

FINAL REPORT

Route 101 Corridor Interchange Study in Mendocino County (Ukiah Area)

For Mendocino Council of Governments

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**Prepared by:
TJKM Transportation Consultants
5960 Inglewood Drive, Suite 100
Pleasanton CA 94588-8535
Tel: 925.463.0611
Fax: 925.463.3690**

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EXECUTIVE SUMMARY

The need for the Route 101 Corridor Interchange Study in Mendocino County resulted from concerns regarding growth and development in the Ukiah Area. The participating agencies within the Mendocino Council of Governments determined that a comprehensive review of all Ukiah area interchanges on Route 101 was in order. The study was created out of those initial concerns.

This final report summarizes the technical analysis performed throughout the study including preliminary designs and cost estimates for the concepts for interchange improvements. Specific designs and estimates are included in this report's Technical Appendix.

Background and Context of Transportation Planning in Mendocino County

Transportation planning in Mendocino County is the responsibility of the Mendocino Council of Governments (MCOG), which is designated as the Regional Transportation Planning Agency (RTPA). MCOG is a Joint Powers Agency comprised of Mendocino County and the Cities of Fort Bragg, Point Arena, Ukiah and Willits. The MCOG Board of Directors is comprised of two members of the County Board of Supervisors, one representative from each of the four cities, and one Countywide elected official. With the addition of the California Department of Transportation (Caltrans) District 1 Director, the MCOG Board becomes the Policy Advisory Committee. A Technical Advisory Committee (TAC) serves to advise the MCOG on various transportation matters. The TAC is comprised of representatives from the Planning and Public Works/Transportation staff of the joint powers entities, transit, air quality, rail, and Caltrans representatives. MCOG contracts annually with an Executive Director to handle staffing needs.

U.S. Route 101 is the primary north-south transportation corridor that serves the region's ground transportation needs. It is the most important route in Caltrans District 1, providing access to three of the five county seats, five of the six urban areas, and eight of the fourteen incorporated cities, including the three largest cities in the District (Eureka, Arcata and Ukiah).

Purpose of the Study

Although Route 101 was built as a rural roadway to carry low volumes, recent growth in the region has increased traffic volumes. Apart from the general growth, there are planned developments in the Brush Street area, Lovers Lane area, and the Masonite area. A number of other major developments east of the Route 101 corridor are expected to occur in the future. Because of the significance of such developments on the operations of Route 101 and on the safety of the traveling public, MCOG decided to undertake a comprehensive study of the Route 101 corridor in the greater Ukiah area that would identify needed improvements, their costs, and priorities.

Scope of the Study

The scope of this study has been to complete an evaluation of six freeway interchanges along Route 101 in the Ukiah area. The evaluation included an analysis of present needs, existing and future levels of service (LOS), constraints on improvement options, right of way needs, and planning level improvement costs. Conceptual designs and preliminary cost estimates have been prepared. The study interchanges listed from north to south are:

- Lake Mendocino Drive
- North State Street
- East Perkins Street / Vichy Springs Road
- East Gobbi Street

- Talmage Road (State Route 222)
- South State Street (State Route 253)

Apart from these interchanges, there are northbound slip ramps at City Well Road located about 3500 feet north of the East Perkins Street interchange. Due to the low volumes on these ramps, they are not expected to adversely influence the adjoining interchanges at present. However, they should be monitored for future planning purposes.

Initial Data Collection and Review

TJKM compiled existing conditions data from several sources for this study. These data include traffic volumes, number of collisions by location, and aerial photography. In this report, TJKM details initial trends that were evident from the data, which were used for evaluating existing interchange conditions.

Initial Screening Criteria and Existing Condition Analysis Results

Existing conditions for the six study interchanges were evaluated using three main criteria:

- Collision experience
- Congestion experience
- Geometric adequacy

Based on this existing condition analysis, TJKM determined the following:

- Collisions
 - Three interchange ramps are experiencing higher than normal collision rates: East Perkins Street northbound on-ramp, North State Street northbound off-ramp, and North State southbound off-ramp
 - On the freeway mainline, the section containing the North State Street interchange is experiencing higher than normal collision rates
 - The top three intersections with high total collisions over four years are North State / 101 Northbound Off-Ramp (10 collisions), East Perkins / 101 Northbound Off-Ramp (8 collisions), and East Perkins / 101 Southbound Off-Ramp (4 collisions).
- Operations
 - All interchange ramps are operating at uncongested levels.
 - All freeway mainline sections are operating at uncongested levels.
 - Five intersections are operating at congested levels:
 - North State Street / 101 NB Off-Ramp
 - East Perkins Street / Orchard Avenue
 - East Perkins Street / 101 SB Ramps / Pomeroy Street
 - East Perkins Street / 101 NB Ramps
 - East Gobbi Street at 101 SB Ramps
 - Queuing is affecting existing operations at the East Perkins Street / Orchard Avenue and East Perkins Street / 101 Southbound Ramp intersections. The segment between these two intersections experiences significant congestion during peak hours. Analysis revealed that:
 - During the a.m. and p.m. peak periods the westbound through movement at East Perkins Street / Orchard Avenue experiences a queue that is long

