Miles)

FACTYPE	Base	Ecom	TelCom	Ecom_TelCom
Interstate	9,723,487	9,683,108	9,122,037	9,066,182
Principal arterial	3,726,913	3,713,831	3,554,636	3,534,494
Minor arterial	4,496,566	4,467,671	4,148,398	4,103,273
Collector	2,147,966	2,127,919	1,904,035	1,874,304
Minor Collector	447,905	444,210	402,278	396,745
Local	630,036	620,997	540,412	527,428
TOTAL	**21,172,873**	**21,057,737**	**19,671,797**	**19,502,426**

Table 4 Delay (Hours)

FACTYPE	Base	Ecom	TelCom	Ecom_TelCom
Interstate	29,233	29,066	17,771	17,386
Principal arterial	60,039	59,054	49,863	48,621
Minor arterial	51,512	50,426	37,390	35,962
Collector	11,429	11,179	7,504	7,164
Minor Collector	1,237	1,205	836	791
Local	3,274	3,191	1,970	1,860
TOTAL	**156,723**	**154,121**	**115,335**	**111,784**

Table 5 Free-flow Speed (miles/hour)

FACTYPE	Base	Ecom	TelCom	Ecom_TelCom
Interstate	64.0	64.0	64.1	64.1

Principal arterial	49.8	49.8	49.7	49.7
Minor arterial	36.5	36.5	36.5	36.5
Collector	38.8	38.8	39.0	39.0
Minor Collector	42.0	42.0	41.9	41.9
Local	29.4	29.5	29.5	29.6
TOTAL	**48.4**	**48.4**	**48.7**	**48.7**

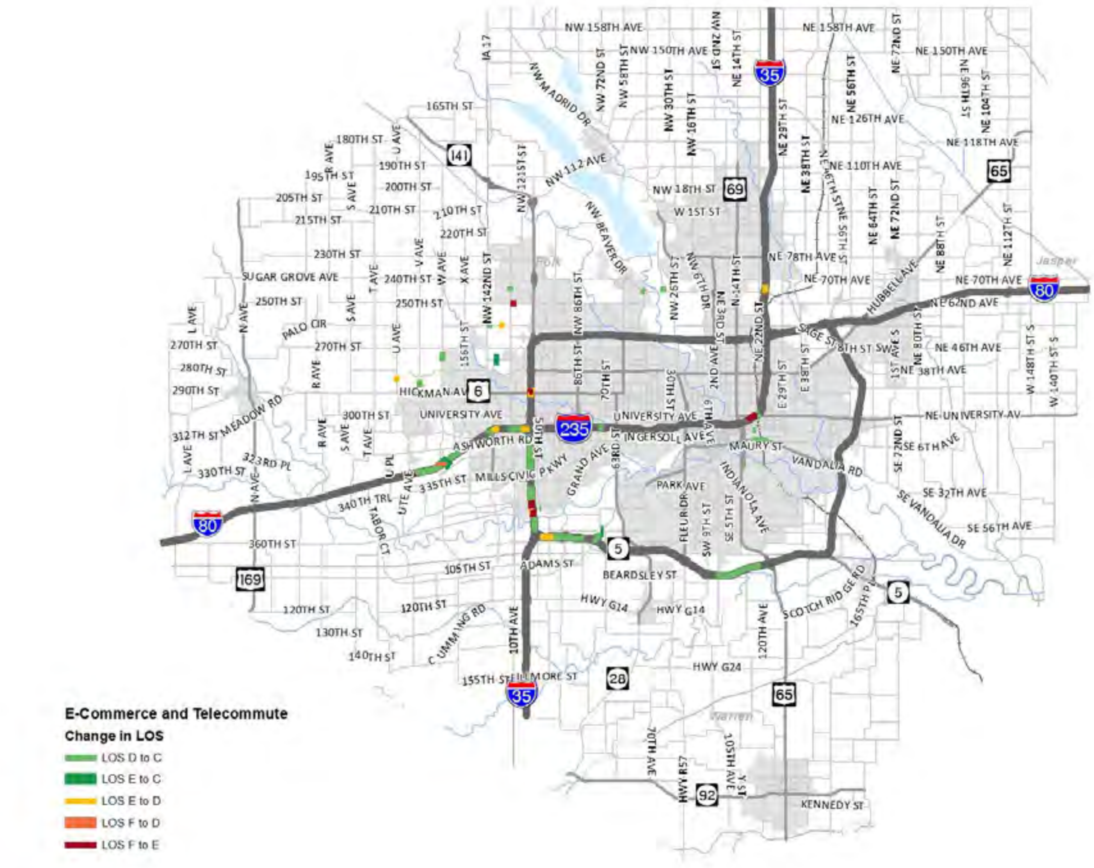
Table 6 Congested Speed (miles/hour)

FACTYPE	Base	Ecom	TelCom	Ecom_TelCom
Interstate	53.7	53.7	57.0	57.1
Principal arterial	27.6	27.8	29.3	29.5
Minor arterial	25.7	25.8	27.5	27.7
Collector	32.1	32.2	33.8	34.0
Minor Collector	37.6	37.7	38.5	38.7
Local	25.5	25.6	26.7	26.8
TOTAL	**35.6**	**35.8**	**37.9**	**38.1**

Figure 16 E-commerce LOS: Difference vs. Base

Figure 17 Telecommute LOS: Difference vs. Base

Figure 18 E-commerce & Telecommute LOS: Difference vs. Base



Key findings

Based on the statistics in the tables above, the VMT decreases for the three scenarios from 21.2M miles in the baseline to 21.1M miles in E-commerce, 19.7M miles in Telecommute, and 19.5M miles in the Combination scenario. Thus, the highest reduction in VMT occurs in the Combination (E-commerce and Telecommute together) scenario (7.9%), followed by Telecommute (7.1%) and E-commerce (0.5%). Similarly, the highest delay reduction occurs in Combination (28.7%), followed by Telecommute (26.4%) and E-commerce (1.7%). The average congested speeds increase from 35.6 mph in the baseline to 35.8 mph in E-commerce, 37.9 mph in Telecommute, and 38.1 mph in Combination.

As seen from the LOS maps, the E-commerce does not have significant improvement in the daily LOS. However, the Telecommute and the Combination scenarios show considerable improvements near the downtown Des Moines, especially the higher functional class facilities or ones carrying more volumes like I-80 and I-35.

Step 5. Determine Right-Sizing Implications

The final step is to review specific investment decisions (or if relevant, decision-making processes) and their sensitivity to the scenario. This step should focus on identifying agency investment decisions that are sensitive to the scenario and subsequently identifying strategy refinements based on the insights provided by the scenario. For example, a scenario might reveal a risk of overinvestment, in which case, an agency might choose to delay a particular investment or conduct further analysis of how project needs vary depending on underlying assumptions about the economy and trade. Alternately, a scenario analysis may serve to identify and reinforce needs that are resilient across multiple futures. This should give decision-makers greater confidence in investing resources to address these needs.

Appendix P3.A

Reference Tables from DMAMPO Model

Table 7 DMAMPO Model Directional Trip Making Factors[5]

Table 2.3.3: Directional Factors by Trip Purpose

	Weekday			
Trip Purpose	AM	MD	PM	OP
HBWL	0.97	0.55	0.07	0.38
HBWM	0.99	0.54	0.07	0.42
HBWH	1.00	0.51	0.07	0.27
HBSC	0.99	0.29	0.03	0.11
HBSH	0.83	0.48	0.40	0.27
HBO	0.81	0.61	0.48	0.38
NHB	0.50	0.50	0.50	0.50
HOSP	0.50	0.50	0.50	0.50
APRT	0.50	0.50	0.50	0.50
RREC	0.50	0.50	0.50	0.50
HOT	0.50	0.50	0.50	0.50
SU	0.50	0.50	0.50	0.50
COMBO	0.50	0.50	0.50	0.50

[5] In travel demand modeling, the movement of vehicles from point of origin to destination can be described in terms of vehicles moving from points of trip production (households) towards points of attraction (work). Directional factors, by period and type of trip making activity, summarize the percentage of total trips moving from production to attraction (i.e. home to work) as opposed to work to home.

Table 8 DMAMPO Model Trip Attraction Rates

Table 2.13.1: Weekday Daily Trip Attraction Rates

Weekday Daily Trip Attraction Rates											
LUCODE	LUNAME	HBW	HBSC	HBSH	HBO	NHB	UNIV	HOSP	APRT	RREC	HOT
10	RES	0.166	0.000	0.069	0.802	0.278	0.000	0.000	0.000	0.000	0.000
11	SFD	0.166	0.000	0.069	0.802	0.278	0.000	0.000	0.000	0.000	0.000
19	MHP	0.166	0.000	0.069	0.802	0.278	0.000	0.000	0.000	0.000	0.000
20	SFA	0.166	0.000	0.069	0.802	0.278	0.000	0.000	0.000	0.000	0.000
21	APT	0.166	0.000	0.069	0.802	0.278	0.000	0.000	0.000	0.000	0.000
22	DOR	0.166	0.000	0.069	0.802	0.278	0.000	0.000	0.000	0.000	0.000
23	STUD	0.166	0.000	0.069	0.802	0.278	0.000	0.000	0.000	0.000	0.000
24	RET	0.166	0.000	0.069	0.802	0.278	0.000	0.000	0.000	0.000	0.000
25	SNF	1.949	0.000	0.381	1.306	1.095	0.000	0.000	0.000	0.000	0.000
26	HOT	2.401	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.351
27	GQ	0.166	0.000	0.069	0.802	0.278	0.000	0.000	0.000	0.000	0.000
28	FRAT	0.166	0.000	0.069	0.802	0.278	0.000	0.000	0.000	0.000	0.000
30	MFG	2.304	0.000	0.000	1.152	1.152	0.000	0.000	0.000	0.000	0.000
31	IPK	1.155	0.000	0.000	0.189	0.212	0.000	0.000	0.000	0.000	0.000
32	WAR	1.306	0.000	0.059	0.283	1.451	0.000	0.000	0.000	0.000	0.000
33	FTER	0.639	0.000	0.000	0.096	0.452	0.000	0.000	0.000	0.000	0.000
34	STOR	0.000	0.000	0.000	0.150	0.127	0.000	0.000	0.000	0.000	0.000
35	EXT	0.003	0.000	0.000	0.498	0.421	0.000	0.000	0.000	0.000	0.000
36	LF	0.003	0.000	0.000	0.498	0.421	0.000	0.000	0.000	0.000	0.000
40	CAIR	4.801	0.000	0.000	0.000	0.000	0.000	0.000	27.040	0.000	0.000
41	GAIR	1.800	0.000	0.000	0.182	0.182	0.000	0.000	0.000	0.000	0.000
42	ROW	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	UTL	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44	PARK	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	TERM	0.177	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	SFC	2.165	0.000	3.890	1.164	8.341	0.000	0.000	0.000	0.000	0.000
51	NSC	1.950	0.000	10.638	3.932	12.269	0.000	0.000	0.000	0.000	0.000
52	CSC	1.624	0.000	10.335	0.594	9.412	0.000	0.000	0.000	0.000	0.000
53	RSC	1.082	0.000	1.349	0.707	3.081	0.000	0.000	0.000	0.000	0.000
55	AUC	2.165	0.000	1.609	0.659	2.222	0.000	0.000	0.000	0.000	0.000
56	SS	2.591	0.000	21.182	6.046	17.905	0.000	0.000	0.000	0.000	0.000
57	FF	1.735	0.000	77.460	16.964	59.516	0.000	0.000	0.000	0.000	0.000
58	SDR	2.592	0.000	16.591	9.105	18.379	0.000	0.000	0.000	0.000	0.000
59	ORC	1.151	0.000	1.884	2.926	3.640	0.000	0.000	0.000	0.000	0.000

Table 9 DMAMPO model Time of Day Distribution

Table 2.3.1: Time of Day Percentages for Attractions by Land Use and Day of Week (Please Refer to the ISMS Manual Appendix I for LUC Details)

LUC	Time Period	WD HBW	WD HBSC	WD HBSH	WD OTHER	WD NHB	WE HBW	WE HBSC	WE HBSH	WE OTHER	WE NHB
0	AM	65.08%	100.00%	2.99%	28.96%	18.82%	12.78%	0.00%	12.84%	11.38%	8.53%
	PM	6.34%	0.00%	25.43%	16.67%	18.24%	0.00%	0.00%	6.74%	8.82%	19.71%
	OP	12.96%	0.00%	46.21%	23.63%	11.73%	12.78%	0.00%	14.92%	20.97%	35.20%
	MD	15.62%	0.00%	25.37%	30.73%	51.21%	74.44%	100.00%	65.50%	58.83%	36.56%
10	AM	16.99%	26.04%	6.18%	10.25%	8.57%	7.46%	0.00%	5.88%	5.60%	3.47%
	PM	51.29%	55.70%	18.73%	30.97%	22.90%	28.50%	0.00%	18.40%	27.94%	36.91%
	OP	21.19%	0.00%	35.28%	25.29%	19.40%	26.92%	100.00%	16.94%	19.13%	13.55%
	MD	11.53%	18.26%	39.81%	33.49%	49.13%	37.12%	0.00%	58.78%	47.33%	46.08%
11	AM	23.16%	34.72%	5.07%	14.29%	14.66%	7.46%	0.00%	5.88%	5.60%	3.47%
	PM	38.86%	40.93%	38.92%	41.22%	45.87%	28.50%	0.00%	18.40%	27.94%	36.91%
	OP	25.09%	0.00%	16.53%	15.70%	5.48%	26.92%	100.00%	16.94%	19.13%	13.55%
	MD	12.91%	24.35%	39.48%	28.79%	34.00%	37.12%	0.00%	58.78%	47.33%	46.08%
19	AM	13.39%	34.72%	9.82%	11.01%	9.82%	7.46%	0.00%	5.88%	5.60%	3.47%
	PM	55.55%	40.93%	18.00%	30.52%	18.00%	28.50%	0.00%	18.40%	27.94%	36.91%
	OP	14.46%	0.00%	36.06%	28.86%	36.06%	26.92%	100.00%	16.94%	19.13%	13.55%
	MD	16.61%	24.35%	36.12%	29.62%	36.12%	37.12%	0.00%	58.78%	47.33%	46.08%
20	AM	14.02%	0.00%	0.00%	4.67%	0.00%	7.46%	0.00%	5.88%	5.60%	3.47%
	PM	55.23%	100.00%	0.00%	21.65%	9.71%	28.50%	0.00%	18.40%	27.94%	36.91%
	OP	30.76%	0.00%	52.47%	27.74%	0.00%	26.92%	100.00%	16.94%	19.13%	13.55%
	MD	0.00%	0.00%	47.53%	45.94%	90.29%	37.12%	0.00%	58.78%	47.33%	46.08%

Methodological Considerations for Future Testing of Variability

Telecommuting

Throughout the telecommuting methodology, certain assumptions were made based on available data to develop the best approximation of telecommuting impacts to support the exploration of uncertainty and potential right-sizing impacts. In the implementation, it is important to keep in mind the influence of certain assumptions that could be refined in future efforts. The following are three observations on the process that could be adjusted to look at sensitivity in response:

1. **Additional exploration of income effects on telecommuting.** The methodology relies on national research on maximum telecommuting responses. In doing so, the methodology does not make use of the income strata detail contained in the DMAMPO model. This was because the research was presented by industry, which already assumed an implicit mix of occupations and incomes present within the industry. However, there is also likely to be a relationship between the flexibility of jobs and worker incomes. If the rates of telecommuting adoption were to be unraveled based on household income by using industry-occupation employment data, then an even more nuanced story could be created that would enable incidence analysis to look at how changes in travel behavior impact demographics within the model.

2. **Incorporation of region-specific insights.** If in the future additional research were conducted on region-specific telecommuting responses – either through reporting of actual behavior during COVID-19 or through more detailed analysis of industry and occupational data, then these local factors could be substituted for a more refined picture. The region might also be interested in tracking telecommuting levels over time, to see how responses measure up against the theoretical limits both during the pandemic and in recovery.
3. **Incorporation of more detailed industry-employment data.** Third and lastly, the current approach depends on the link of travel behavior to zonal land use characteristics and from there to industries. This was imperfect – as some of the more mixed or general land use categories can accommodate multiple kinds of industry activity. One test to the model that could be conducted in the future would be to forego the land use approach and instead use the Census' longitudinal employment-household dynamics database (LEHD) for its ability to track journey to work behavior by industry and income strata. This would allow for bypassing of the land use-industry relationships. The disadvantage of this, however, is that the data put out by census, while able to go down to a block-level of detail that typically corresponds with most travel models, can have a lack of specificity when using its origin-destination feature regarding detail on industry. Additionally, there are issues regarding suppression of data (to maintain confidentiality) that make it run the risk of showing differing outcomes. It was for this reason that the research team elected to stay with linkages contained within the travel demand model.

E-commerce

In order to construct a plausible scenario involving e-commerce, there were four junctures where assumptions were made concerning the behavior of key variables. These each represent an avenue for future testing of deviations from the defined scenario:

1. **Rate of e-commerce adoption.** The first unsurprisingly would be the rate of e-commerce adoption within the model region. The outlined methodology makes use of national trends to produce a bounded range of expected e-commerce penetration. Other data sources may be available that can provide region-specific pictures of e-commerce usage.
2. **E-commerce adoption and income.** Second, e-commerce consumption may vary by income group, with either a positive correlation between the two or a threshold effect between low income and moderate to high-income households. Additional research could address this and its resulting magnitude and spatial implications for trip-making.
3. **Online ordering and customer pickup.** Third, there are indications from the National Household Travel Survey that online shopping does not necessarily correspond to a 1:1 reduction in trips. Rather than disappearing, some e-commerce associated trips might instead appear in a different form such as curbside pickup or picking up of ordered goods from delivery lockers. These complexities were not addressed in the initial scenario demonstration but could impact the results by reducing the number of foregone trips or changing the destination of the trip completely.

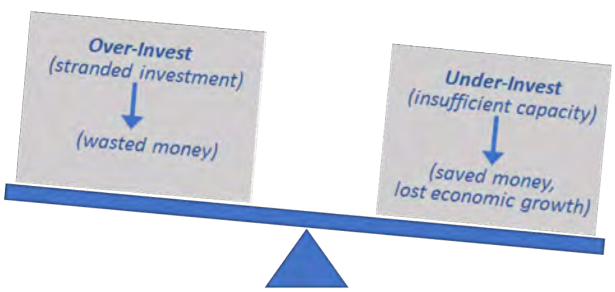
Instructions for Trade Scenario, 2021.

Introduction

The goal of this primer is to outline how state DOTs or MPOs can develop right-sizing scenarios that address economic and technological uncertainty. It draws on specific development and application of a statewide trade scenario and a regional digital economy scenario in Iowa. The scenario analysis investigates how changes in the economy and technology can drive change in the magnitudes and spatial patterns of both passenger and freight demand, resulting in changes in traffic and transportation needs.

Right-sizing in this context is about identifying uncertainty in future economic and technological conditions and using that to understand the potential for over and under investment risk (**Error! Reference source not found.**). By understanding the sensitivity of needs to different futures, transportation decision-makers can more confidently manage risk, directing resources towards assets that are critical under multiple futures, while taking a more careful look at others with more variability in need.

Figure 1 Risk and Opportunities



For each of the scenario applications, the primer follows a series of steps, as shown in *Figure 1*.

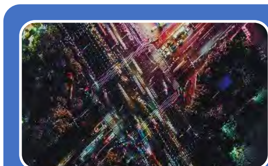
Figure 2 Right-Sizing Scenario Analysis Steps

Scenarios: *Define right-sizing scenario goals and drivers*

- Identify meaningful sources of uncertainty
- Focus on "levers" that change transportation demand or behavior

Data and Tools: *Identify data and tools to characterize scenarios*

- Identify data and tools that can help identify potential future changes in scenario drivers
- Identify the relationship between scenario drivers and "levers" within travel models



Transportation Performance: *Implement scenarios in travel models*

- Run travel demand models with alternative data or parameters developed for the scenario and for an accepted baseline
- Produce outputs such as maps and aggregate indicators of transportation performance

Sensitivity of Needs: *Explore differences between the scenario and the baseline*

- Compare scenario outcomes to the baseline, using maps, aggregate performance metrics, or examination of key corridors/locations of interest

Right-Sizing Implications: *Review investment decisions and their sensivity to scenarios*

- Explore the sensitivity of performance to the right-sizing scenarios
- Identify agency investment decisions that are sensitive to scenario drivers
- Identify strategy refinements (e.g., delay investment, conduct further analysis, focus on needs that are resilient across futures)

Trade Scenario Primer and Iowa Statewide Application

Step 1. Define Scenario Goals and Drivers

Right-sizing scenarios can help transportation agencies explore external factors that are outside an agency’s control that may have direct implications for their future investment decisions. They can help agencies better understand and manage uncertainty in future investment needs.

Define scenario goals. Right-sizing scenario analysis begins by defining the big picture goals of the scenario exploration, in terms of the types of external factors and uncertainties that are of interest.

The Iowa statewide trade scenario was designed to explore potential future changes in international trade and their implications for statewide trucking demand and performance on the Iowa highway network. Shifts in the pattern of trade have the potential to affect both goods movement to and from Iowa businesses, as well as pass-through traffic with origins and destinations outside of Iowa that use Iowa’s road network.

Define specific scenario drivers. To define a trade scenario of specific relevance to Iowa, the team first identified major corridors of interest and commodities that are particularly important to the Iowa economy. This involved exploration of existing patterns of trade and truck traffic.

Characteristics of the trade scenario tailored to the interests of Iowa DOT:

- Focus on trade that affects east-west traffic
- Focus on Iowa exports of agricultural commodities
- Focus on trade shifts between

Based on feedback from Iowa DOT, the research team developed a trade scenario that is relevant to east-west traffic, with an eye towards Iowa DOT's interest in investment needs on I-80, and that is focused on shifts in key Iowa export markets.

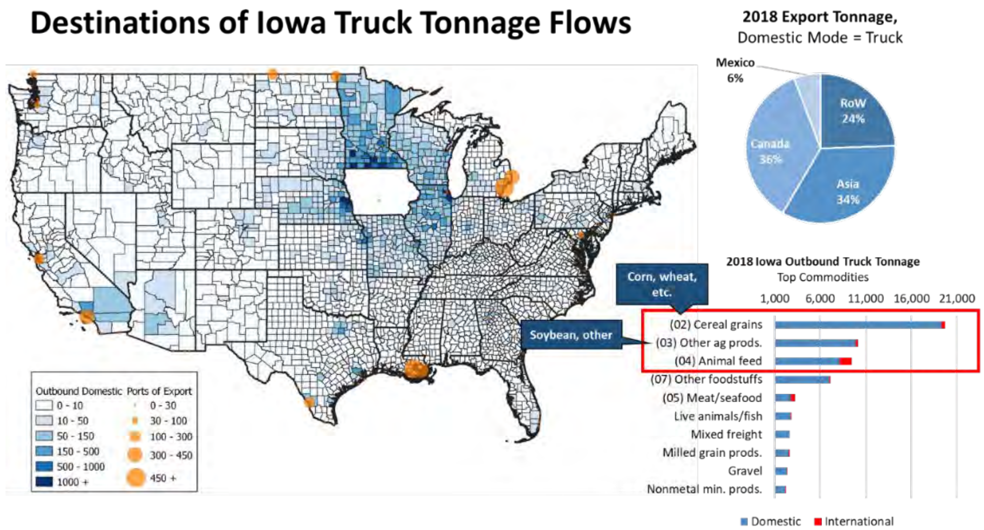
The research team began by reviewing the trade of Iowa commodities, the markets they involve, and the potential routes they rely on. *Figure* summarizes the outbound destination of Iowa goods in 2018. The left diagram shows the county and port destination of outbound Iowa goods (domestic partners and international ports of export). To the right are the destinations of export tonnage – with goods being delivered primarily to Canada and Asia. In terms of the dominant goods represented, the following three are of key importance to the state:

- Cereal Grains (such as corn and wheat)
- Other agricultural products (such as soybeans)
- Animal Feed

These commodities were selected based on the volume of tons moving in relation to the state, as opposed to the value of goods shipped. While the value of goods moving has a direct tie into the economy, it emphasizes different types of commodities, which tend to be of a higher value and lower volume. To examine uncertainty in truck volumes based on redistribution of trade, focusing on high tonnage commodities was more appropriate.

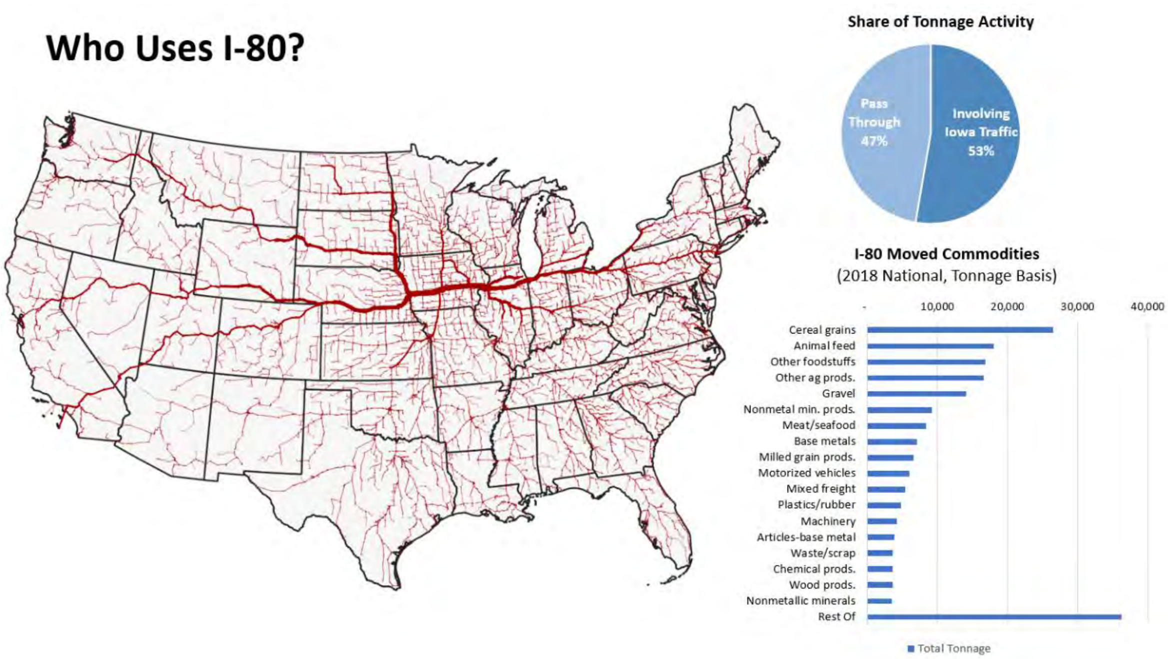
The research team also examined the mix of trade and commodity flows along I-80. For this purpose, the team assigned county-level trade data onto the Freight Analysis Framework (FAF) network and then conducted a select link analysis of freight activity making use of I-80. *Figure* depicts the volume of freight on I-80 and feeding corridors. It also summarizes the kinds of goods moving along the corridor. This analysis confirms that the identified commodities (cereal gains, other agricultural products, and animal feed) are not only significant to Iowa's economy and trade, but also the corridor of interest, I-80. It also shows that while a large volume of Iowa traffic relies on the corridor, just shy of half (47%) of the tonnage moving on the corridor is passing through the state.

Figure 3 Destinations of Iowa Truck Tonnage Flows (2018)



Source: County-level allocation by EBP levering data from FAF, WiserTrade, and USATrade,

Figure 4 Profile of freight movement on I-80



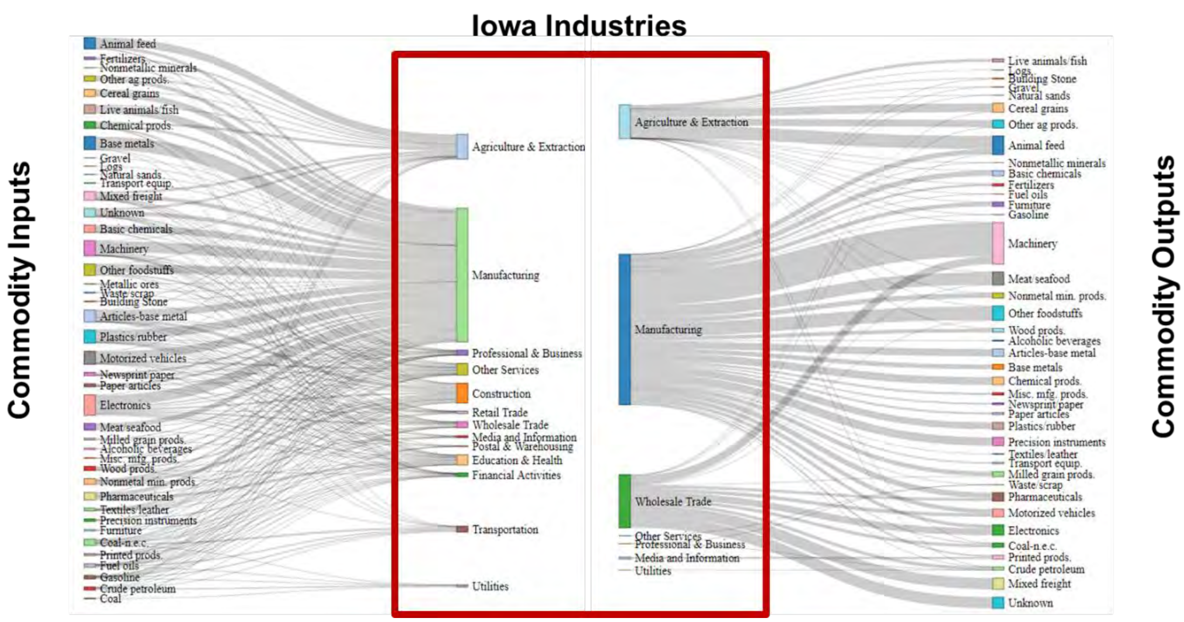
Based on the above diagnostics of key freight and trade relationships, the right-sizing scenario was developed so that it would affect a 10% shift in agricultural exports from domestic to international markets both for Iowa and for other states that also produce the identified commodities. **This scenario represents a spike in global demand for agricultural products through unsatisfied population growth that causes a rise in prices and international demand for US agricultural exports**. Shifting trade for both Iowa and the rest of the United States is a more plausible scenario in the sense that shifts in global trade dynamics would be unlikely to only affect Iowa.

Step 2. Identify Data and Tools to Characterize Scenarios

Identify data or tools to characterize potential future changes in scenario drivers. Once scenario goals are defined and drivers have been identified, the next step is to identify data or tools that can be used to characterize the scenario in quantitative terms.

The Iowa trade scenarios leverage the TREDPLAN economic-freight modeling system to relate changes in trade patterns to shifts in origin-destination freight flows and modal reliance. *Figure* shows the freight-economy relationships that underpin the forecasting analysis in TREDPLAN. The model relates goods movement and industry activity in terms of what businesses consume and produce and traces that detail spatially. It also includes information on patterns of modal usage by commodity and market that provide the platform for examining the impact of trade shifts.

Figure 5 Freight-Economy Model: Iowa Industries Consume and Produce Commodities



Identify the relationship between scenario drivers and "levers" within travel models. Scenario drivers must also be connected to available "levers" within travel models. In this step, analysts identify how parameters or input data within a travel demand model can be used to represent the scenario of interest.

In the case of the Iowa trade scenario, TREDPLAN was used to generate the following for implementation within the Iowa statewide travel model:

- A 2050 truck flow database reflecting the differences of the trade scenario
- A similar database capturing the new 2050 tonnage in the trade scenario that is classified as "multiple modes and mail"

These databases reflect the following key freight flow and modal dynamics of the defined trade scenario, relative to the future baseline:

- **Redirection of trucks from domestic markets to international ports**. This is reflected in the updated scenario truck flow database developed for the scenario.
- **Mode-shift away from truck to rail and intermodal movements**. Because the domestic movement of the identified commodities relies more heavily on trucking, while international exports tend to move by rail or by multiple modes, a shift between serving domestic and international markets results in a corresponding mode shift in the trade scenario. This manifests in two ways on the transportation network. First, a segment of truck volumes is reallocated to rail and removed from the truck flow database. Second, a portion of removed truck volumes is reallocated to intermodal moves that connect agricultural producers to rail or inland waterway terminals.

These shifts are summarized in *Table 1*. *Figure* shows the national shift towards specific international markets of the three targeted commodities in the trade scenario. *Figure 74* summarizes the change in truck tonnage for 2050 between the baseline and the trade diversion scenario. The scenario results in increased truck flows in particular to certain west coast ports of exit for trade with Asia.

Table 1 Summary of Trade by Mode in the Baseline and Trade Diversion Scenario

		Tonnage (Thousands)		
Trade Type	**Domestic Mode**	2050 Baseline	2050 Trade Scenario	Difference
Domestic	Truck	14,738,470	14,669,375	(69,095)
Import	Truck	988,877	988,877	-
Export	Truck	1,123,877	1,156,799	32,922
Domestic	Rail	1,570,993	1,549,169	(21,824)
Import	Rail	317,007	317,007	-
Export	Rail	519,986	570,565	50,579
Domestic	Water	611,159	606,468	(4,691)
Import	Water	125,969	125,969	-
Export	Water	323,886	328,940	5,053
Domestic	Multiple modes & mail	428,357	423,055	(5,302)
Import	Multiple modes & mail	190,486	190,486	-
Export	Multiple modes & mail	238,722	250,001	11,279
Domestic	All Other Modes	3,835,484	3,835,404	(80)

Import	All Other Modes	580,441	580,441	-
Export	All Other Modes	153,631	154,791	1,160
Domestic	TOTAL	21,184,462	21,083,470	(100,992)
Import	TOTAL	2,202,779	2,202,779	-
Export	TOTAL	2,360,103	2,461,095	100,992

Figure 6 National Scenario Change in Export Tonnage (All Modes) by Country for Affected Commodities

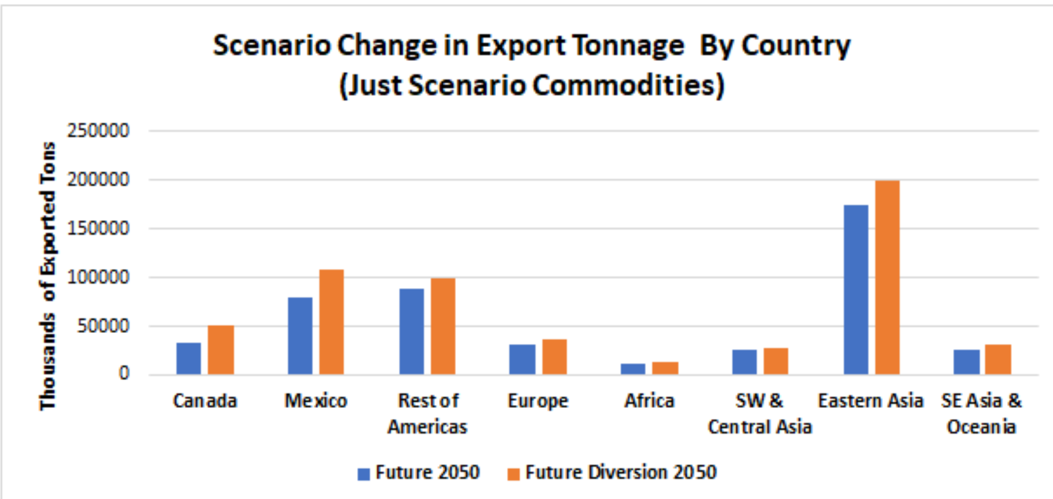
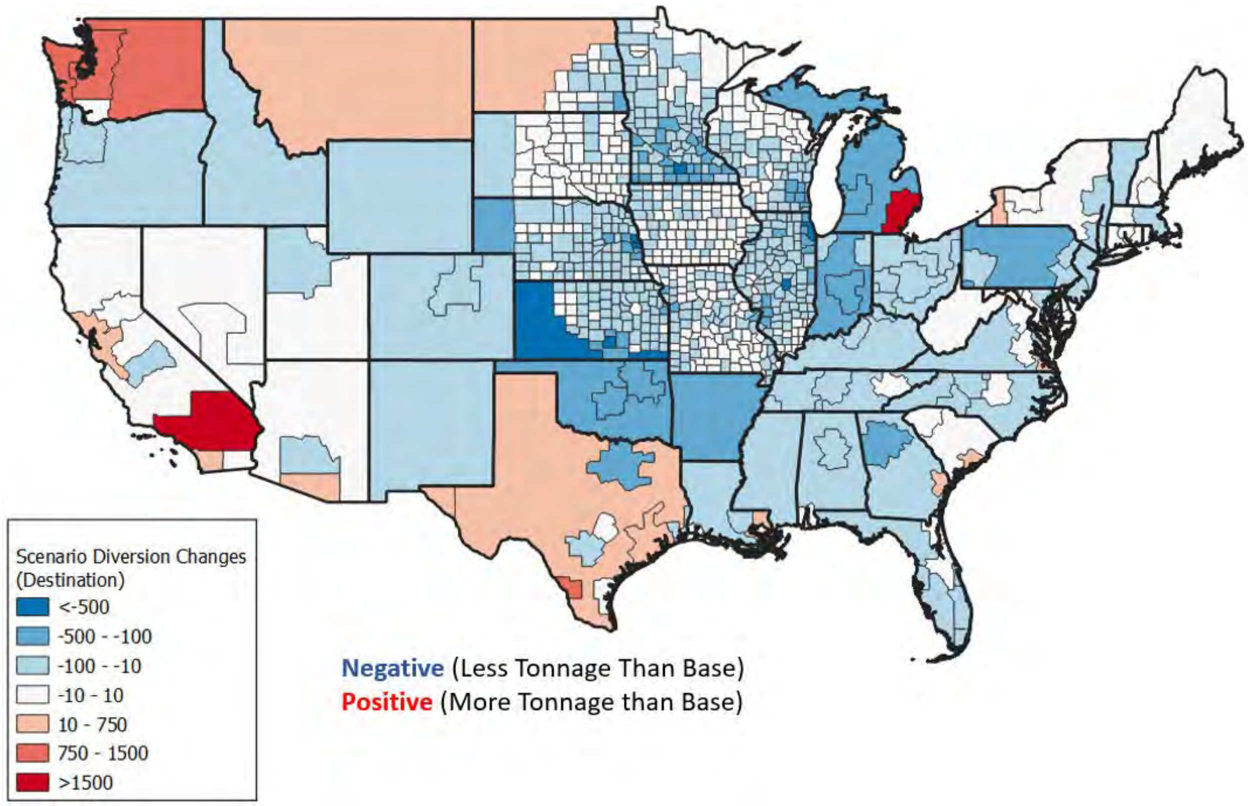


Figure 7 Change in truck volumes by destination (domestic or international port) – trade scenario relative to baseline in 2050



Step 3. Identify Transportation Performance Impacts

The next step of the scenario exploration is to implement the right-sizing scenario in the available travel model. This means running the travel demand model with the alternative data or parameters identified in step 2 for the scenario and running it for an accepted future baseline that represents the same future analysis year but for the adopted baseline economic and trade forecast.