- enough to block the upstream 101 Southbound Ramp intersection. Also, the left turn queue at Orchard Avenue may spill over into the through lane.
- At the East Perkins Street / 101 Southbound Ramp intersection, the southbound left turn off the freeway experiences significant queues
 - Field observations revealed that North State Street off-ramp queues spill over to the freeway during AM peak hours.
 - All freeway merging and weaving areas operate acceptably under existing conditions.
 - Geometric Adequacy - TJKM compared existing on-ramp taper lengths with current Caltrans on-ramp design standards. The majority of on-ramps have taper lengths that are below current on-ramp design standards. The East Perkins to 101 Southbound and South State to 101 southbound on-ramps are the only ramps that currently meet or exceed the standard. The North State to 101 Southbound, East Perkins to 101 Northbound, and Talmage to 101 southbound on-ramps fall short but are very close to the standard.
 - Interchange Spacing Adequacy - all interchanges are spaced less than two miles apart, and therefore do not meet the desired spacing criteria. In addition, there currently are no auxiliary lanes for weaving and merging traffic. In particular, the East Perkins, East Gobbi, and Talmage interchanges are spaced less than one mile apart from one another. A likely challenge to adding an auxiliary lane between the East Perkins Street and East Gobbi Street interchanges is the pedestrian overcrossing between these locations, whose bridge piers are located very close to the pavement edges on both sides of the freeway.
 - Initial Interchange Evaluation - The North State Street and East Perkins Street interchanges are by far the top two interchanges with the highest cost of excess delay and/or collisions. For the North State Street interchange, the excess cost is primarily due to collisions. For the East Perkins Street interchange, the excess cost is primarily due to congestion. Congestion costs are the only costs associated with three other interchanges, while the South State Street (SR 253) interchange has no associated costs.

Future 2025 Condition Analysis Results

For the year 2005 condition, six study interchanges were evaluated based on three main criteria: 1) collision experience, 2) congestion experience, and 3) geometric adequacy. For year 2025, only congestion is evaluated, since collision and geometric criteria cannot be meaningfully evaluated in the future. Facilities with traffic volume demand equal to or greater than their capacities are given a more detailed examination later in this report, where specific interchange improvements are discussed.

TJKM forecasted future 2025 traffic volumes for this study. All future developments, including those near the North State Street interchange area, were considered while forecasting future volumes. TJKM determined the following results for future 2025 conditions:

- Five interchange ramps are projected to operate unacceptably:
 - Southbound off-ramp at North State Street (a.m. peak)
 - Southbound off-ramp at East Perkins Street (a.m. peak)
 - All four North State Street interchange ramps (p.m. peak)
- All freeway mainline segments will operate without congestion under future conditions.

- The following study intersections are anticipated to operate unacceptably under future conditions:
 - Lake Mendocino Drive at 101 Southbound Ramps (a.m. and p.m. peak)
 - Lake Mendocino Drive at North State Street (p.m. peak only)
 - North State Street at 101 Northbound Ramps (a.m. and p.m. peak)
 - North State Street at 101 Southbound Off-Ramp (a.m. and p.m. peak)
 - North State Street at 101 Southbound Off-Ramp (p.m. peak only)
 - North State Street at Kuki Lane (a.m. and p.m. peak)
 - East Perkins Street at Orchard Avenue (a.m. and p.m. peak)
 - East Perkins Street at 101 Southbound Ramps (a.m. and p.m. peak)
 - East Perkins Street at 101 Northbound Ramps (a.m. and p.m. peak)
 - East Gobbi Street at Orchard Avenue (a.m. and p.m. peak)
 - East Gobbi Street at 101 Southbound Ramps (a.m. and p.m. peak)
 - Talmage Road at Airport Park Boulevard (a.m. and p.m. peak)
 - Talmage Road at 101 Southbound Ramps (p.m. peak only)
 - Talmage Road at 101 Northbound Ramps (p.m. peak only)

- All merging and weaving sections in the study area will operate acceptably.

Preliminary Improvements

The operational concerns identified during the analysis were examined in more detail to determine preliminary improvements. Concerns highlighted include high collision rates for on- and off-ramps, ramp junctions with cross streets, and mainline locations; and traffic volume demand at or greater than mainline, ramp or intersection capacity. Other criteria include the geometric adequacy of on- and off-ramps, warrants for signals at ramp and ramp-related intersections, interchange spacing, and observations from field checks of the interchanges.

Specific problems and operational concerns were identified for each interchange under both 2005 and 2025 traffic conditions. Based on the identified concerns, graphics are provided in this report to illustrate the details of the recommended improvements at each interchange. All improvements described herein are preliminary and were evaluated further in terms of conceptual engineering and cost estimation where appropriate.

Interchange 1: Route 101 at Lake Mendocino Drive

Concerns

- Inadequate merge capacity for northbound and southbound on-ramps (2025)
- Inadequate overall intersection capacity at 101 Southbound Ramp / Lake Mendocino Drive and North State Street / Lake Mendocino Drive (West Leg) intersections (2025)

Improvements

- 2025: Install signal at 101 Southbound Ramp / Lake Mendocino Drive intersection
- 2025: Increase acceleration lengths for both northbound and southbound on-ramps

Interchange 2: Route 101 at North State Street

Concerns

- Excess collision rate on both northbound and southbound off-ramps (2005)
- Excess collision rate on northbound on-ramp (2005)
- Excess collision rate at northbound ramp intersection (2005)

- Excess collision rate on freeway mainline in vicinity of ramp merging areas - northbound in particular (2005)
- Congestion at northbound and southbound ramp intersections (2005 and 2025)
- Congestion on all on- and off-ramps (2025), including queuing on both off-ramps leading to near capacity or over capacity (queue spillover to mainline) in 2025 p.m. peak hour
- Congestion and queue spillover for southbound North State left turn onto 101 Southbound on-ramp without signal (2025)
- Congestion at nearby Kuki Lane intersection south of interchange (2025)
- Inadequate merge length and tight/substandard radius for northbound on-ramp (2005)
- Inadequate merge capacity for northbound and southbound on-ramps (2025)

Improvements

- 2005: Install signals at northbound and southbound ramp intersections, and coordinate with existing nearby North State Street / Kuki Lane signal
- 2005: Provide three lanes on northbound Route 101 mainline structure to accommodate extended acceleration lane by re-striping the bridge area and adding pavement to the north and south of the bridge

TJKM also examined a potential alternative to increase the radius of the 101 Northbound loop on-ramp, which would lengthen the on-ramp and thereby increase the merge taper length. This alternative would have the following constraints:

1. Potential land takings – there is a large building located only 145 feet away from the pavement edge of the 101 Northbound off-ramp to North State. Therefore, the possibility exists that the building may need to be taken, since increasing the loop on-ramp radius would also move the adjacent off-ramp closer to this building. This could significantly increase the overall cost of improvements at the North State interchange.
2. The on-ramp taper length, currently 420 feet, would still not likely meet Caltrans standards even with loop ramp lengthening. Current Caltrans standards are 180 meters (590 feet) of on-ramp taper length. Because of the nearby building constraint, increasing taper length to a minimum of 590 feet is difficult.

- 2025: Realign southbound on- and off-ramps to meet at a single signalized intersection
- 2025: Increase acceleration length for southbound on-ramp merge onto southbound mainline
- There has been a recent proposal to create a driveway access for a private property at a midpoint of the 101 Northbound ramps. The access would be located only approximately 400 feet from the ramp terminals at North State Street. This access is not recommended for two reasons: Caltrans standards require at least 600 feet between ramp terminals and any mid-ramp access, and Caltrans only permits mid-ramp access for public streets, not private roadways.

Interchange 3: Route 101 at East Perkins Street

Concerns

- Excess collision rates at northbound and southbound ramp intersections (2005)
- Excess collision rates on northbound on-ramp (2005)
- Congestion at northbound and southbound ramp intersections and nearby East Perkins Street / Orchard Avenue intersection (2005 and 2025)
- Queuing from westbound vehicles at East Perkins Street / Orchard Avenue intersection causing blockages of nearby southbound ramp intersection (2005 and 2025). Queue extends past intersection to East Perkins Overcrossing in 2025 p.m. peak

- Queuing of southbound off-ramp vehicles (2005 and 2005), with queue spillover to mainline in 2025, without signal
- Queuing of northbound off-ramp vehicles with queue spillover to mainline in 2025 a.m. peak, without signal
- Inadequate merge length for northbound on-ramp
- Merging congestion for northbound on-ramp (2025)
- Poor sight distance at both northbound and southbound ramp intersections due to sharp vertical curvature of the East Perkins Street Overcrossing (2005)
- Tight / substandard radii for both northbound and southbound loop on-ramps. Right turns onto these on-ramps have poor channelization (2005)

Improvements

- 2005: Add signal to southbound ramp intersection and coordinate with optimized East Perkins / Orchard signal. Add signal to northbound ramp intersection and coordinate with nearby signals. There is also potential to add a roundabout to the northbound ramp intersection, as was outlined in the May 2003 *Brush Street Triangle Study*.
- 2025 (preliminary alternative): A preliminary alternative would be to close the southbound ramps at East Perkins and relocate them to Orchard Avenue at Brush Street, north of the current ramp location. A signal at the Brush Street / Orchard Avenue intersection would be recommended along with the ramp relocation. There is also potential to add a roundabout to the Brush Street / Orchard Avenue intersection, as was outlined in the May 2003 *Brush Street Triangle Study*. It should be noted that while congestion at the East Perkins interchange would decrease, it is likely that congestion would increase at the East Perkins Street / Orchard Avenue intersection due to the redistribution of ramp trips to / from the Brush Street / Orchard Avenue intersection.

However, some modifications to the East Perkins Street / Orchard Avenue intersection by adding lanes could alleviate congestion at this intersection. Preliminary analysis indicates that adding a westbound through-left lane and a southbound right turn lane would improve the level of service to acceptable levels. Following are some of the pros and cons of this improvement:

- Pros: Removal of southbound Perkins ramps would improve traffic operations for East Perkins Street and its nearby intersection with Orchard Avenue. It would also eliminate the current queuing concern on the southbound Perkins ramps, the need for a signal at those ramps, and potentially the need to widen the East Perkins Overcrossing. Furthermore, the improvement could potentially reduce collisions.
- Cons: Potential new ramps at the Orchard Avenue / Brush Street intersection provide new operation and collision concerns, including those related to a new non-standard interchange configuration. Caltrans does not support splitting interchanges in this way. Also, the new configuration would add turning movement traffic to the East Perkins Street / Orchard Avenue intersection, which already has operational concerns.

It also should be noted that the proposed preliminary configuration for new Brush Street ramps at 101 Southbound would be a partial diamond, or half of a standard diamond interchange. To address driver orientation for a newly split interchange, TJKM recommends that “trailblazing” signage supplement the new configuration, so

that clear routes are indicated to the relocated ramps and the existing northbound Perkins ramps.