In order to model the trade scenario, the freight flow data was converted to the model compatible truck trip tables for both, the baseline and the trade scenario. The travel model for Iowa includes the internal traffic analysis zones (TAZ) within Iowa and eight surrounding states – Illinois, Minnesota, Kansas, Wisconsin, Missouri, North Dakota, South Dakota, and Nebraska, and includes fourteen external stations. The FAF flows were in tonnage and for the FAF boundary, extending beyond the modeling area. So, a process was developed to convert the FAF tonnage to daily truck trip tables for the model, and the steps are mentioned below:

- Considered the FAF flows that have origin or destination in Iowa modeling region or the flows that pass through it. The FAF origin/destinations zones were allocated to appropriate model zones.
- The tonnage conversion to trucks was based on the payload factors by commodity provided in the FHWA's report "Research, Development, and Application of

Methods to Update Freight Analysis Framework Out-of-Scope Commodity Flow Data and Truck Payload Factors, 2010".

- Annualization factor of 260 was used to convert the annual trips to daily trips.

Based on the baseline and trade scenario model runs, impacts on transportation performance can be examined through:

- Maps of changes in key performance such as volume and volume-to-capacity ratios
- Aggregate metrics such as changes in vehicle hours or miles traveled or the percent of travel occurring in congested conditions

Step 4. Examine Sensitivity of Needs Between Scenario and Baseline

With the modeling results from Step 3, Step 4 is to examine the sensitivity of needs between the defined scenario and the baseline. This involves comparing scenario outcomes to the baseline, to determine the scale of impact on network performance and to evaluate whether future deficiencies identified in the baseline are ameliorated or exacerbated by the alternative scenario. Transportation agencies should in particular look at changes in performance along key corridors or locations of interest where significant investments are being planned or considered. This examination will help to identify whether needs identified in the baseline future forecast are sensitive to the types of exogenous changes explored in the scenario.

The results of the analysis are presented in the maps in Appendix P3, Iowa Statewide Analysis.

Step 5. Determine Right-Sizing Implications

The final step is to review specific investment decisions (or if relevant, decision-making processes) and their sensitivity to the scenario. This step should focus on identifying agency investment decisions that are sensitive to the scenario and subsequently identifying strategy refinements based on the insights provided by the scenario. For example, a scenario might reveal a risk of overinvestment, in which case, an agency might choose to delay a particular investment or conduct further analysis of how project needs vary depending on underlying assumptions about the economy and trade. Alternately, a scenario analysis may serve to identify and reinforce needs that are resilient across multiple futures. This should give decision-makers greater confidence in investing resources to address these needs.

APPENDIX PLAY 3

Iowa Right-Sizing Policy Summary

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Iowa Right-Sizing Policy Summary – Appendix P3A

Preservation Cost

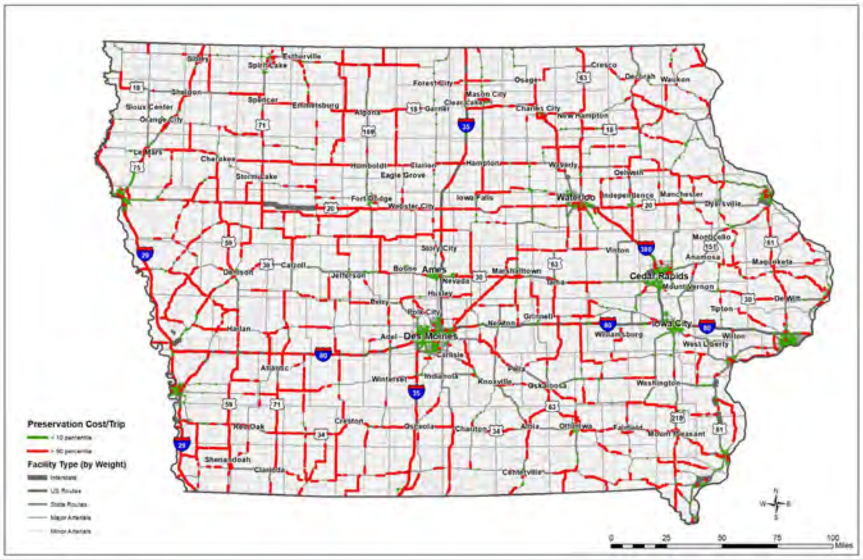
Assumptions

- High volume: Truck Percent>15% or LOS of D or worse
- Annualization Factor: 307.5

Annual Preservation Cost

Factype	Description		O&M	Preservation	Resurface	Pres Cycle	Resurf Cycle	Annualized per LM*
1	Freeway/Expressway	High Volume	$ 1,000	$ 40,000	$ 425,000	6	10	$ 50,167
		Low Volume	$ 1,000	$ 40,000	$ 365,000	8	12	$ 36,417
3	Principal Arterial	High Volume	$ 1,000	$ 40,000	$ 322,500	6	10	$ 39,917
		Low Volume	$ 1,000	$ 27,500	$ 250,000	8	12	$ 25,271
4	Minor Arterial	High Volume	$ 1,000	$ 40,000	$ 322,500	6	10	$ 39,917
		Low Volume	$ 1,000	$ 27,500	$ 250,000	8	12	$ 25,271
5	Major Collector	High Volume	$ 1,000	$ 40,000	$ 322,500	6	12	$ 34,542
		Low Volume	$ 1,000	$ 27,500	$ 250,000	8	14	$ 22,295
6	Minor Collector / Local	All	$ 1,000	$ 40,000	$ 250,000	6	12	$ 28,500
7	ramps	All	$ 1,000	$ 40,000	$ 425,000	6	12	$ 43,083

Preservation Cost per Trip by Link



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3

Preservation Cost per Trip by Link (Urban)

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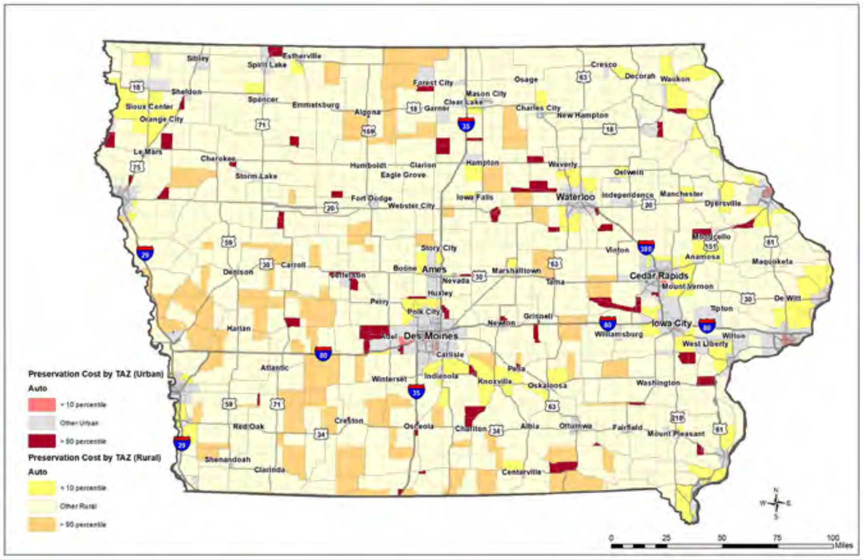
4

Preservation Cost per Auto Trip by TAZ



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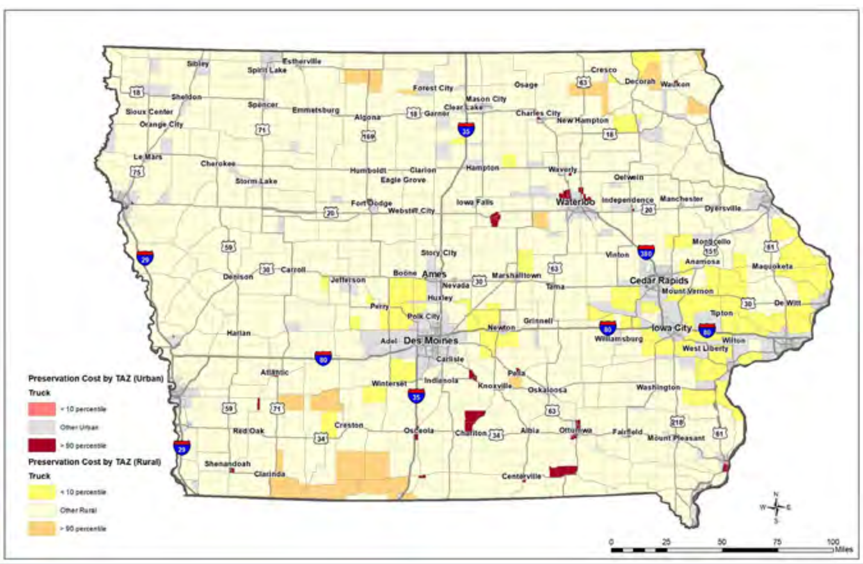
5

Preservation Cost per Truck Trip by TAZ



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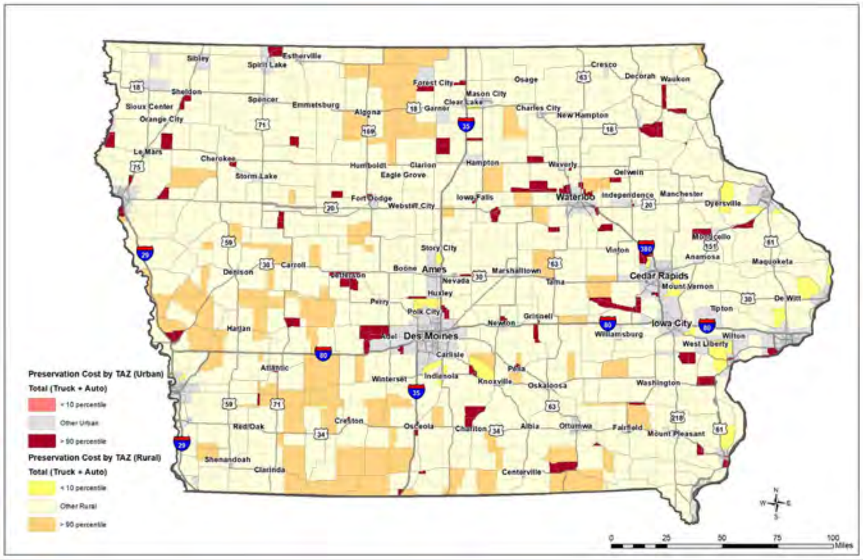
6

Preservation Cost per Trip by TAZ



7

Preservation Cost per Trip by TAZ (Urban)

8

User Cost

Value of Time Cost

- VOT ($/hr)
  - Auto: 16.6
  - Truck: 29.5
- Occupancy
  - Auto: 1.67
  - Truck: 1

Vehicle Operating Cost

- VOC ($/mile)
  - Auto: 0.41
  - Truck: 0.96

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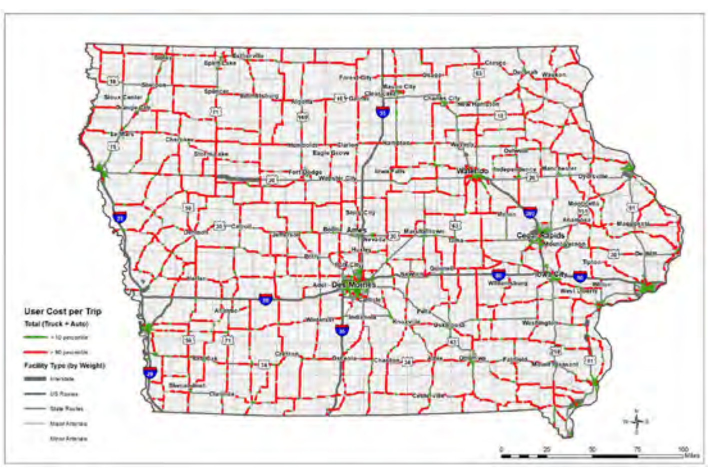
9

User Cost per Trip by Link



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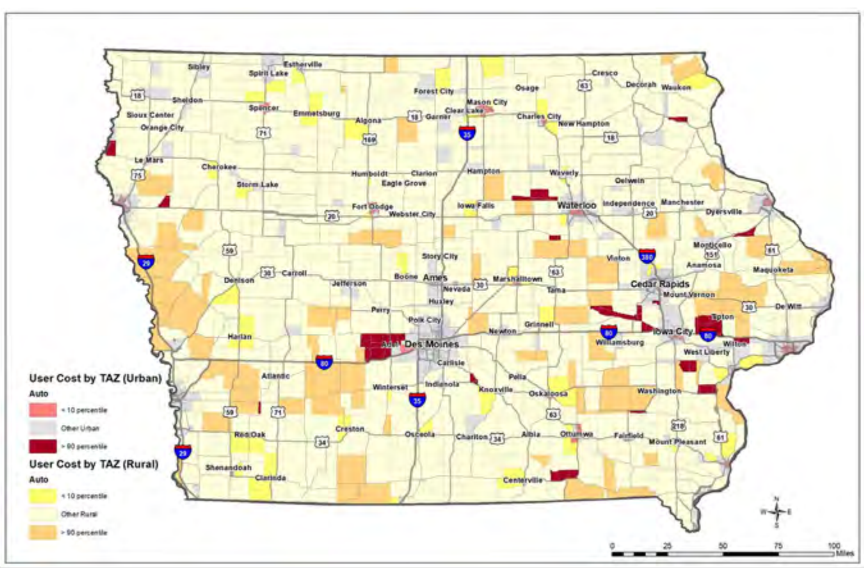
10

User Cost per Trip by Link (Urban)

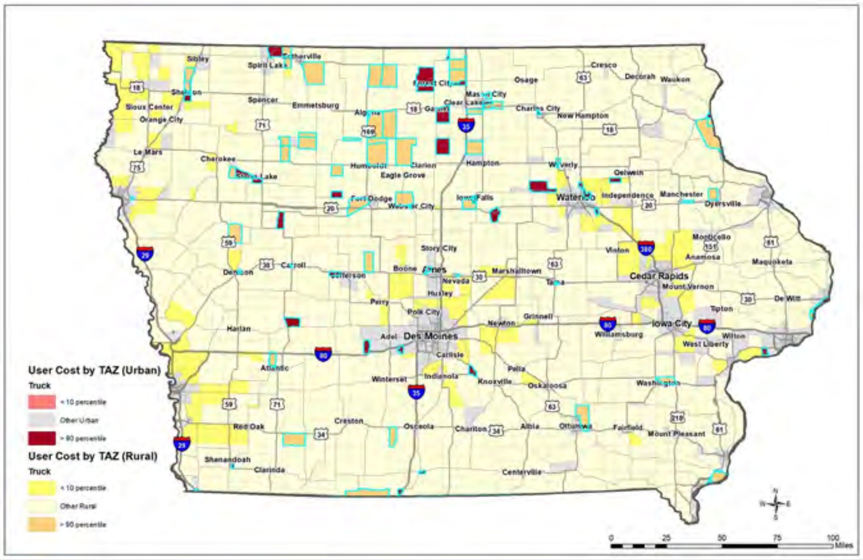
11

User Cost per Auto Trip by TAZ



12

User Cost per Truck Trip by TAZ



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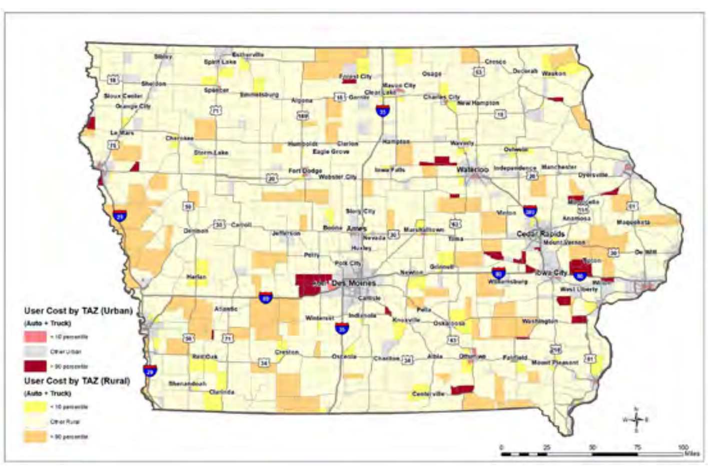
13

User Cost per Trip by TAZ



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14

User Cost per Trip by TAZ (Urban)

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15

Crash Cost

- Four-year crash data: 2017,2018,2019 and 2020
- Crash Cost
  - Fatality: $10,636,600
  - Injury: $250,600
  - Property Damage Only: $4,400
- Annualization: 307.5