- 2025: Increase acceleration length for northbound on-ramp
- 2025: Add auxiliary lane connecting northbound off-ramp with upstream northbound on-ramp from East Gobbi Street interchange to improve merging and weaving operations
- 2025: Widen East Perkins Street Overcrossing as needed to accommodate queued vehicles at newly signalized ramp intersections

Interchange 4: Route 101 at East Gobbi Street

Concerns

- Congestion at East Gobbi Street / Orchard Avenue and East Gobbi Street / 101 Southbound Ramp intersections (2005 and 2025)
- Southbound off-ramp near capacity in 2025
- Poor sight distance at both northbound and southbound ramp intersections due to sharp vertical curvature of the East Gobbi Street Overcrossing (2005)

Improvements

- 2005: Add signals at East Gobbi Street / Orchard Avenue and East Gobbi Street / 101 Southbound Ramp intersections and coordinate their operations. The City of Ukiah has programmed signal installation at the East Gobbi Street / Orchard Avenue intersection for its 2005-06 Fiscal Year. There is also potential to add a roundabout to the East Gobbi Street / Orchard Avenue intersection, as was outlined in the May 2003 *Brush Street Triangle Study*.
- 2025: Add auxiliary lane connecting northbound on-ramp with downstream northbound off-ramp at East Perkins Street interchange to improve merging and weaving operations
- 2025: Widen East Gobbi Street Overcrossing as needed to accommodate queued vehicles at newly signalized southbound ramp intersection

Interchange 5: Route 101 at Talmage Road (S.R. 222)

Concerns

- Congestion at nearby Talmage Road / Airport Park Boulevard intersection (2005 and 2025)
 - 2005 p.m. westbound left turn queue spillover – could block southbound ramp intersection
 - 2025 westbound queues could block southbound ramp intersection
- Congestion at northbound and southbound ramp intersections (2025)
- Southbound off-ramp to westbound Talmage Road – queue spillover to mainline in 2025 p.m. peak
- Excess collision rate at nearby Talmage Road / Airport Park Boulevard intersection
- Poor sight distance at both northbound and southbound ramp intersections due to sharp vertical curvature of the Talmage Road Overcrossing

Improvements

- 2025: Add signals to northbound and southbound ramp intersections. This would very likely require modification of the entire interchange to a tight diamond (Type L-1) configuration. Coordinate new signals with optimized existing signal at Talmage Road / Airport Park Boulevard intersection. A second option would be to modify the existing interchange to a partial cloverleaf design utilizing existing right-of-way.

- 2025: Widen Talmage Road Overcrossing as needed to accommodate queued vehicles at newly signalized ramp intersections

Interchange 6: Route 101 at South State Street / Boonville-Ukiah Road (S.R. 253)

Concerns: No significant concerns in 2005, and no significant concerns anticipated in 2025

Improvements: No improvements considered at this time.

Before implementation of the above-recommended improvements, the following points should be considered:

- Proposed new signals that are in close proximity to existing signals must be coordinated to address both State Highway and local street operational concerns.
- All proposed signal design and construction must be reviewed by and coordinated with Caltrans Traffic Operations staff for coordination with State Highway operations in the Ukiah Valley.
- Increasing capacity on local routes parallel to the freeway should be considered as an alternative to freeway improvements. Expanding local street capacity may preclude the need for expensive freeway mainline improvements, such as increasing merging lengths.

Relative to this final point, Mendocino County currently is evaluating an extension of Orchard Avenue northerly from its current Brush Street terminus to Lake Mendocino Drive. Orchard Avenue is a local roadway that is west of and runs parallel to the U.S. Route 101 freeway. This improvement would add to local street capacity and reduce local trips on the freeway.

Prioritization of Near-Term Improvements / Final Recommendations

TJKM prioritized those near-term improvements that can be implemented easily in the near term. These near-term improvements were prioritized based on a cost-benefit analysis using a 10-year horizon. Annualized benefits from the improvements and their annualized costs were used to calculate the benefit to cost (B/C) ratio. Based on this B/C ratio, projects were prioritized. Table ES-1 shows the results of the prioritization of proposed near-term improvements.

TABLE ES-1: PRIORITIZATION OF NEAR-TERM IMPROVEMENTS

<i>Rank</i>	<i>Improvements</i>	<i>Capital Cost</i>	<i>Cumulative Capital Cost</i>	<i>Annualized Capital Cost</i>	<i>Cumulative Annualized Capital Cost</i>	<i>Annualized Benefits</i>	<i>Cumulative Benefits</i>	<i>B/C Ratio</i>
1	E. Perkins St./SB Ramps Signal	\$230,000	\$230,000	\$32,200	\$31,000	\$1,093,421	\$1,093,421	33.96
2	E. Perkins St./NB Ramps Signal	\$230,000	\$460,000	\$32,200	\$63,200	\$87,905	\$1,181,326	2.73
3	Restripe / add lane on Route 101 NB at N. State St. merge	\$160,000	\$620,000	\$22,400	\$85,600	\$48,469	\$1,229,795	2.16
4	N. State St./NB Ramps Signal	\$230,000	\$850,000	\$32,200	\$117,800	\$51,574	\$1,281,369	1.60
5	N. State St./SB Ramps Signal	\$240,000	\$1,090,000	\$33,600	\$151,400	\$32,922	\$1,314,291	0.98
6	Gobbi St./Orchard Ave. Signal	\$230,000	\$1,320,000	\$32,200	\$183,600	\$16,834	\$1,331,125	0.52
7	Gobbi/SB Ramps Signal	\$165,000	\$1,485,000	\$23,100	\$206,700	\$1,518	\$1,332,643	0.07

Notes: 1. B/C Ratio calculation assumptions include a 10-year annualized capital cost, cost of \$41,000 per collision, and \$15/hour cost for lost wages.
 2. Gobbi St./Orchard Ave. Signal has been programmed by the City of Ukiah for FY 05-06

The above table illustrates that the proposed signal at the East Perkins Street / 101 Southbound Ramp intersection will realize the most benefits at the least cost in the near term. The East Perkins Street / 101 Northbound Ramp intersection signal and 101 Northbound / North State merge restriping are the next highest in terms of benefit to cost ratios.