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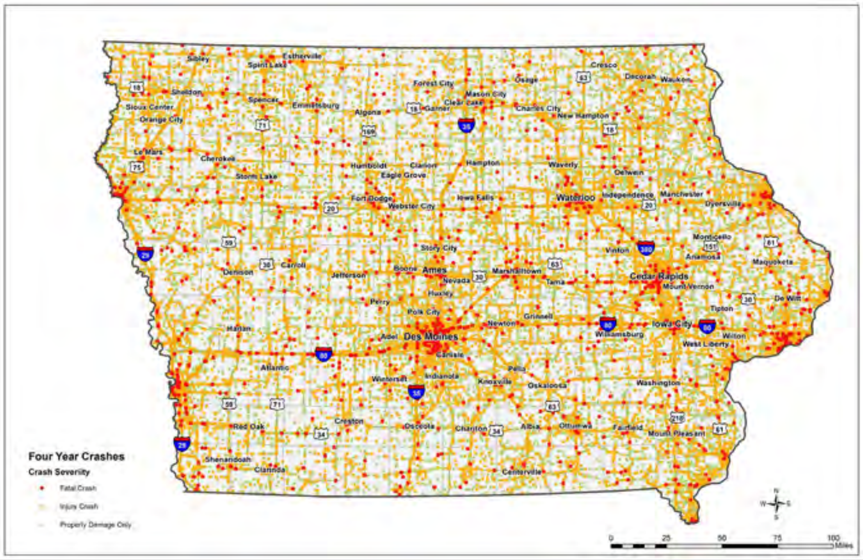
16

Four-year crash locations



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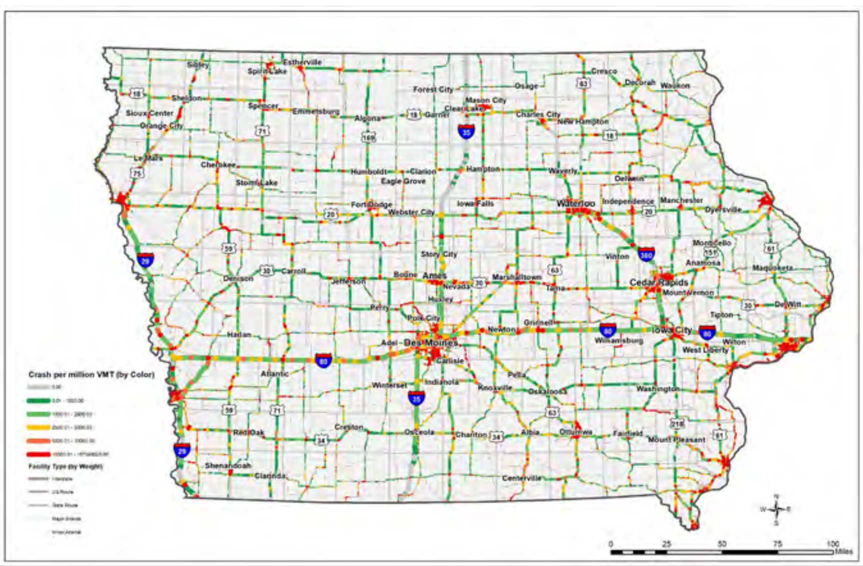
17

Crash per Million VMT



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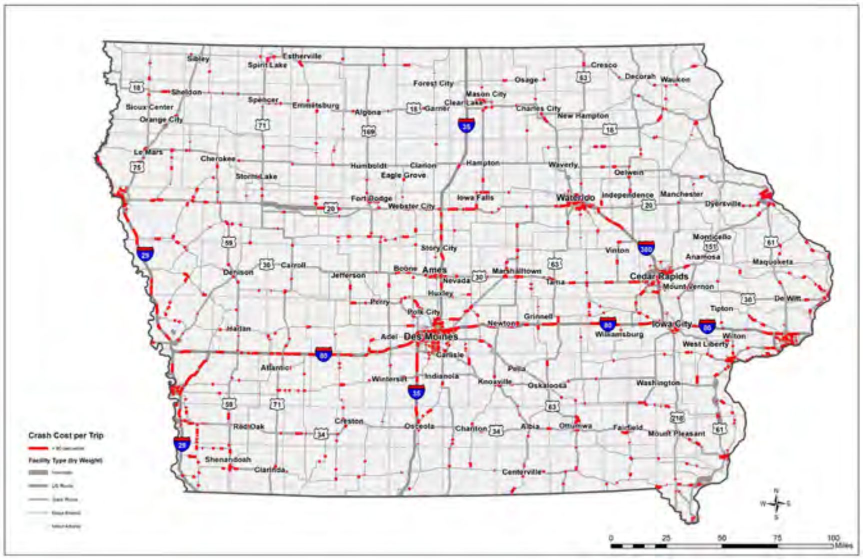
18

Crash Cost per Trip by Link (>90 percentile)



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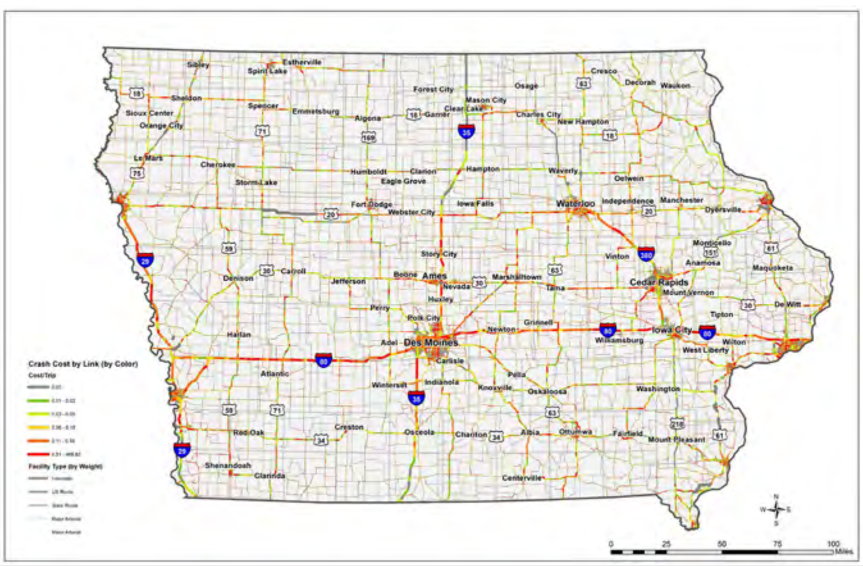
19

Crash Cost per Trip by Link



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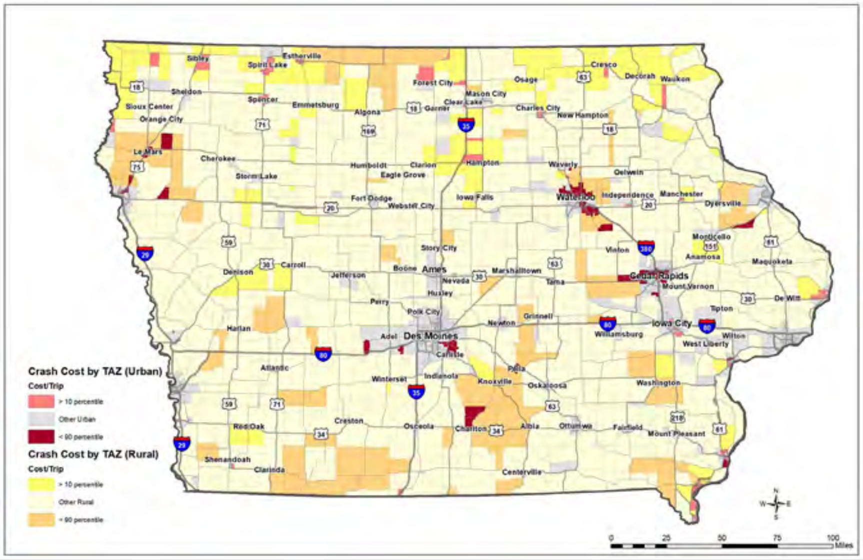
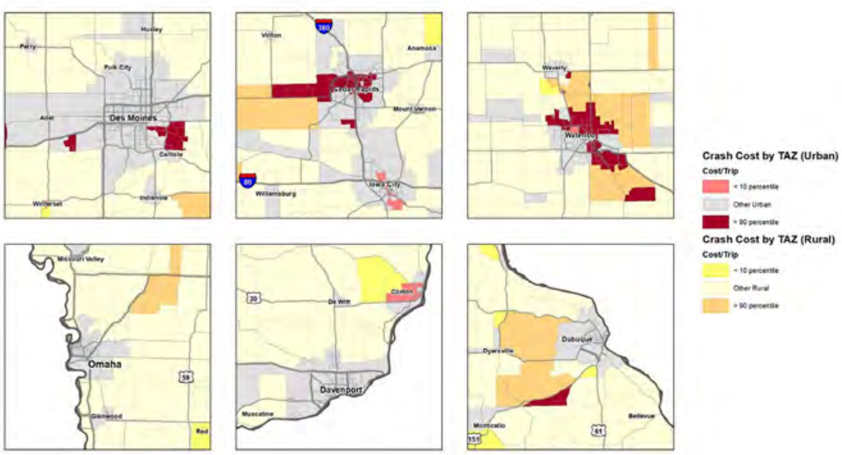
20

Crash Cost per Trip by TAZ



21

Crash Cost per Trip by TAZ (Urban)



22

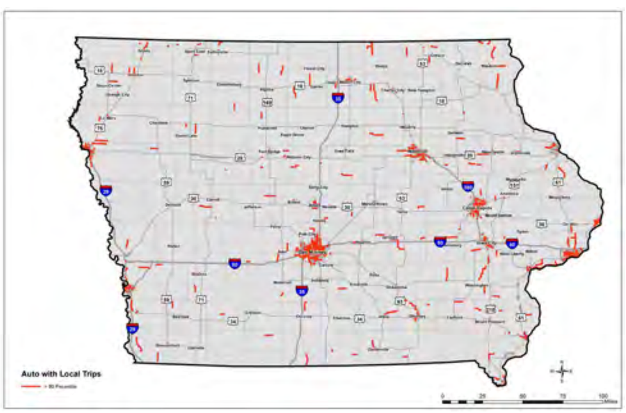
Trip Length Analysis

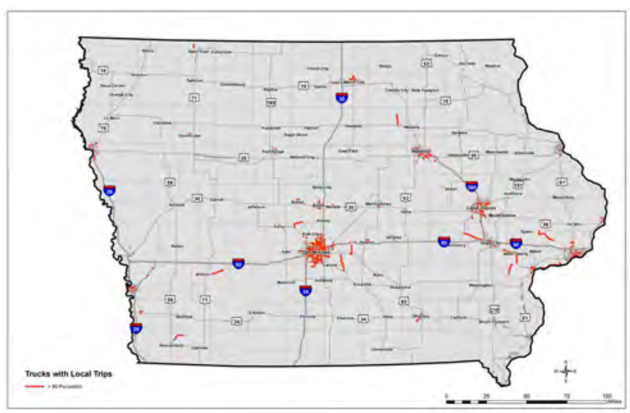
Trip Length (miles)

- Local : 0-50
- Inter-city : 50-150
- Statewide : 150-300
- Inter-state : >300

23

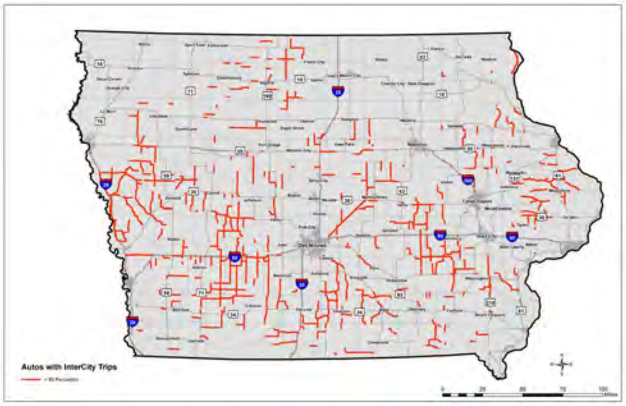
Links with Local Trips > 90 percentile Auto and Truck

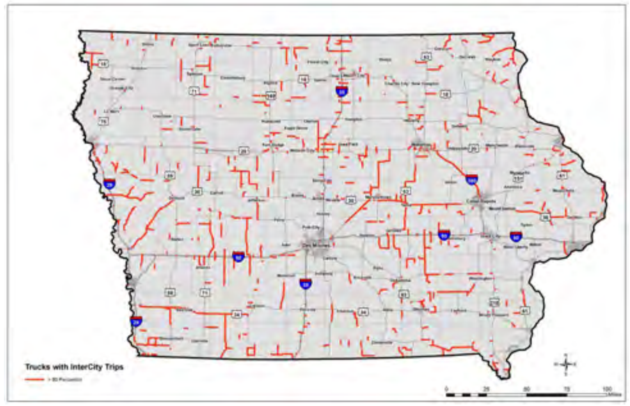




24

Links with Inter-city Trips > 90 percentile
Auto and Truck





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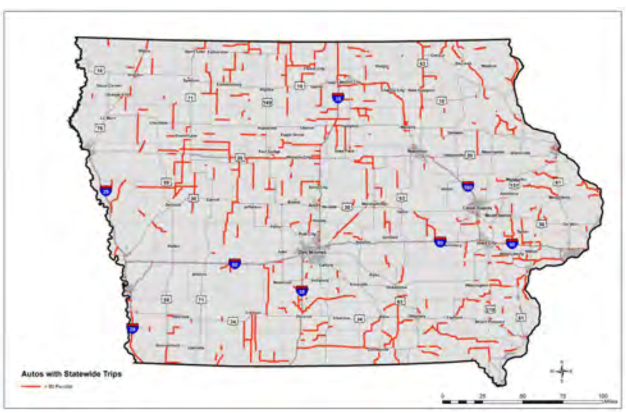
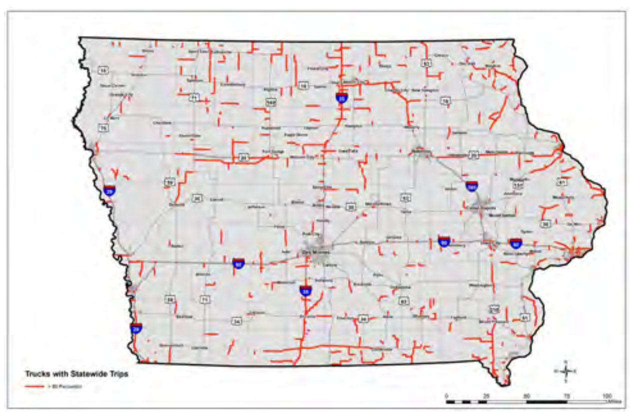
25

Links with Statewide Trips > 90 percentile
Auto and Truck





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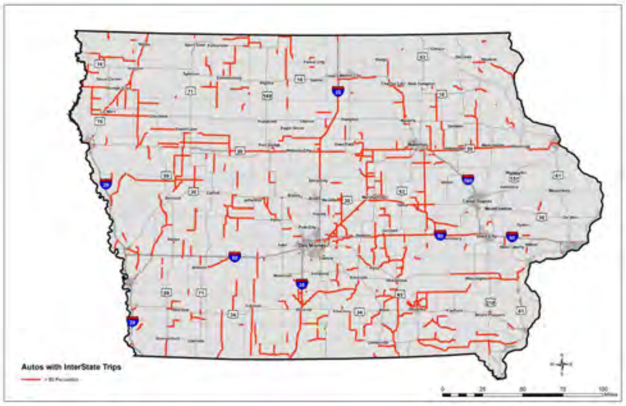
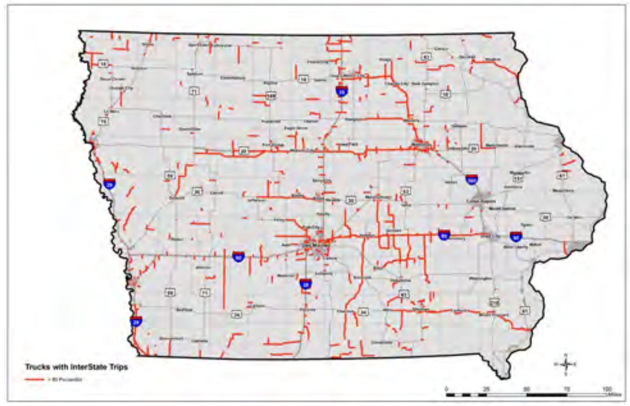
26

Links with Inter-state Trips > 90 percentile Auto and Truck





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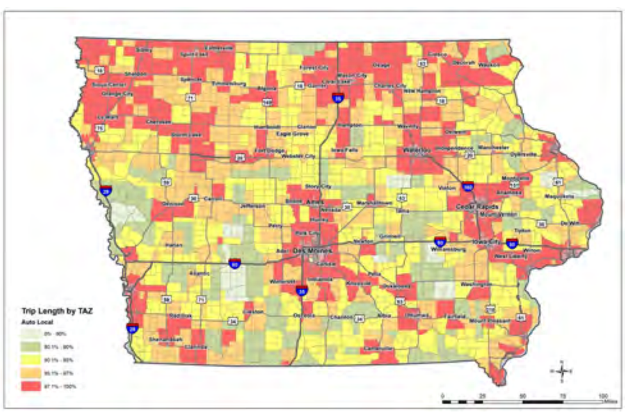
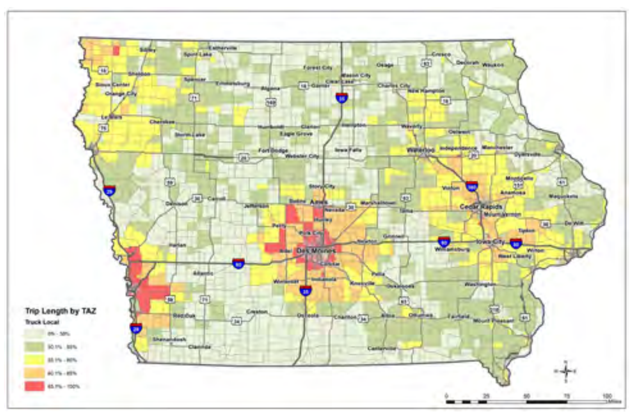
27

TAZs with Percentage of Local Trips Auto and Truck





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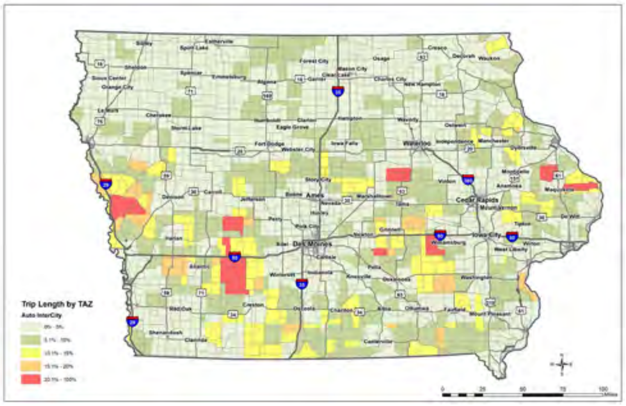
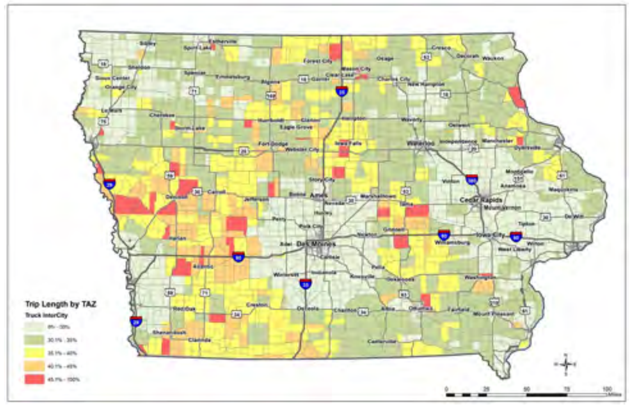
28