INTRODUCTION AND STUDY BACKGROUND

Introduction

The need for the Route 101 Corridor Interchange Study in Mendocino County resulted from concerns regarding growth and development in the Ukiah Area. The participating agencies within the Mendocino Council of Governments determined that a comprehensive review of all Ukiah area interchanges on Route 101 was in order. The study was created out of those initial concerns.

This final report summarizes the technical analysis performed throughout the study including preliminary designs and cost estimates for the concepts for interchange improvements. Specific designs and estimates are included in this report's Technical Appendix.

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Transportation planning in Mendocino County is the responsibility of the Mendocino Council of Governments (MCOG), which is designated as the Regional Transportation Planning Agency (RTPA). MCOG is a Joint Powers Agency comprised of Mendocino County and the Cities of Fort Bragg, Point Arena, Ukiah and Willits. The MCOG Board of Directors is comprised of two members of the County Board of Supervisors, one representative from each of the four cities, and one Countywide elected official. With the addition of the California Department of Transportation (Caltrans) District 1 Director, the MCOG Board becomes the Policy Advisory Committee. A Technical Advisory Committee (TAC) serves to advise the MCOG on various transportation matters. The TAC is comprised of representatives from the Planning and Public Works/Transportation staff of the joint powers entities, transit, air quality, rail, and Caltrans representatives. MCOG contracts annually with an Executive Director to handle staffing needs.

Mendocino County lies within the northern extension of California's Coastal Ranges. The mountainous nature of the county tends to minimize the ground transportation options particularly in the east-west direction. The U.S. Census Bureau, Census 2000 places Mendocino County's population at 86,265. The bulk of the population in the Mendocino County is concentrated in a few areas of the county. Ukiah, Talmage, and Redwood Valley make up the largest single population concentration in Mendocino County.

U.S. Route 101 is the primary north-south transportation corridor that serves the region's ground transportation needs. It is the most important route in Caltrans District 1, providing access to three of the five county seats, five of the six urban areas, and eight of the fourteen incorporated cities, including the three largest cities in the District (Eureka, Arcata and Ukiah). It connects with three other principal arterials within District 1 - Route 20 near Ukiah, Route 299 north of Arcata, and Route 199 north of Crescent City. Route 101 is functionally classified as a Rural Principal Arterial and is a Federal Aid Primary Route. Route 101 also has significant inter-regional and inter-state importance. It is heavily used for the transportation of inter-city/interstate commerce, and thus is the lifeline of the North Coast. Goods needed by residents of the area are shipped to merchants along the route while logs and lumber products are transported from local harvest areas and mills to markets in the Bay Area and beyond.

Purpose of the Study

Although Route 101 was built as a rural roadway to carry low volumes, recent growth in the region has increased traffic volumes. Apart from the general growth, there are planned developments in the Brush Street area, Lovers Lane area, and the Masonite area. A number of other major developments

east of the Route 101 corridor are expected to occur in the future. Because of the significance of such developments on the operations of Route 101 and on the safety of the traveling public, MCOG decided to undertake a comprehensive study of Route 101 corridor in the greater Ukiah area that would identify needed improvements, their costs, and priorities.

Scope of the Study

The scope of this study has been to complete an evaluation of six freeway interchanges along Route 101 in the Ukiah area. The evaluation included an analysis of present needs, existing and future levels of service (LOS), constraints on improvement options, right of way needs, and planning level improvement costs. Conceptual designs and preliminary cost estimates have been prepared. The study interchanges listed from north to south are:

- Lake Mendocino Drive
- North State Street
- East Perkins Street / Vichy Springs Road
- East Gobbi Street
- Talmage Road (State Route 222)
- South State Street (State Route 253)

Apart from these interchanges, there are northbound slip ramps at City Well Road located about 3500 feet north of the East Perkins Street interchange. Due to the low volumes on these ramps, they are not expected to adversely influence the adjoining interchanges at present. However, they should be monitored for future planning purposes.

INITIAL DATA COLLECTION AND REVIEW

TJKM compiled existing conditions data from several sources for this study, which are outlined below. These data include traffic volumes, number of collisions by location, and aerial photography. In addition, this section details initial trends that were evident from the data, which were used for evaluating existing interchange conditions.

New and Existing Traffic Count Data

The California Department of Transportation (Caltrans) provided TJKM with published 1994 through 2003 average daily traffic (ADT) information for the Route 101 freeway mainline and interchange ramps. The mainline volumes are two-way without directional splits, while the ramps are one-way volumes. These volumes were used as a basis for calculating collision rates for all freeway mainline, ramp, and local intersection locations in the study area.

TJKM collected existing a.m. and p.m. peak hour turning count data at eight study area intersections in October and November 2004. Field Data Services supplemented these data by collecting a.m. and p.m. peak hour turning count data in March 2005 at additional study area locations, which included eleven intersections and one freeway mainline count. The intersection counts were used as the basis for a.m. and p.m. peak hour level of service (LOS) calculations at all study intersections, and the freeway mainline count was used to evaluate the mainline facility's congestion.

Recent Area Studies

TJKM consulted recent traffic studies conducted within the study area to assess their scope, breadth, sufficiency and relevancy to this study. This enabled the development of a needs assessment for further data collection, and it also provided an initial understanding of possible operational constraints at the study interchanges.