TAZs with Percentage of Inter-city Trips Auto and Truck





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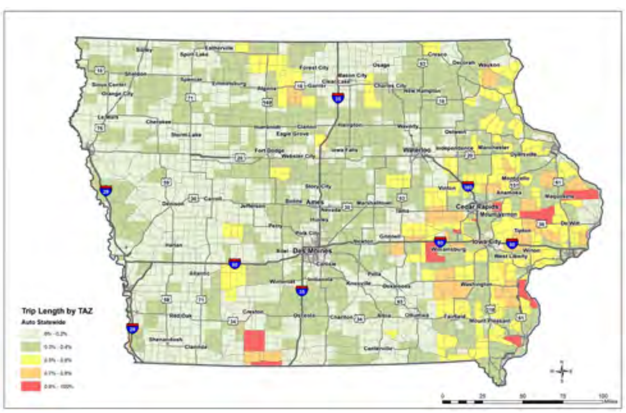
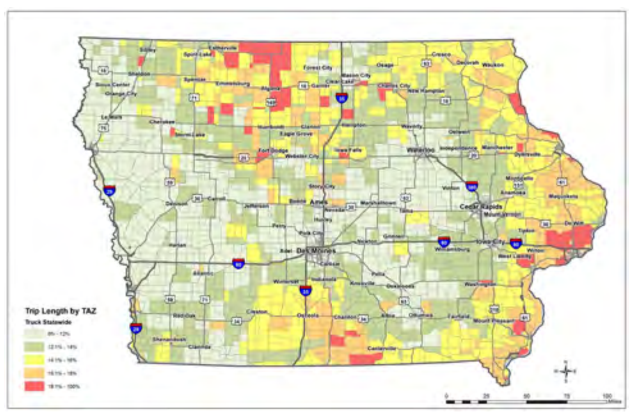
29

TAZs with Percentage of Statewide Trips Auto and Truck





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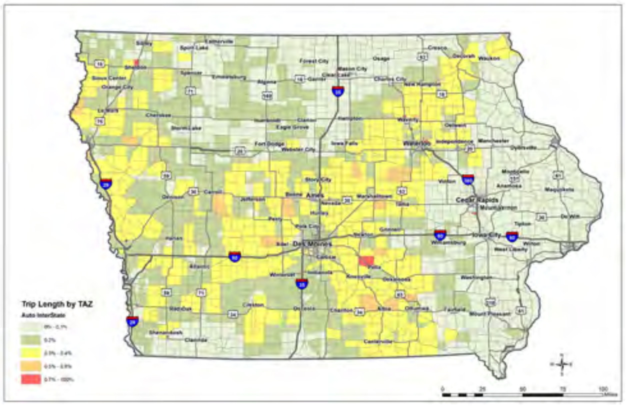
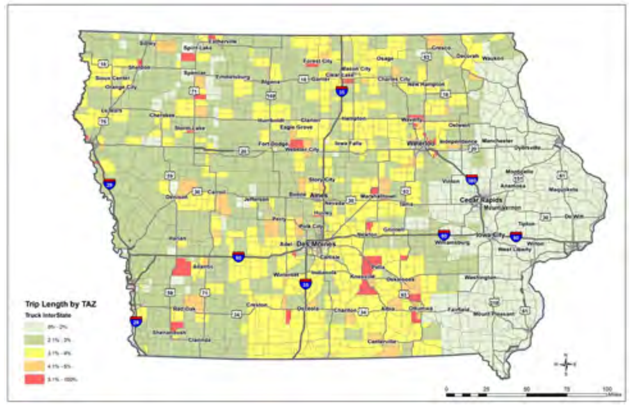
30

TAZs with Percentage of Inter-state Trips Auto and Truck





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31

Trade Scenario

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32

Input Data

- 2050 Base
  - FAF/County to FAF/County to flows
- 2050 Trade Scenario
  - FAF/County to FAF/County to flows
  - Multimodal flows
- 2040 iTRAM truck trips

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33

Methodology/Assumptions

- Calculate distance to each external for FAF and iTRAM zones
- FAF-iTRAM flows
  - Calculate total distance via each external. Minimum distance via each external
  - Selected external based on minimum distance and allocate to FAF
- FAF-to-FAF flows
  - Tag links within 100 miles of external stations with respective external
  - Create skims by including viaitram field and tagged external field
  - Get nearest external for O and for D
- Multimodal
  - Split the shares between rail, barge and truck only (Shares by Noel)
  - Rail: Nearest Rail TAZ (discard when same TAZ) irrespective of which FAF trip is going to. From each production zone, the assigned zone becomes the attraction zone.
  - Barge: Nearest Barge TAZ to each FAF. Trips from each iTRAM zone assigned to that Barge TAZ.

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34

Methodology/Assumptions

- No-Build: Main commodity flows converted to trucks
- Build: Main + multimodal commodity flows converted to trucks
- Distribution taken from iTRAM 2040 truck trips
- Annualization: 365
- Trucks: Tons/Truck=20
- Empty load factors not used
- OD: (PA+PA.t)/2

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35

Methodology/Assumptions

Daily Trips	Before processing	After processing
Model		2,035,713
Base	231,156	2,066,261
Trade	227,999	2,056,517

Scaling

If Model trips = 0, NB and Build trips from new flows
If Model trips > 0, NB=model trips and build=proportional increase

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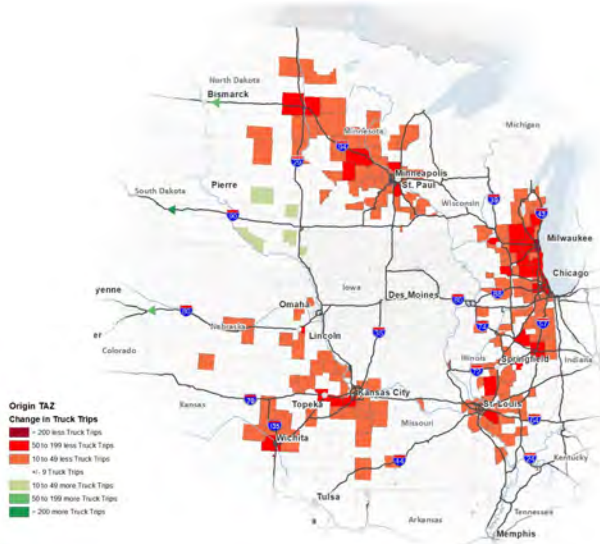
36

Truck Trips Difference by Origin TAZ



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37

Truck volume difference by link

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38

Truck Select Link Difference: I-35 SB

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39

Truck Select Link Difference: I-80 EB

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40

Truck Select Link Difference: I-90 EB

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41

APPENDIX PLAY 3

Des Moines Right-Sizing Policy Summary

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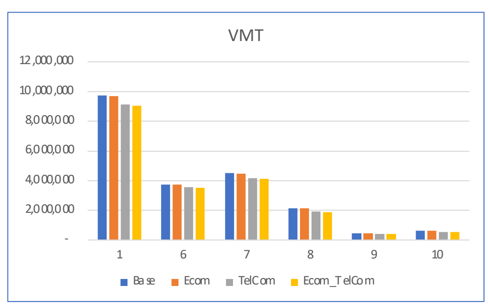
Des Moines Right-Sizing Policy Summary – Appendix P3B

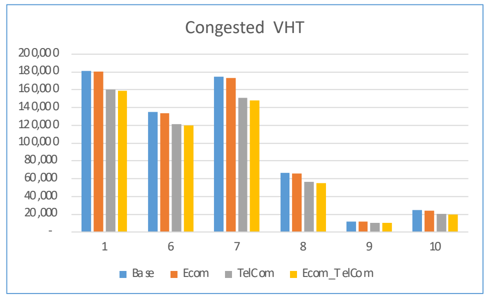
VMT

	FACTYPE	Base	Ecom	TelCom	Ecom_TelCom
1	Interstate	9,723,487	9,683,108	9,122,037	9,066,182
6	Principal arterial	3,726,913	3,713,831	3,554,636	3,534,494
7	Minor arterial	4,496,566	4,467,671	4,148,398	4,103,273
8	Collector	2,147,966	2,127,919	1,904,035	1,874,304
9	Minor Collector	447,905	444,210	402,278	396,745
10	Local	630,036	620,997	540,412	527,428
	TOTAL	21,172,873	21,057,737	19,671,797	19,502,426



Congested VHT

	FACTYPE	Base	Ecom	TelCom	Ecom_TelCom
1	Interstate	181,100	180,296	160,151	158,886
6	Principal arterial	134,948	133,695	121,324	119,670
7	Minor arterial	174,818	172,910	150,927	148,236
8	Collector	66,817	66,005	56,345	55,192
9	Minor Collector	11,906	11,781	10,441	10,259
10	Local	24,678	24,274	20,266	19,699
	TOTAL	594,267	588,961	519,454	511,942

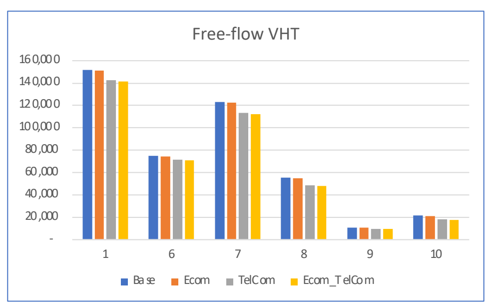


9/3/21 metro analytics 6

6

Free-flow VHT

	FACTYPE	Base	Ecom	TelCom	Ecom_TelCom
1	Interstate	151,868	151,230	142,380	141,500
6	Principal arterial	74,908	74,641	71,461	71,050
7	Minor arterial	123,307	122,484	113,537	112,273
8	Collector	55,388	54,826	48,840	48,028
9	Minor Collector	10,669	10,576	9,605	9,468
10	Local	21,404	21,084	18,296	17,839
	TOTAL	437,544	434,840	404,119	400,157

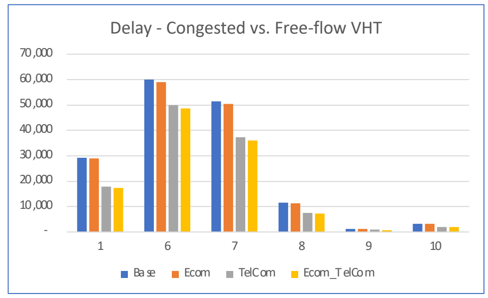


9/3/21 metro analytics 7

7

Delay – Congested vs. Free-flow VHT

	FACTYPE	Base	Ecom	TelCom	Ecom_TelCom
1	Interstate	29,233	29,066	17,771	17,386
6	Principal arterial	60,039	59,054	49,863	48,621
7	Minor arterial	51,512	50,426	37,390	35,962
8	Collector	11,429	11,179	7,504	7,164
9	Minor Collector	1,237	1,205	836	791
10	Local	3,274	3,191	1,970	1,860
	TOTAL	156,723	154,121	115,335	111,784



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Average speed

Average Free-flow Speed

	FACTYPE	Base	Ecom	TelCom	Ecom_TelCom
1	Interstate	64.0	64.0	64.1	64.1
6	Principal arterial	49.8	49.8	49.7	49.7
7	Minor arterial	36.5	36.5	36.5	36.5
8	Collector	38.8	38.8	39.0	39.0
9	Minor Collector	42.0	42.0	41.9	41.9
10	Local	29.4	29.5	29.5	29.6
	TOTAL	48.4	48.4	48.7	48.7

Average Congested Speed

	FACTYPE	Base	Ecom	TelCom	Ecom_TelCom
1	Interstate	53.7	53.7	57.0	57.1
6	Principal arterial	27.6	27.8	29.3	29.5
7	Minor arterial	25.7	25.8	27.5	27.7
8	Collector	32.1	32.2	33.8	34.0
9	Minor Collector	37.6	37.7	38.5	38.7
10	Local	25.5	25.6	26.7	26.8
	TOTAL	35.6	35.8	37.9	38.1

9

Volumes and LOS Maps

- Based on average weekday results

9/3/21 metro analytics 10

10

Daily Volume Difference (All vehicles): Ecommerce vs. Base

9/3/21 metro analytics 11

11

Daily Volume Difference (All vehicles): Telecommute vs. Base

9/3/21

metro analytics 12

12

Daily Volume Difference (All vehicles): Ecom_Telecom vs. Base

9/3/21

metro analytics 13

13

Daily LOS: Base

9/3/21

metro analytics

14

14

Daily LOS: Ecommerce

9/3/21

metro analytics

15

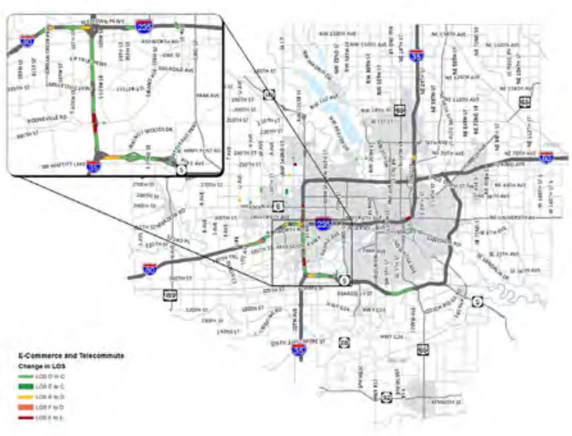
15

Daily LOS: Telecommute

9/3/21 metro analytics 16

16

Daily LOS: Ecommerce_Telecommute



9/3/21 metro analytics 17

17

TAZ-based Trips

- Trip difference (vs. Base)
  - Ecom: Daily Auto by Origin and Daily Combo by destination
  - Telecommute: AM Auto by Destination
  - Ecom + Telecommute: AM Auto by Destination
- Desire Lines – AM Commute auto trips between districts (Difference Telecommute vs. Base)
- Dot density maps – Auto trips difference (AM commute) by origin TAZs to destination district

9/3/21 metro analytics 18

18

Difference vs. Base
Ecommerce: Daily Auto Trips by Origin

9/3/21 metro analytics 19

19

Difference vs. Base
Ecommerce: Daily Combo Trips by Destination

9/3/21

metro analytics

20

20

Difference vs. Base
Telecommute: AM Auto Trips by Destination

9/3/21

metro analytics

21

21

Difference vs. Base
Ecommerce_Telecommute: AM Auto Trips by Destination

9/3/21 metro analytics 22

22

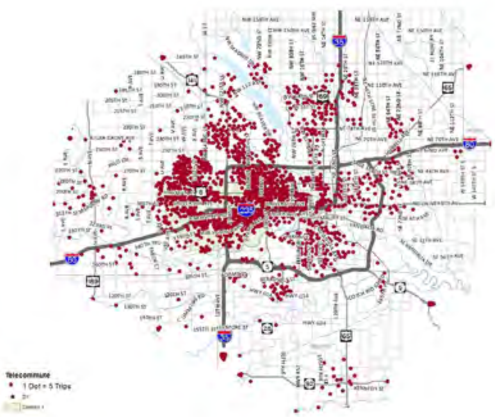
Telecommute Auto Difference Desire Lines By District - AM

9/3/21 metro analytics 23

23

Telecommute: Difference vs. Base (Loss of Auto Trips)

District 1



District 2

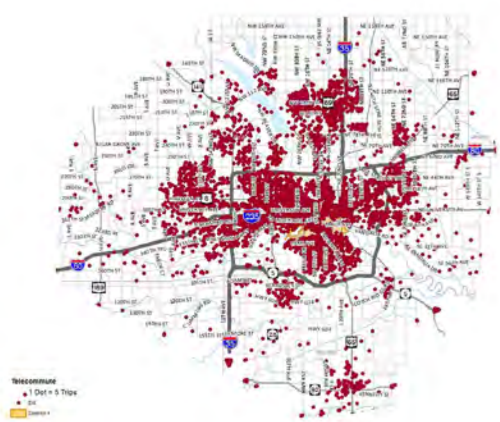
9/3/21 metro analytics 24

24

Telecommute: Difference vs. Base (Loss of Auto Trips)

District 3

District 4

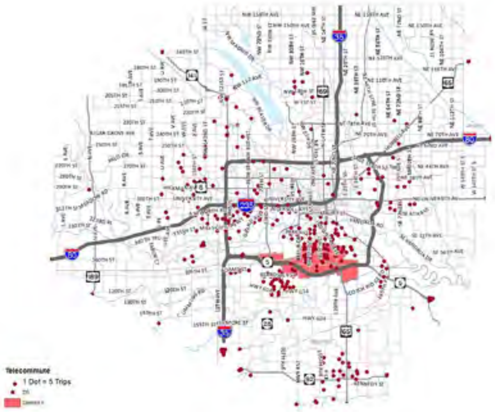


9/3/21 metro analytics 25

25

Telecommute: Difference vs. Base (Loss of Auto Trips)

District 5



District 6

9/3/21 metro analytics 26

26

Telecommute: Difference vs. Base (Loss of Auto Trips)

District 7

District 8

9/3/21 metro analytics 27

27

LOS change maps

- Based on Daily LOS
- The colors show final LOS
    - Green: LOS A-C (V/C<0.7)
    - Yellow: LOS D (V/C<0.85)
    - Orange: LOS E (V/C<0.1)
    - Red: LOS F (V/C>=1)
- Thinner line shows one level better and thicker shows two levels better. Example: In Telecommute if a link is "thick green", it's level of service is A-C, and in the Bas, it was E. If it was "thin green", it had changed from D to A-C,
- Use fields Diff_E, Diff_T, Diff_E_T in VC_improvment.dbf
    - First digit is LOS and second digit is level of improvement

9/3/21

metro analytics 28

28

Ecommerce LOS: Difference vs. Base

9/3/21

metro analytics 29

29

Telecommute LOS: Difference vs. Base

Downtown (zoomed)

9/3/21

metro analytics 30

30

Ecommerce Telecommute LOS: Difference vs. Base

Downtown (zoomed)

9/3/21

metro analytics 31

31

APPENDIX PLAY 4

Create a Future-Proof Network

APPENDIX P4

Metro Analytics, White Paper – Master Architecture Grid-Spacing Methodology: Examples from North Carolina and Utah, 2021

Introduction

The National Cooperative Highway Research Program recently published *NCHRP Report 917*, a guidebook for right-sizing infrastructure to underlying or emerging economic and community needs. Recognizing that few state DOTs will have experience with right-sizing, NCHRP funded a follow-up implementation effort with these primary purposes: 1) better define how to implement the guidebook in real-world settings, 2) provide practical examples, tools, and methods other states can follow, and 3) influence target agencies to adopt right-sizing techniques into their business processes.