The May 2003 *Brush Street Triangle Study* identified specific congestion and safety problems at the segment of East Perkins Street between the signalized intersection at Orchard Avenue and the Route 101 Southbound ramp terminals. The study also found that the Orchard Avenue / East Perkins Street intersection had a collision rate of 0.90 crashes per million vehicle miles (c/mvm), versus the statewide collision rate of 0.58 c/mvm for this type of facility, based on 1999-2001 SWITRS data.

The April 1997 *Airport / Redwood Business Park Traffic Analysis* included evaluation of traffic conditions at the Talmage / 101 Southbound Ramps and Airport Park Boulevard / Talmage Road intersections. In particular, a sight distance problem related to the Talmage Overcrossing and the 101 southbound ramps was identified.

Collision Information

TJKM collected collision history information over the four-year period from 2000 through 2003 within the study area. This information came from two sources – Caltrans and the California Highway Patrol (CHP). Caltrans provided collision information on the Route 101 freeway mainline and interchange ramps from its Traffic Accident Surveillance and Analysis System (TASAS) database. CHP collision data came from its Statewide Integrated Traffic Records System (SWITRS) database. The SWITRS data covers a 1,000-foot radius around all study area intersections and also includes the freeway mainline and ramps. This data was used to calculate collision rates at all study mainline, ramp, and intersection locations.

Other Information Sources

TJKM received aerial photography from two main sources. Mendocino County provided 2004 color aerial photography, which covers the entire study area. The County supplemented this information with 1993 USGS aerial photography. The City of Ukiah also provided aerial photography from 2001 for the study interchanges.

The 2004 aerial photography contains all recent modifications to the study interchanges, including a realignment of the Route 101 southbound off-ramp at North State Street and widening of the North State Street northbound on-ramp at the merge location. All aerial information was used to supplement existing geometric information already collected at many of the study locations.

EXISTING CONDITION ANALYSIS METHODOLOGY AND RESULTS

Initial Screening Criteria

Existing conditions for the six study interchanges were evaluated using three main criteria:

- Collision experience
- Congestion experience
- Geometric adequacy

These criteria provided an initial screening to identify existing concerns at locations in the study area. In terms of collisions, TJKM calculated average collision rates using TASAS and SWITRS collision data and Caltrans average daily traffic (ADT) data. These rates were determined for each type of study facility – on/off ramps, mainline locations, ramp/street intersections, and nearby local street intersections. Calculated collision rates for all study facilities were then compared with published 2001 Caltrans, TASAS and SWITRS average rates for each facility.

Locations with calculated collision rates higher than the 95% upper control limit (UCL) of the published averages were considered significant and subsequently were evaluated in terms of correctable collision types. The 95% UCL criterion is based upon the rate-quality control analysis method detailed in the Institute of Transportation Engineers (ITE) *Traffic Engineering Handbook*. Generally, collision rates above a control limit (in this study, the 95th percentile) indicate that it is unlikely that the collision rates occurred due to chance, or normal variation. The inference is that features of traffic control, street, or intersection geometry or ambient causes are contributing to the elevated collision rate, and thus, countermeasures can be designed to reduce the excess collisions at the location or along the road segment.

In terms of traffic congestion, locations with traffic volume demand at or greater than the capacity of the facility were also flagged as areas of concern for existing conditions.

Geometric criteria included adequacy of interchange spacing, on- and off-ramp layout, lane layout and storage lengths at ramp / street intersections, and the presence and length of freeway acceleration and deceleration lanes. Locations with geometric concerns were identified for further evaluation.

The collision and congestion criteria were assigned costs and then evaluated together to determine a first-order rank of interchanges, in order of priority from most operationally constrained to least under existing conditions. This ranking is provided later in this report. Specific results are reported below.

Collision Analysis Results

TJKM reviewed the four-year collision history in the study area to aid evaluation of interchanges. The locations reviewed included all study freeway ramps, mainline locations, ramp terminal intersections, and local street intersections in close proximity to the interchanges. The analysis method for each facility type was detailed in the Task 3 report. (Working Paper No. 1)

Ramp Collision Analysis

TJKM calculated collision rates for those collisions occurring at the beginning, middle, or end of the study interchange ramps. Table 1 illustrates the results of the ramp collision analysis. The UCL represents the collision rate at the upper limit of the 95th percentile confidence interval. Ramps with calculated rates above this UCL are highlighted and were evaluated further.