Iowa, Georgia, North Carolina, and Utah were each selected for implementing various aspects of the guidebook, and staff members from the research team worked with representatives in these states to help states craft right-sizing efforts to their needs. The right-sizing effort in North Carolina consisted of two parts: 1) an effort to engage NCDOT and the French Broad River MPO (FBRMPO) in Asheville to apply the concept of a Network Master Architecture, and 2) engaging NCDOT and the City of Raleigh to apply right-sizing to a specific at-grade arterial corridor – US-70, or Glenwood Avenue, near Crabtree Mall.

This white paper details the Asheville Master Architecture right-sizing effort.

Network Right-Sizing in the Asheville, NC region

Warning*: All concepts, views, and opinions expressed in this white paper have not been vetted outside of the research team and a small group of interagency staff in North Carolina. Case studies were based solely on publicly available information, and team members with limited local knowledge, and are thus likely to have significant inaccuracies. All locational and policy concepts are to demonstrate methodologies, techniques, and topics for discussion and should not be taken as site-specific recommendations. While ideas for specific locations are shown, it would take significant time and resources to vet, none of which has been done for the concepts herein.*

Summary of Network-Level Right-Sizing in Asheville, NC

America's 60-year history of 20 and 30-year long range plans has several weaknesses. Chief among these is that random development in a semi-rural area can make it impossible to create additional corridors that would be extremely helpful as the area approaches buildout. The current planning process fails to recognize how much demand can yet happen after the horizon year – important to know when planning right-of-way and access control. If parallel support corridors cannot be built due to development blocking all available paths, then increasing demand will simply overload existing facilities.

To address this, *NCHRP 917* recommends network planning and corridor preservation based on a spacing analysis, followed by phasing based on horizon year demand. More specifically, first identify an ideal allocation of multimodal corridors as if the developable area were entirely developed – a process that may take well beyond the typical 20-30-year planning horizon. Then, with community agreement regarding the wisdom and general location of the corridors to be preserved, specific segments can then be preserved and activated for construction as demand warrants.

The research team defines this as first creating a "Master Architecture" of multimodal corridors and facility types that ideally would exist at build-out within a space that everyone agrees could start to fully urbanize within say 30-50-years under plausible growth scenarios. This space can be the full region, a county, or even a sub-county level. Then, the typical long-range planning process will identify which segments of the spatial architecture need to be activated, by phase, over the next 20-30-years. Some segments, while not heavily needed soon, nonetheless will need to be identified soon so that ongoing development will not block the ability to create needed corridors.

Here is a summary of the technique for developing a master architecture in Asheville that was recommended in January, along with critique offered by our DOT and MPO reviewers. After that, this memo proposes an approach for strengthening identified weaknesses so that the overall process can be more broadly applied in North Carolina and around the country.

Approach to creating a Master Architecture in Asheville

Recall that *NCHRP 917* recommends that a right-sized region, at buildout, will have a range of collectors, arterials, and expressways, ideally following the pattern shown in **Figure 1** . The basic pattern is a collector every half-mile, an arterial every 1-mile, and an expressway or freeway every 5-miles. This 5x5 "tile" is then repeated across the entire county or region.

- Collectors usually have 2-3-lane cross-sections and minimal access control.
- Arterials usually have 4-5-lane cross-sections and some access control
- Expressways usually have 4-10-lane cross-sections and have strong access control.

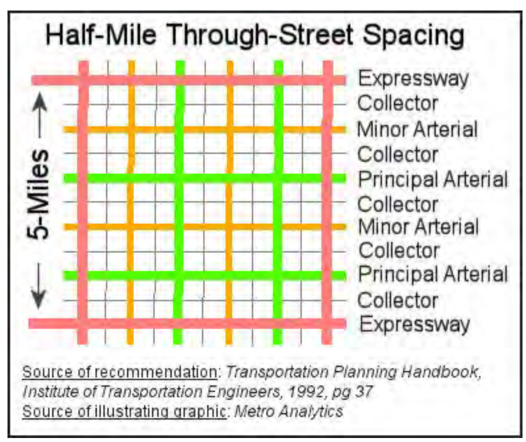


***Figure 1** Starting point pattern for roadway spacing from NCHRP 917*

Some regions, even at buildout, will have low average densities due to high levels of mountains, wetlands, or unusually low suburban densities that cannot easily be intensified. In these cases, a collector every half-mile is still recommended, but the spacing between arterials and expressways may increase without significant consequence.

Figure 2 compares the 5x5 tile with 7x7 and 10x10 tiles, which may be more appropriate for areas of lower densities at buildout. In the Asheville area, due to many mountains, it seemed reasonable to utilize the 10x10 tiles as an ideal to strive for in identifying potential corridor preservation needs.

Fishnet pattern for 5x5-mile tile, where buildout is likely to be heavy suburban to urban

Miles from Expwy 1	-	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
Roadway ID	1	2	3	4	5	6	7	8	9	10	Rpt	2	3
Functional Class	E	C	M	C	P	C	M	C	P	C	E	C	...

Expressway/Fwy	Minor Arterial
Principal Arterial	Collector

Fishnet pattern for 7x7-mile tile, where buildout includes significant open space or low density

Miles from Expwy 1	-	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
Roadway ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Rpt	2	3
Functional Class	E	C	P	C	C	M	C	C	P	C	C	M	C	C	E	C	...

Rpt Repeat Pattern

Fishnet pattern for 10x10-mile tile, where buildout includes significant open space or low density (Made for Asheville area)

Miles from Expwy 1	-	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0
Roadway ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Rpt	2	3
Functional Class	E	C	C	M	C	C	P	C	C	M	C	C	P	C	C	M	C	C	P	C	E	C	...

Figure 2 *Potential analysis grid patterns. The top is the same as the NCHRP 917 pattern. Middle is for areas with significantly less development or infill potential due to mountains, wetlands, or large swaths of very low-density development that is unlikely to intensify. The bottom pattern is the starting point for Asheville area, which is extreme in the amount of undevelopable land.*

Figure 3 shows the results of applying the 10x10 tiles to the five-county area of the FBRMPO. On the left is the existing plus planned network, while the right is a "fishnet grid" overlay for the buildable areas (grey is mountainous). The key takeaway from this graphic is that as the region grows, it will need a lot more general connectivity than is presently being planned. If the region is leery of creating many more 5-lane auto-oriented commercial corridors, it may easily create two smaller collectors instead of a single larger arterial without any consequence. There will also be at least a few locations where expressway corridors may be valuable.

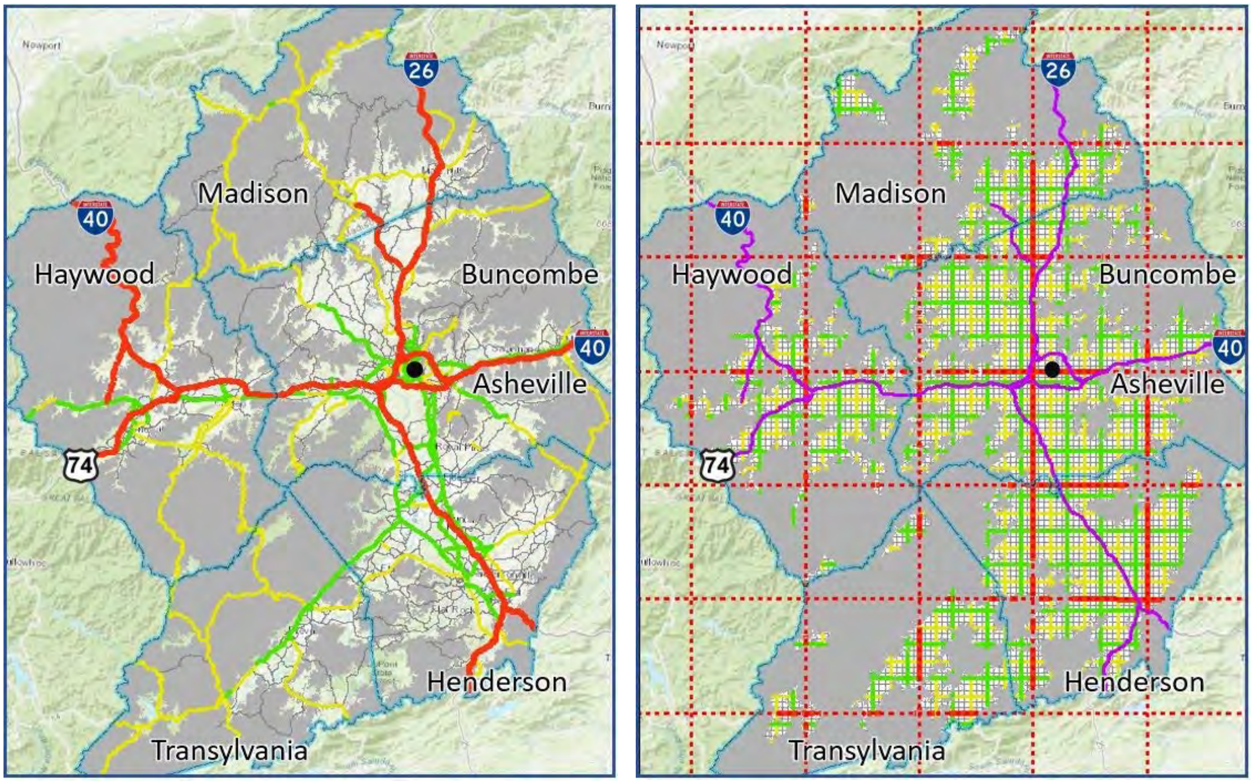


Figure 3 *Existing + Planned network vs an analysis overlay grid (10x10-mile tiles)*

Figure 4 depicts the same thing but zooms in on Buncombe County. Feedback from MPO and DOT representatives suggests that such a "fishnet overlay" graphic is helpful in part because it is clearly not suggesting a specific alignment for anything in particular. Instead, it is effectively demonstrating that the region will eventually need more through-streets than are being planned. The message is that, in fast-growing areas, counties and municipalities would do well to get agreement that a through-street at least

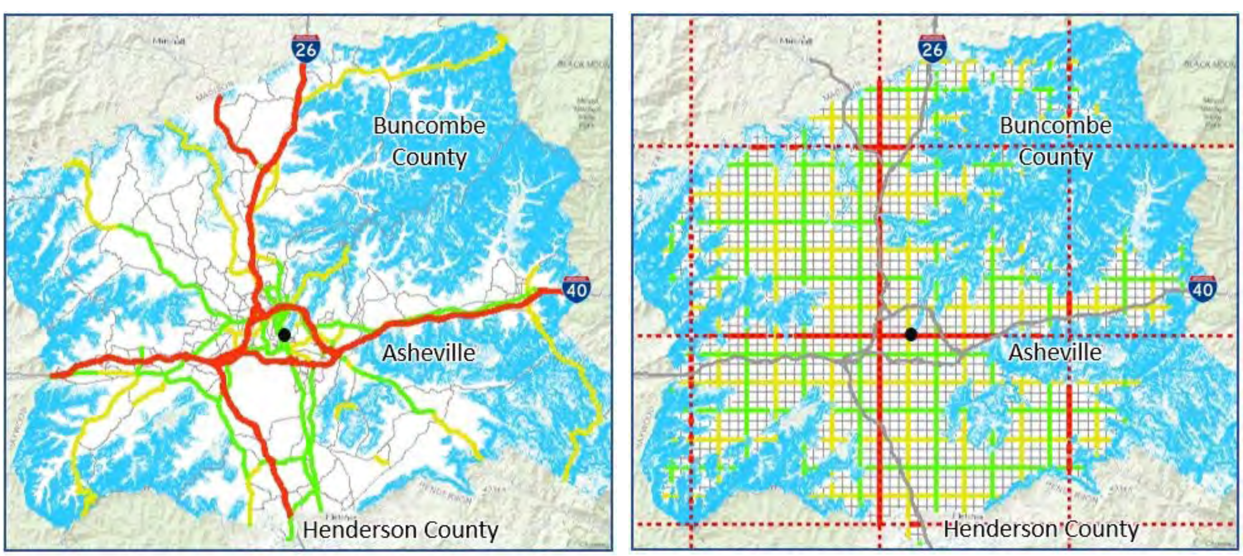


Figure 4 *Zooming in on Buncombe County*

every half-mile, with preservation for cycle tracks and potentially fixed-guideway transit, is a good idea for long-term mobility. If they can agree on that, the next step is to look for gaps in the ideal network structure and elevate the urgency of preservation where options are quickly getting harder.

Top-Level View of Additional Counties

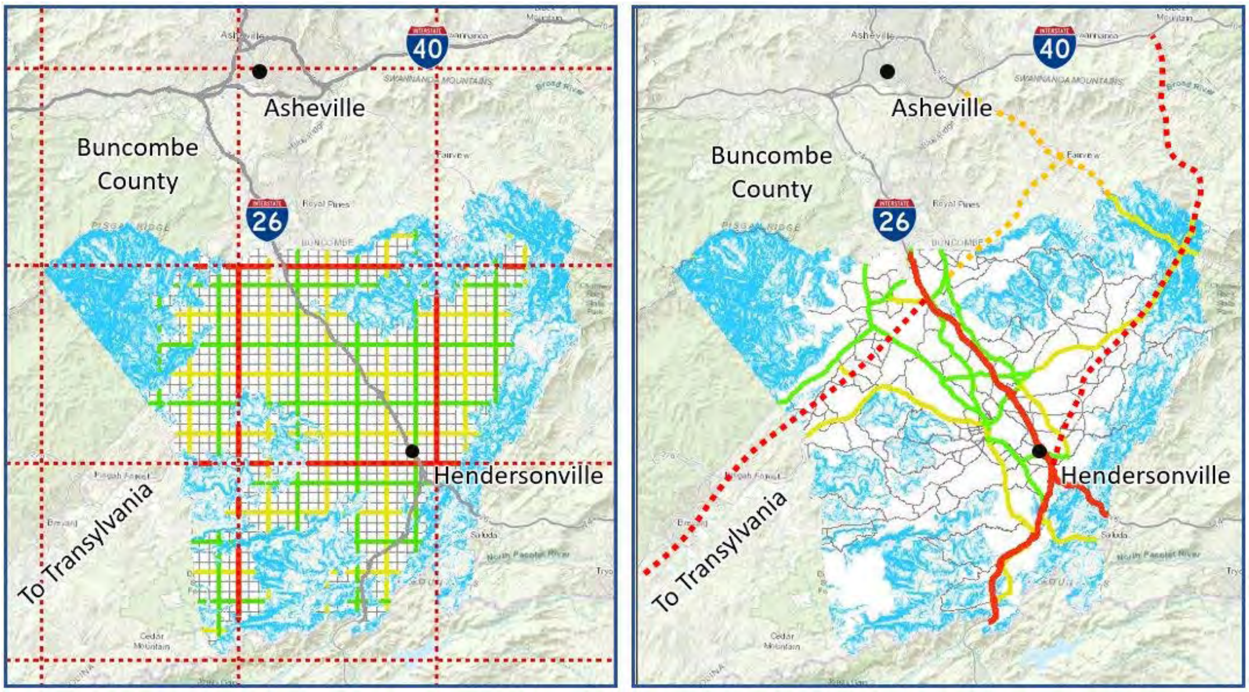


Figure 5 *Henderson County, comparing 10x10 grid (red) vs Existing. Dotted lines are NOT planned, but instead, represent a few of the more significant preservation opportunities revealed by this method.*

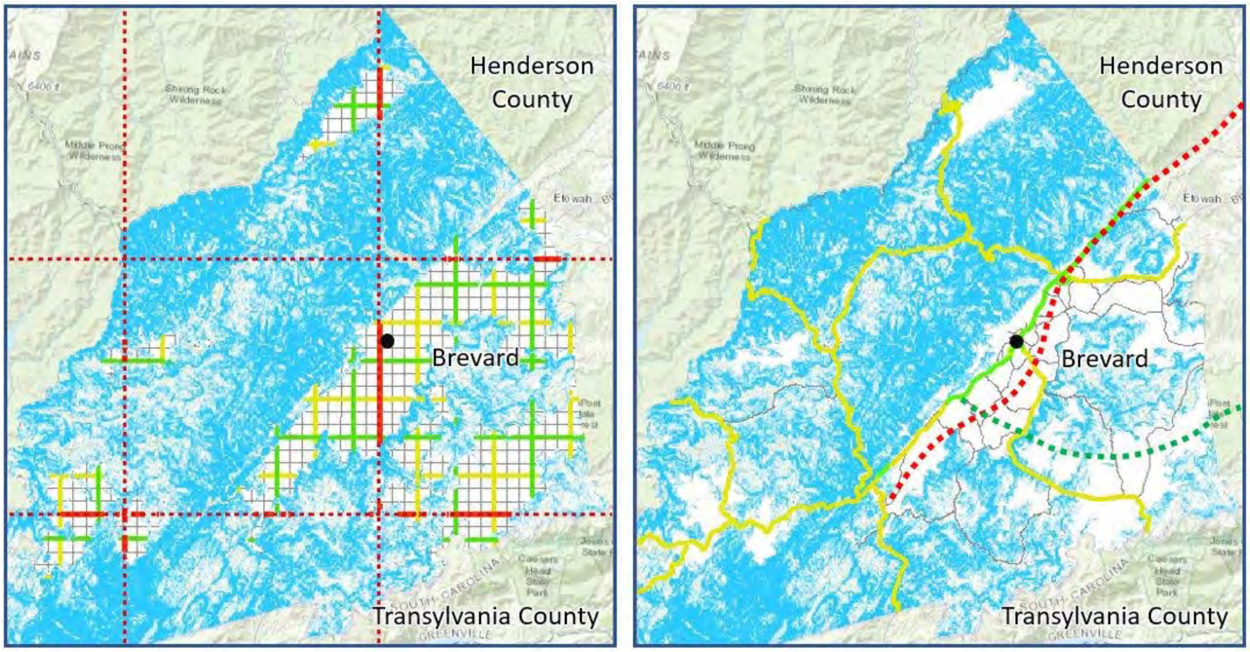


Figure 6 *Transylvania County. Dotted lines show a few potential additions or upgrades that this method suggests should be explored soon to secure ideal preservation.*

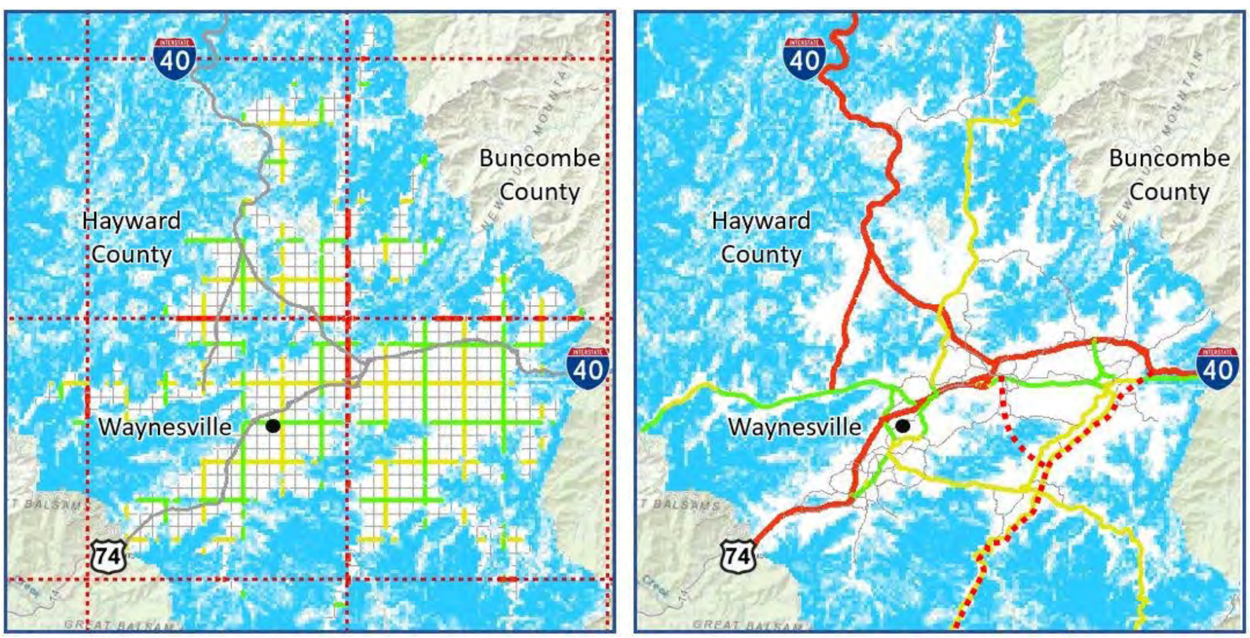


Figure 7 *Hayward County, with candidate expressway extensions to the southwest*

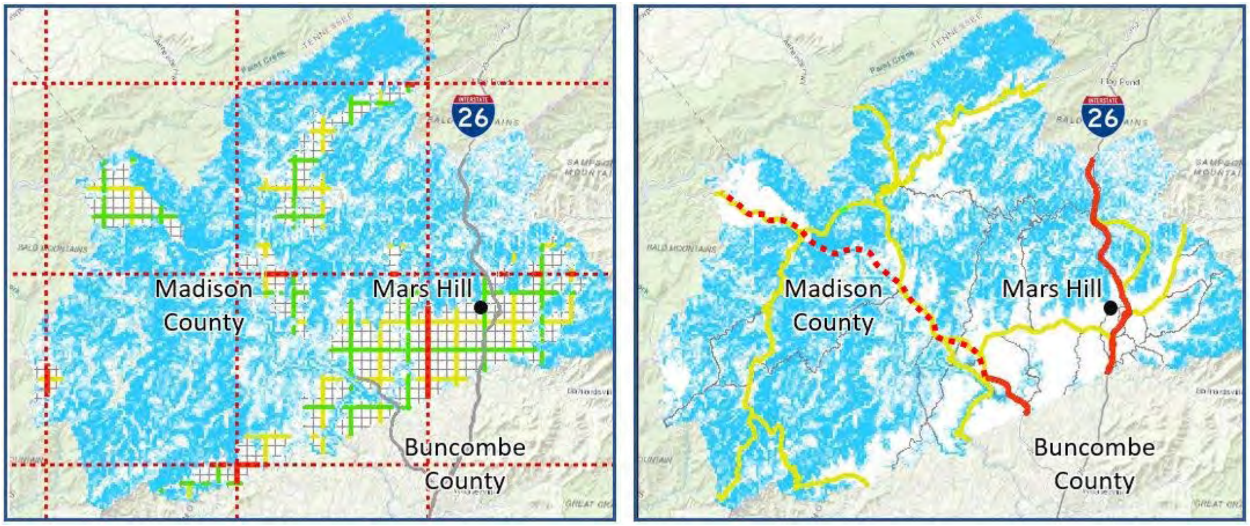


Figure 8 Madison County, with possible expressway extension to the northeast

Communicating "Fishnet Maps" to the Public

There is some concern that county-level "fishnet maps" showing how an ideal network might look at full buildout could cause rural residents to worry about the overall concept of urbanization to a greater degree than they are comfortable with. Will residents of rural areas in Buncombe County, upon seeing such a map, get nervous that agencies are taking actions that will turn their beloved rural spaces into a huge city and thereby harm their rural lifestyles?

There are several potential approaches for helping the community appreciate the value of preserving through streets every half-mile and the overall benefits of spatial network planning and preservation, followed by demand planning.

7. **Ignore unthreatened areas:** Rather than show a fishnet grid over "all developable areas in the county," ignore areas that may be less than 10% developed today and will only see tiny additional growth in the next 20-30-years.
8. **Focus on chokepoints and fast-changing areas**: The public can appreciate the value of planning areas that are or will experience growth. Where is development occurring rapidly? Where are geographic chokepoints? If an area today is 10% developed or higher, or if geography is tight with very few relief-valve options, it may be wise to define additional corridors now so that random development does not inadvertently block valuable future corridors.
9. **More corridors mean each will maintain a rural feel for longer**: Rural areas often perceive more roads as a threat to their rural character. In some cases, rural communities have intentionally blocked new corridors, thinking it will slow down development. It doesn't. Instead, it concentrates too much traffic on just a few roads, and the result feels extremely urban even at low levels of development. More corridors that are small and uncongested will feel rural for longer than

having just a few corridors that must be widened, then widened again. Make that case when showing a fishnet grid or an expanded grid so they appreciate the value of getting more connections into their plans.

10. **Emphasize that corridor planning does not affect the rate of change**: Planning for where through-streets will go once development arrives does not affect the rate of development. It merely ensures that development, whenever it occurs, will be well organized.

Refining Candidate Alignments in Buncombe County

After establishing a top-level view (such as Buncombe County) that compares the existing plus planned network to the fishnet overlay, the next step is to zoom in and start looking for large areas of developable land that could use improved connectivity. Feedback from MPO and DOT representatives has cautioned that to have meaningful conversations with the counties and communities involved, it is important that maps of candidate corridors not get too specific about where potential roadways should actually go.

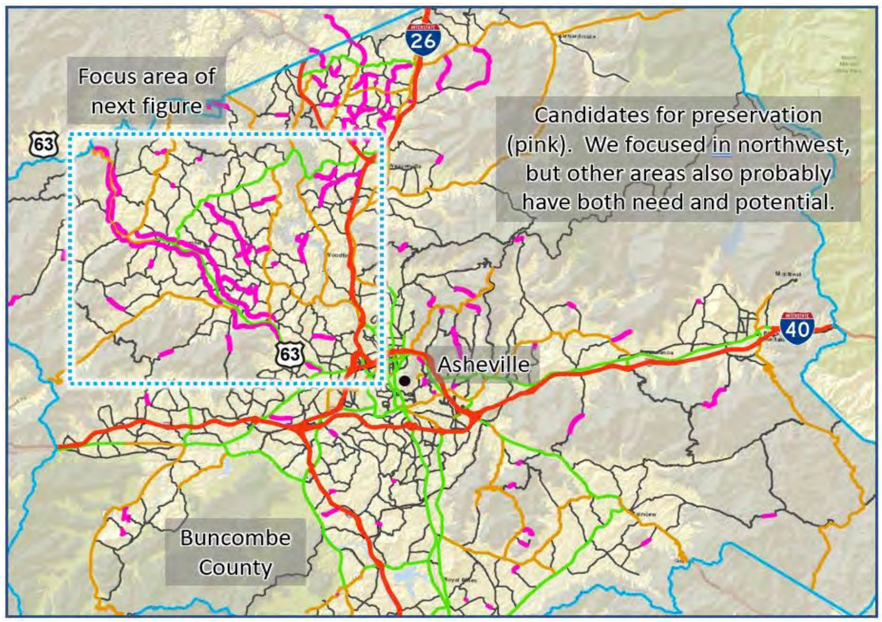


Figure 95 Finding paths of least resistance amidst terrain existing development

Figure 95 is an overview of existing plus planned streets in Buncombe County. In red are freeways and expressways. Green, orange and dark grey are principal arterials, minor arterials, and collectors, respectively.

It is overlayed with bold pink segments, which are iteration 1 "apparent paths of least resistance" that fill some gaps in the network. These pink lines were created by zooming in close and "threading the needle" through existing development and environmental constraints.

While the new pink paths are very specific when one zooms in, at this zoom level it is a non-threatening map because no specific properties can be identified.

Examples of Zooming In

Figure 10 is a sub-county view. It is likely non-controversial to specific property owners because no specific parcels can be identified. In this case, notice that NC-63 (red dotted line) is about 6-miles from I-26 (red solid line), making it an ideal candidate to preserve as a future expressway.

To serve as an expressway, NC-63 will benefit from backage roads, and it appears that such roadways are still possible along most of the length. To communicate this option, small area maps are helpful. The next sections discuss how to make good maps for these small area purposes.

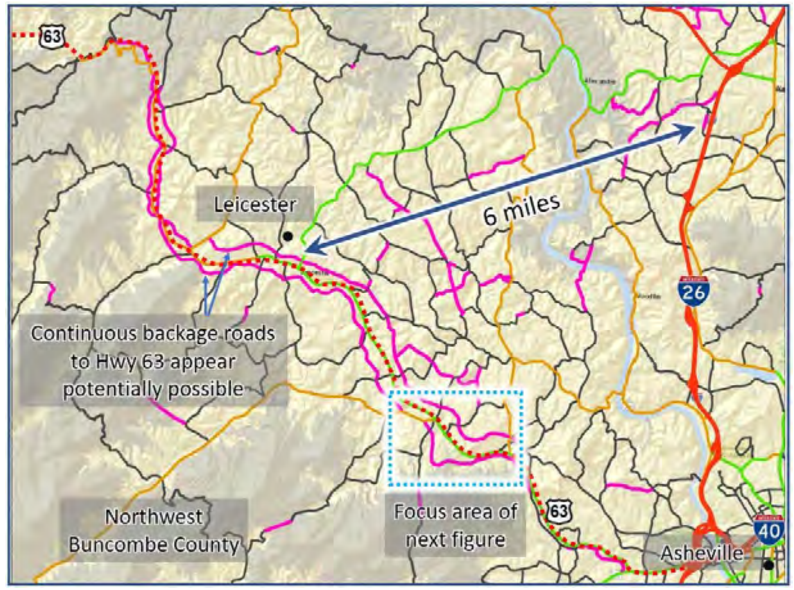


Figure 10 NC-63 is ideally positioned as a future expressway. Backage roads appear to be still possible with relatively few impacts to existing homes or businesses.

Example of What <u>NOT</u> to Do

Figure 11 is an example of what not to do during the earliest stages of introducing potential pathways. Aerials help see where there are many pathway options vs where there may be few options, but the solid lines imply someone has already decided on the best pathways.

Figure 11 Maps like this imply alignment decisions have been made. It fails to recognize that negotiation will change these paths considerably, and some segments may be abandoned.

Buffers are Better

Figure 12 may be more appropriate for public display. In green and dark blue are significant streets that already exist. The purple buffers imply that it would be helpful to create a significant street (collector or higher) in this area. Buffers communicate that no decisions have been made, and the connection can be decided locally at a future time, potentially even outside of the buffer.

Level of Urgency

Areas encircled in black and red represent spaces where it is still reasonably possible to "thread the needle" with few if any buildings impacted. However, options in the circled areas are closing fast so if the connection is to ever exist, that should be decided on very quickly.

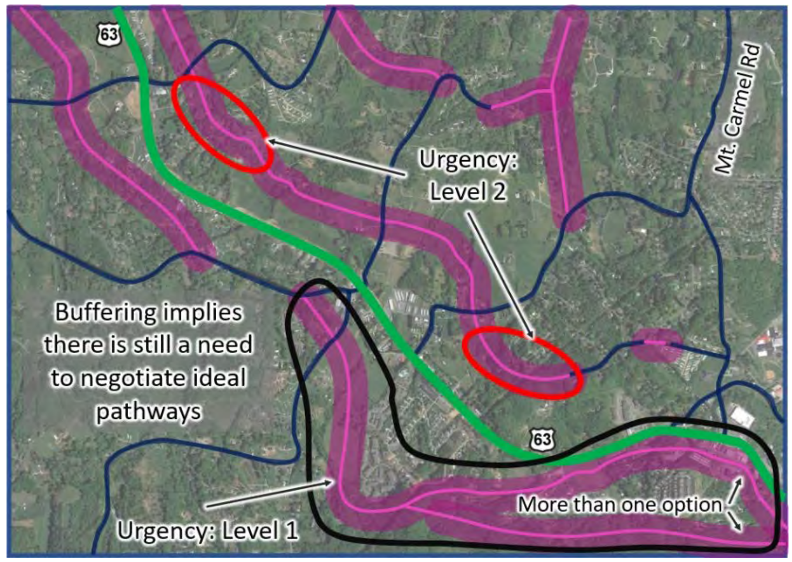


Figure 12 Aerial with buffers for potential new corridors implies there is a need to negotiate.

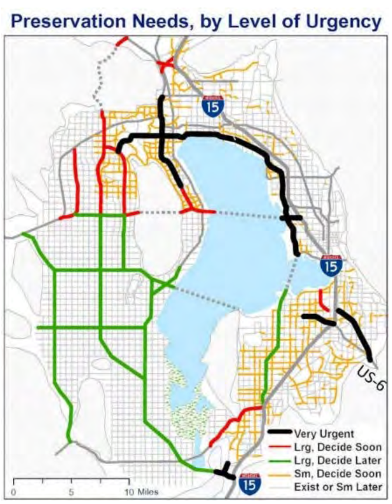


Figure 13 Example of urgency map in Utah County, Utah

When zoomed in, purple segments can be circled, like this, or segments can just be recolored according to urgency. When zoomed out, **Figure 13** is an example of another way of identifying which links are the most critical for getting into plans so that development can form around these corridors rather than block these corridors.

Process for the Public Presentation of "Paths of Least Resistance" Maps

To create publicly acceptable maps that show potential gap-filling pathways, the following is a summary of approaches presented earlier:

1. **Fishnet maps:** Fishnet maps are an easy way to demonstrate if a county or city has areas that need more network than has been formally planned for. After getting an interagency agreement that this is useful, create first-iteration path-of-least-resistance maps.
2. **Paths of Least Resistance:** Using an aerial photo and other GIS layers, zoom in and create "apparent paths of least resistance" for potential new corridors. These are the "best iteration 1 guess" at the pathways that fill gaps and create pathway continuity in the least controversial / least impactful way.
3. **County or City-Level Maps**:
    a. Use solid lines for existing streets and dashed lines (or a bold color) for potential new streets. There is no need to display potential new streets as buffers when zoomed out on non-aerial maps, as it is impossible to tell exactly which parcels might be affected.
4. **Close-up Small Area Maps**: After getting interagency buy-in to the first iteration paths of least resistance, it should be ok to create small-area maps for localized discussions. Aerial photos will likely be helpful to reveal the relative ease or difficulty of establishing the alignments that have been drawn.
    a. If an aerial is used, it is critical to show a wide buffer, suggesting that the actual alignment would be determined locally at a later date.
    b. Express that the eventual path may even fall outside of the illustrative buffer and that possibly no path will be created if it is ultimately too hard or not needed.
    c. If the buffer traverses an area that is impossible to cross without significant negative impacts, consider not traversing that space at all. It may be better to have a 95% corridor with 5% blocked than to end up with a 0% corridor due to the difficulties of trying to force a way through 5%.
5. **Level of Urgency Maps**:
    a. When filling gaps in the network, some segments are more urgent than others. Consider a 2-mile collector corridor. The first half-mile may be both geographically constrained and developing rapidly, it is urgent to decide quickly how to traverse this first half-mile. After that, there are many more options; if one gets closed off, others still exist.
    b. On zoomed-out maps, create "heat maps" where urgent segments may be black and red, with all other new segments as a cooler color.

c. On zoomed-in maps and aerials, show the transparent wide buffers as before, but also show a black or red "zone" where decisions need to be made soon.

d. Critical (black) vs Important (red): Both black and red imply there is rapid development and relatively few options, so perhaps black could represent higher-order facilities that are harder to live without or chokepoints where there will be a lot of demand with very few options.

Integrating the Master Architecture Process into Planning

A region-wide master architecture may be best led at the MPO level. Since the goal is to identify a network that will function nicely beyond the horizon year, it makes sense to create this architecture in conjunction with, if not prior to, the fiscally constrained long-range plan. Here are the major steps we see in this process, and where they most likely fit.

Step 1: Fishnet Pattern to Create Interagency Awareness of Need: Counties, cities, and DOT members need to first discover if their existing plus planned network will be adequate as subareas of the region approach buildout. To reveal this, MPO staff can easily create a "fishnet grid" for side-by-side comparison with the existing plus planned network, similar to those in **Figure 1** to ***Figure 8***. MPO staff would then present these county-level graphics to other staff at counties, cities, and NCDOT. This way they can easily see any gaps in their plans, and start formulating a strategy to fill in the gaps, or otherwise compensate for areas where they will not be able to create a more connected network. Such a map might be considered part of the Visioning step, before a needs assessment. However, coordination might best be kept at an interagency staff level and not developed as part of a public visioning process for now. NCDOT could also initiate this "fishnet grid" awareness by creating such side-by-side comparisons for all MPOs. But ultimately, MPOs would likely be involved in working with counties and cities for further awareness.

Step 2: Best-Fit Paths #1, (for interagency feedback): With general agreement among interagency staff that there are gaps in the network, the next step is to identify "best guess" alignments for closing those gaps. Use the "fishnet grid" pattern and the right-sizing strategy for backage roads along key arterials to help identify missing or under-sized aspects of the macro-network. A consultant or a GIS expert at any of the participant agencies (MPO, DOT, or County) uses aerial photos and other relevant layers to create "apparent paths of least resistance" similar to those in **Figure 10**. While the fishnet grid may have covered buildable land well into rural areas, in this refinement it may be better not to show any new network in areas likely to see only tiny levels of development over the next 20-30 years.

Step 3: Best-Fit Paths #2, (after interagency feedback): Once the first agency (likely the MPO) has created the first iteration paths of least resistance, contact county or city staff for feedback. Show the fishnet comparison for their area and explain that for resiliency and congestion management, it is good to have a through-street at least every half-mile along with an overall architecture for build-out conditions. Ask them to review your iteration 1 pathways and modify as necessary based on local sensitivities.