TABLE 1: RAMP COLLISION RATES

<i>Ramp Description</i>	<i>Four Year Collision Total</i>	<i>ADT (1,000 vehicles)</i>	<i>MVM</i>	<i>Actual Collision Rate</i>	<i>Statewide Average Rate</i>	<i>Rate Above Statewide</i>	<i>95% UCL</i>
SB ON FR RTE 253	0	1.0	1.46	0.00	0.50	-	1.80
NB OFF TO RTE 253	1	1.0	1.39	0.72	0.60	0.12	2.04
2WAY SEG 253/101 OFF-ON	1	2.4	3.50	0.29	1.20	-	2.30
NB ON FR RTE 253	1	1.5	2.12	0.47	0.65	-	1.79
SB OFF TO RTE 253	2	1.9	2.77	0.72	1.90	-	3.44
101/222 SEP NB OFF	1	1.3	1.83	0.55	0.90	-	2.32
101/222 SEP SB ON	0	1.3	1.90	0.00	0.45	-	1.51
NB ON FR EB RTE 222	0	3.7	5.33	0.00	0.75	-	1.46
NB ON FR WB RTE 222	0	1.8	2.63	0.00	0.40	-	1.23
SEG SB OFF TO UKIAH	3	2.6	3.80	0.79	0.45	0.34	1.15
101SB OFF TO 222E SEG 1	3	1.6	2.34	1.28	0.90	0.38	2.13
101/222 SEP SB OFF	1	4.2	6.13	0.16	0.25	-	0.66
SB ON FR GOBBI ST	0	1.8	2.56	0.00	0.80	-	1.91
NB OFF TO GOBBI ST	0	1.4	1.97	0.00	1.35	-	2.96
SB OFF TO GOBBI ST	3	2.0	2.92	1.03	1.35	-	2.64
NB ON FR GOBBI ST	0	1.9	2.70	0.00	0.80	-	1.88
E PERKINS ST NB OFF RMP	8	2.7	3.87	2.07	1.50	0.57	2.65
E PERKINS ST NB ON LOOP	10	4.2	6.13	1.63	0.85	0.78	1.54
E PERKINS ST SB ON LOOP	1	2.7	3.94	0.25	0.85	-	1.74
E PERKINS ST SB OFF RAMP	10	4.3	6.28	1.59	1.50	0.09	2.38
N STATE ST UC NB OFF	18	4.5	6.50	2.77	1.50	1.27	2.36
N STATE ST SB ON RAMP	7	5.0	7.23	0.97	0.80	0.17	1.41
N STATE ST NB ON RAMP	6	3.9	5.69	1.05	0.85	0.20	1.57
N STATE ST SB OFF RAMP	14	4.2	6.13	2.28	1.15	1.13	1.94
LAKE MEN DR NB OFF RAMP	6	2.4	3.43	1.75	1.15	0.60	2.25
LAKE MEN DR SB ON RAMP	0	2.7	3.87	0.00	0.55	-	1.30
LAKE MEN DR NB ON RAMP	0	1.8	2.67	0.00	0.55	-	1.48
LAKE MEN DR SB OFF RAMP	2	1.8	2.67	0.75	1.15	-	2.41

Notes: ADT = average daily traffic
MVM = million vehicle miles
95% UCL = upper 95% control limit for average collision rate for segment or intersection
NB = Northbound, SB = Southbound
Off =Off-ramp, On = On-Ramp

As highlighted above, there are three locations with actual collision rates higher than the 95% UCL. They are the East Perkins Street northbound on-ramp, North State Street northbound off-ramp, and the North State southbound off-ramp. All other locations fall below the 95% UCL for the corresponding ramp types.

Mainline Collision Analysis

Table 2 shows the results of the mainline collision analysis. Caltrans groups TASAS collision data by mainline segment. This can provide a means of detecting any influence of on/off ramps at interchanges on mainline collisions.

TABLE 2: MAINLINE COLLISION RATES

Mainline Section	Beginning Post Mile	Ending Post Mile	Four Year Collision Total	ADT (1000's)	MVM	Actual Collision Rate	Statewide Average Rate	95% UCL
South State Interchange	21.048	21.589	3	21.54	17.04	0.26	0.49	0.80
Between South State and Talmage	21.59	21.768	0	23.60	6.16	0.00	0.46	0.99
Between South State and Talmage	21.769	21.839	0	23.60	2.45	0.00	0.56	1.55
Between South State and Talmage	23.046	23.205	0	23.60	5.51	0.00	0.56	1.17
Talmage-East Gobbi-East Perkins	23.206	24.903	28	25.11	62.36	0.53	0.61	0.78
North State Interchange	25.77	26.313	24	30.54	24.29	1.16	0.59	0.87
Between North State and Lake Mendocino	26.314	26.563	10	31.01	19.47	0.60	0.49	0.78
Lake Mendocino Interchange	27.029	27.795	13	30.68	34.35	0.45	0.49	0.70

Notes: ADT = average daily traffic in thousands of vehicles
MVM = million vehicle miles
95% UCL = upper 95% confidence interval for average collision rate for segment or intersection

As highlighted in Table 2, there is one mainline freeway segment with higher than the 95% UCL. It is the segment that includes the North State Street interchange. All other locations fall within the 95% UCL for the corresponding mainline facilities. However, attention will also be paid to locations where the actual collision rates are higher than the statewide average rates.

Intersection Collision Analysis

Table 3 illustrates the results of the intersection collision analysis. Intersections were grouped together by interchange in order to evaluate the effect of the interchange ramps on the ramp intersections and nearby local street intersections. In order to calculate the collision rates at each interchange grouping, average daily traffic (ADT) had to be estimated. ADT was calculated by adding total (a.m. plus p.m. peak) volumes through the grouped intersections, then multiplying by a factor of six to approximate ADT. The final calculated rate represents collisions per million entering vehicles per year.

TABLE 3: INTERSECTION COLLISION RATES BY INTERCHANGE

Local Street	Total Collisions	Collisions Per Year	Estimated ADT	Annual Entering Vehicles (million)	Calculated Collision Rate	Statewide Average Collision Rate	95% UCL
East Gobbi	2	0.50	59,352	21.66	0.02	0.43	0.68
North State	14	3.50	69,804	25.48	0.14	0.43	0.66
East Perkins	12	3.00	32,910	12.01	0.25	0.43	0.78
South State	3	0.75	15,252	5.57	0.13	0.43	0.98
Talmage	4	1.00	55,908	20.41	0.05	0.43	0.69

Notes: Units for calculated and statewide average rates are collisions per million entering vehicles per year.
ADT = average daily traffic
95% UCL = upper 95% confidence interval for average collision rate for segment or intersection

In total, there were 35 total reported collisions at the ramp and local intersections during the four-year evaluation period. As the table above shows, collision rates at the interchange groupings fall below 95% UCL for intersections.