Step 4: Test in Travel Models to Reveal Benefits: To help people appreciate that corridor preservation is a good idea, test the MPO's existing fiscally-constrained plan against a plan that is also fiscally constrained, but includes more developer-provided collectors. Additionally, test a post-horizon build-out scenario with all of the illustrative corridors against the fiscally constrained corridors. The results should reveal the benefits of corridor preservation.

__**Step 5: Level of Urgency:**__ Regional gap-filling maps help raise awareness of the need and opportunity for more resilient networks, but they can also be overwhelming in the sheer volume of new corridors never yet contemplated. Guide the audience to "hot spots" where chokepoints and fast-paced development may soon make it impossible to create valuable links.

__**Step 6: Imply flexibility on public maps**__**:** Once satisfied that there is a reasonably viable buildout macro-network where each element has been reviewed by more than one person, organize meetings to present graphics similar to those in **Figure 1** to **Figure 10**. Present these graphics at MPO board meetings, regional interagency gatherings, etc. Encourage those who hear to utilize these same graphics in their own presentations to broaden awareness of the need for a Master Architecture. Emphasize that these are "first iteration" maps with plenty of opportunities for refinement at the local level.

__**Step 7: Illustrative corridors on MPO Regional Plan:**__ With general interagency agreement on which links make sense spatially for a build-out environment, evaluate these links in the regular MPO long-range planning process to see which makes sense to include in the fiscally constrained plan, by phase. Many links may not realize their eventual demand, as reported by a travel model, within the 20-30-year horizon if development by the 20 or 30-year mark is less than build-out. However, this does not mean these links should be abandoned to haphazard development because the point of an architecture is to preserve options for post-horizon growth. Instead, place them in an "illustrative" phase of the plan to show that they are needed but not fiscally constrained, or they likely will be needed post-horizon. If sub-area growth proves much faster than anticipated, illustrative corridors can be activated sooner than anticipated.

__**Step 9: Encourage Inclusion on County and Municipal Plans:**__ With the regional plan established, it will be easier for sub-regional plans to point to the regional plan to justify why they intend to add new links to their own plans.

__**Step 8: Urgent Hot-Spot Studies:**__ When there is fast growth and needed corridors have just enough obstacles in the way that clearly something will get hit, aim to sponsor small area studies to reach stakeholder consensus on what to do. The outcome need not be "AutoCAD drawings" of the actual right-of-way, but it should be somewhat close to that so landowners can work around the corridor or build their part of it.

Process Example: Network Right-Sizing in Utah

The Mountainland Association of Governments (MAG) is the MPO for Utah County, just south of Salt Lake City. It is one of the fastest-growing counties in the country, and they recognized that the normal MPO planning process appeared to be overlooking opportunities for communities to enhance their network.

They discovered that *NCHRP 917* recommends a method for right-sizing regional networks through the Master Architecture process, and they used that process to guide their most recent Regional Transportation Plan (RTP). See “Goal 1” in their plan. This summary outlines the key steps in their successful process.

Step 1: Right-Sized Fishnet vs Existing + Planned

MAG first created a “fishnet overlay” of the county’s developable area and compared that to their most recent RTP plan for 2040 as shown in Error! Reference source not found.. It is easy to see where the 2040 plan has good connectivity and where it is lacking.

Step 2: Iteration 1 Paths of Least Resistance

The fishnet grid shows locations where the planned network is weak. Knowing that, MAG zoomed in to weak areas and looked at open fields where it appears reasonably possible to add more collectors and arterials, or to anticipate upgrading existing collectors to arterials. They also looked for logical expansions of the expressway network. Error! Reference source not found. shows what the county might look like at full buildout if right-sized to fit within their constrained geography.

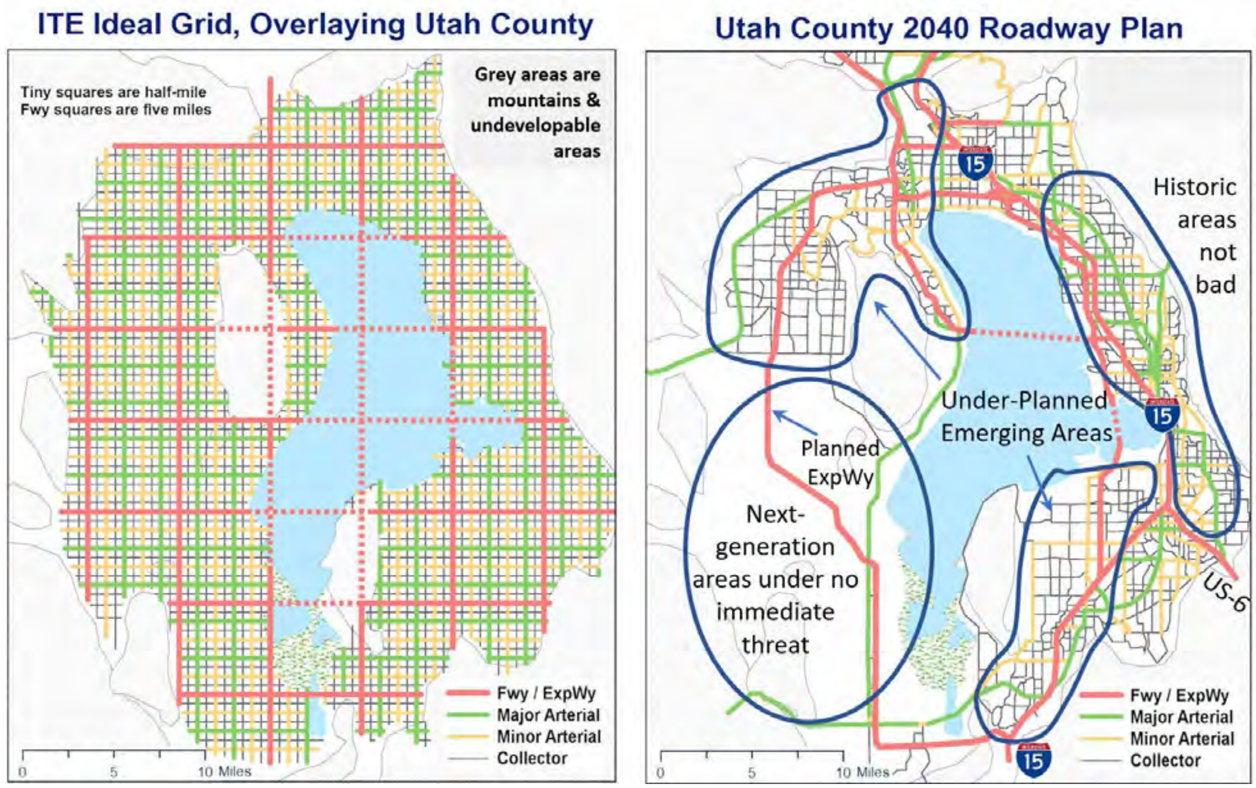


Figure 13 Utah County Fishnet grid vs 2040 Plan

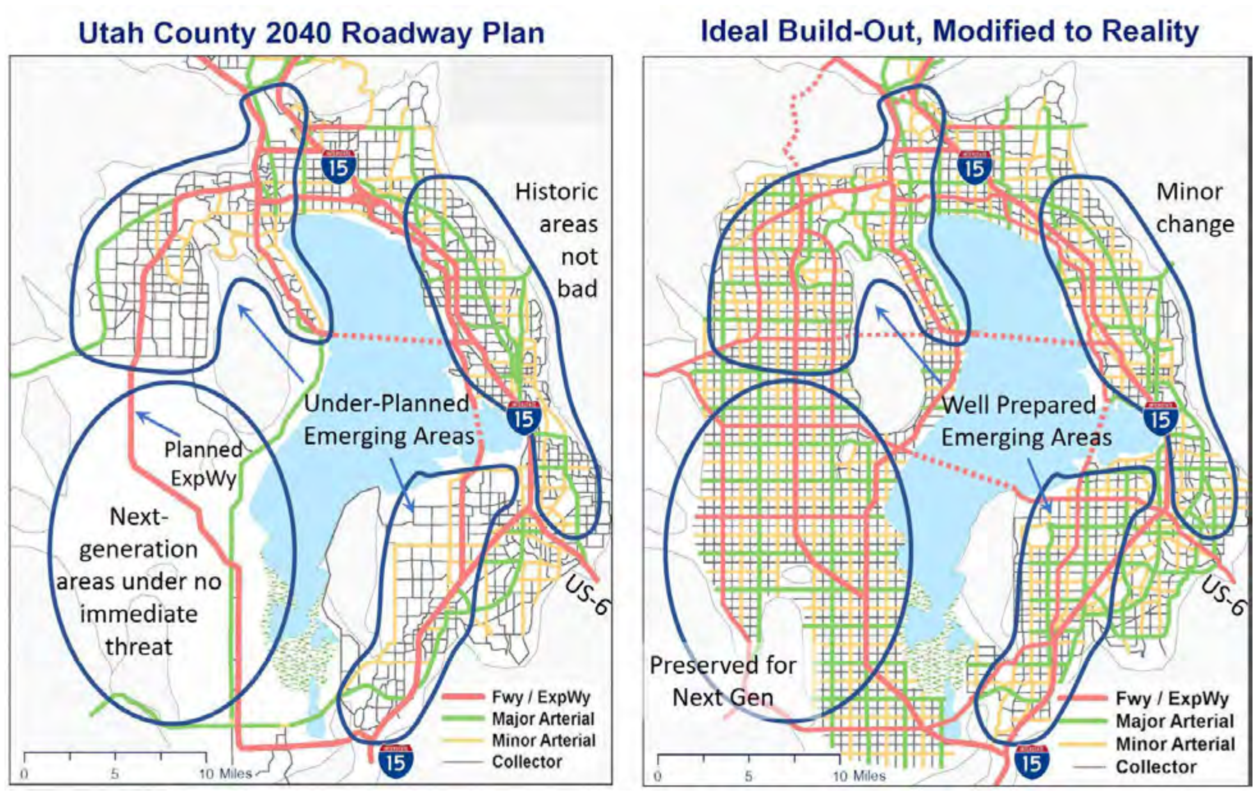


Figure 14 Plan for 2040 vs modified plan, aiming at build-out.

Corridor Preservation Methods and Programs

Identifying corridors to preserve invokes the need to address how to actually preserve them. MPOs have their fiscally constrained list of projects, but the "pink line" method shown here would often be in addition to that. Collectors may be the easiest to address, as they are often funded by private developers and do not always need to be shown as specific projects on an MPO/RPO plan. Instead, an MPO/RPO could consider just showing collectors and arterial backage roads on the plan as "illustrative," or as "funded by ongoing development." This way the collectors need not be in any particular phase, but it does send an effective message to counties and municipalities that development should be coordinated so that these collectors eventually link together. Some arterials can also be preserved by merely noting that it should be an eventual arterial and thus should have higher access management standards and development setbacks.

With such lines on a map, many large landowners can easily adopt the corridor into their plans, possibly "wiggling" it to better match their land use plans. However, conundrums arise when a 2-acre developer, of which the corridor needs 1-acre, may face a serious hardship in getting full value from their land. In these cases, a developer may come to the state or county and effectively say, "Buy the 1-acre you need or its development rights. Otherwise, I need to develop it as per my legal right." If the state or county can't buy what it needs, it will either need to move the corridor to a new location, eventually tear down what is about to get built, or simply give up on the corridor. Existing homes and businesses are already built and thus face a different conundrum. Many will note that the line over their home makes it hard to sell at market rates.

To solve this problem, it may help for a state to adopt a formalized corridor preservation program that has funding available to help address hardship cases that are common among homeowners and small developers. Utah has such a program that is one of the best in the nation to our awareness. Their program is funded by a $10/yr add-on to vehicle registration fees, paid only by residents of counties that see a need to preserve corridors. A committee then meets monthly to review applications and fund the most obvious hardships based on the available budget. As projects receive construction funds, the project pays back the corridor preservation fund at acquisition cost + inflation – which happily does not include inflation due to new buildings! Thus, the fund always gets bigger, making it easier to keep more projects viable, and reducing the overall cost of construction. We advise that a means of managing hardship claims associated with preserving future travel corridors be part of the right-sizing process.

Note: State laws and opportunities will vary, and it may not be possible for North Carolina to construct a program like Utah's. The research team is merely pointing out that effective corridor preservation probably needs a means of addressing hardship cases. Seemingly a state or county could craft their own program and perhaps channel a small portion of fuel taxes or other funds toward such a program.

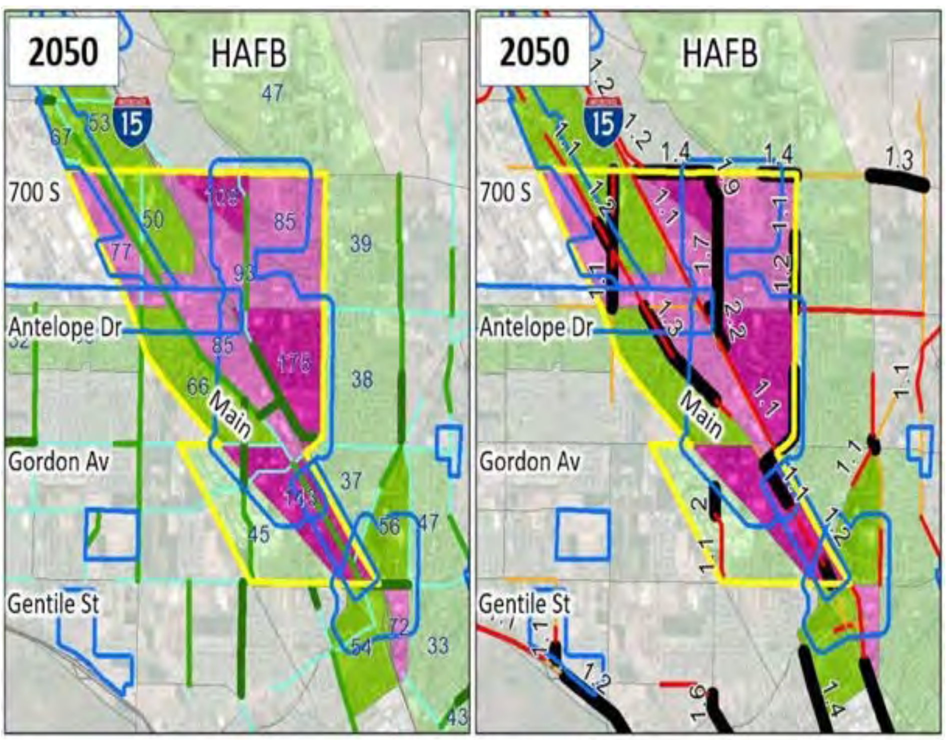
APPENDIX PLAY 5

Consider Centers as a Transportation Performance Investment

APPENDIX P5

Metro Analytics, “Right-Sizing in Support of Activity Centers on the Wasatch Front,” p2, 2021.

Using this 2050 demographic forecast and the associated traffic network performance measures, the research team identified several locations across a 3-county area that stand out as areas that the REMM model believes are likely to grow into full-scale activity centers between now and 2050. **Figure** 1 shows two kinds of analysis that are featured in the next several pages, with the only difference being that the next pages also include 2019 conditions. Blue polygons are WFRC’s activity centers. Yellow is our own polygon used for statistics showing zones where trip density is very high. For the Layton Activity Center, colors represent trips per acre generated by residential, commercial, and delivery activity. In the left image, posted values are also trips per acre. White, unposted areas will build out at less than 30 trips per acre by 2050. Green areas have 30-70 trips/acre. Pink areas have 70+ trips/acre.



Layton	2019	2050	Total Acres	3,100
HH / Acre	3	7	Trip increase since 2019	62%
Jobs / Acre	10	14	Compared to SL-19 suburbs	3.1
Trips / Acre	57	93	2050 Trips vs SL-19 CBD	63%

Yellow outline increases 62% over present, with 3.1x more trips/acre than SL’s 2019 suburban average. Density is 63% of SL-19 CBD, and same acres.

Figure 1: Overview of Activity Center Analysis

Metro Analytics, “Right-Sizing in Support of Activity Centers on the Wasatch Front,” p23, 2021.

5.4 CHECKLIST OF RIGHT-SIZING ON HIGH VOLUME ARTERIALS

5.4.1 **10-ft Travel Lanes:** 12-ft travel lanes are not appropriate for mixed-use centers primarily because wide lanes contribute to faster driving. 10-ft lanes can be safely navigated by large vehicles and they do not measurably reduce overall capacity. Thus, for safety and for extra room for other features, 10-ft is preferred over 11-ft unless there is a compelling case for 11-ft within the activity center.

5.4.2 **Calming arterial traffic to 35 mph or less:** A speed limit of 35 will still often see many vehicles traveling up to 45 mph if drivers have a wide field of vision and perceive it is safe to do so. Raised table-top intersections, street trees planted within a parking lane, planted medians, and other treatments will help ensure that very few vehicles will exceed 35 mph even on high-volume arterials.

5.4.3 **Calming local traffic to 20 mph or less:** The non-arterial network within centers also gets busy with pedestrians, heavy vehicles, and light vehicles all interacting. Yield Streets and other options described in NACTO’s Urban Street Design Guide will help ensure that local traffic will travel at safer speeds than in the general suburbs that have less overall activity.

5.4.4 **Reduce conflicts; 4-phase signals:** Busy multilane two-way intersections have a large number of conflicts if all four lefts are allowed. They may eventually require “double left” storage lanes and signal phases with massive hardscape footprints and high levels of congestion even at low activity density. Consider the following strategies for improving arterial efficiency, safety, and context compatibility.

5.4.5 **One-Way Arterials:** Couplets, crossing couplets, and even triplets – all can typically handle more traffic with fewer total lanes than comparable two-way arterials. Even at intentionally slow speeds, they can support high levels of activity without extreme delay. Retrofits are often more possible than first glance might suggest.

5.4.6 **Quadrants and Bowties:** For arterials that must remain two-way, these designs both make it possible to eliminate left-turn phases from the primary signal, which in turn opens significant place-making potential. Bowties designed with teardrops or roundabouts can also be used to create planted medians as an access control safety measure, and at the same time offer fast and safe accessibility to properties.

Metro Analytics, “Right-Sizing in Support of Activity Centers on the Wasatch Front,” p40, 2021.

Figure 1 **in this document**) shows the results of the checklist as rated for both present momentum and technical rightsizing potential by category. It appears to us that in many right-sizing categories, there is probably little present momentum. In most cases, this is because we suppose that those with the strongest influence over what will be built there probably have little if any awareness of the topic or its opportunities for this site. There will also be cases where influencers are more aware of the topic than we know, and thus it should be rerated by those with better knowledge of present circumstances. In going through each topic, we were surprised to see that nearly all have strong potential at this site. The reason is primarily that it is still mostly undeveloped, so there are few existing constraints on what is possible. Though many changes would be uncomfortable, somewhat impactful, and require a lot of education and momentum building, we still rated them as strong potential. This is because when comparing the long-term benefits against immediate challenges, the challenges look to us to be worthy of confronting.