Table 4 below shows intersection collisions at specific local intersections in the study area according to SWITRS data records. They illustrate where collisions are concentrated in relation to the interchanges. According to the table, the top three collision locations are North State Street at 101 Northbound Ramps, East Perkins Street at 101 Northbound Ramps, and East Perkins Street at 101 Southbound Ramps.

TABLE 4: COLLISIONS BY INTERSECTION

<i>Intersection</i>	<i>Total Collisions</i>
East Gobbi at 101 NB Off-Ramp	1
East Gobbi at 101 SB Off-Ramp	1
North State at 101 NB Off-Ramp	10
North State at 101 SB On-Ramp	2
North State at 101 SB Off-Ramp	2
East Perkins at 101 NB Ramps	8
East Perkins at 101 SB Ramps	4
South State at 101 NB Ramps	2
South State at 101 SB Off-Ramp	1
Talmage at Babcock Lane / Hastings Road (East of US 101)	3
Talmage at Airport Park Boulevard (West of US 101)	1

Ramp and Mainline Operations Analysis – Existing Conditions

Table 5 illustrates existing volume-to-capacity (v/c) ratios at all study interchange ramp locations. Table 6 shows v/c ratios at key mainline freeway locations.

TABLE 5: FREEWAY RAMP VOLUME – CAPACITY RATIOS (EXISTING CONDITIONS)

Interchange	Ramp	Capacity	A.M. Peak Hour		P.M. Peak Hour	
			Volume	V/C	Volume	V/C
Lake Mendocino	NB OFF	900	147	0.16	260	0.29
	NB ON	900	80	0.09	147	0.16
	SB OFF	900	234	0.26	113	0.13
	SB ON	900	230	0.26	276	0.31
North State	NB OFF	900	412	0.46	360	0.40
	NB ON	750	188	0.25	383	0.51
	SB OFF	900	391	0.43	318	0.35
	SB ON	900	247	0.27	409	0.45
Perkins / Vichy Springs	NB OFF	900	370	0.41	212	0.24
	NB ON	750	275	0.37	436	0.58
	SB OFF	900	621	0.69	350	0.39
	SB ON	750	180	0.24	168	0.22
Gobbi	NB OFF	750	137	0.18	107	0.14
	NB ON	900	219	0.24	181	0.20
	SB OFF	750	246	0.33	276	0.37
	SB ON	900	165	0.18	163	0.18
Talmage	NB OFF	900	104	0.12	149	0.17
	NB ON (from WB)	900	122	0.14	187	0.21
	NB ON (from EB)	750	278	0.37	356	0.47
	SB OFF (to WB)	900	388	0.43	509	0.57
	SB OFF (to EB)	750	86	0.11	206	0.27
	SB ON	900	109	0.12	116	0.13
South State (SR 253)	NB OFF	900	97	0.11	66	0.07
	NB ON	750	131	0.17	162	0.22
	SB OFF	900	139	0.15	123	0.14
	SB ON	900	62	0.07	60	0.07

Notes: v/c = volume-to-capacity ratio
 NB = Northbound, SB = Southbound, WB = Westbound, EB = Eastbound
 ON = On-Ramp, OFF = Off-Ramp

Based on assumed capacities of 750 vehicles per hour for loop ramps and 900 vehicles per hour for all other ramp types, all study ramps currently operate with v/c ratios of 0.69 or less. Perkins Street southbound off-ramp has the highest v/c ratio and therefore needs attention.

Off-ramp operational analysis is also included as part of the study intersection operational analysis in the next section.

TABLE 6: FREEWAY MAINLINE VOLUME – CAPACITY RATIOS (EXISTING CONDITIONS)

Mainline Location	A.M. Peak Hour						P.M. Peak Hour					
	Northbound		Southbound		Two-Way		Northbound		Southbound		Two-Way	
	Vol	V/C	Vol	V/C	Vol	V/C	Vol	V/C	Vol	V/C	Vol	V/C
N of Lake Mendocino	563	0.14	1,724	0.43	2,287	0.29	1,445	0.36	1,098	0.27	2,543	0.32
N of North State	630	0.16	1,720	0.43	2,350	0.29	1,558	0.39	1,261	0.32	2,819	0.35
N of East Perkins / Vichy Springs	854	0.21	1,576	0.39	2,430	0.30	1,535	0.38	1,352	0.34	2,887	0.36
N of East Gobbi	949	0.24	1,135	0.28	2,084	0.26	1,311	0.33	1,170	0.29	2,481	0.31
East Gobbi Over-crossing	730	0.18	889	0.22	1,619	0.20	1,130	0.28	894	0.22	2,024	0.25
N of Talmage	867	0.22	1,054	0.26	1,921	0.24	1,237	0.31	1,057	0.26	2,294	0.29
Talmage Over-crossing	745	0.19	666	0.17	1,411	0.18	1,050	0.26	548	0.14	1,598	0.20
N of South State (SR 253)	571	0.14	689	0.17	1,260	0.16	843	0.21	458	0.11	1,301	0.16
S of South State (SR 253)	537	0.13	612	0.15	1,149	0.14	747	0.19	395	0.10	1,142	0.14

Notes: Assumes capacity of 4,000 vehicles per hour per direction
 Vol = volume
 v/c = volume-to-capacity ratio

A typical capacity for a mainline freeway lane is 2,000 vehicles per hour per lane. Based on this standard, all mainline locations have demand below this threshold, as they currently operate with v/c ratios no greater than 0.43. Such a ratio generally is considered acceptable.

Intersection Operations Analysis – Existing Conditions

TJKM evaluated level of service (LOS) at the 20 study local street intersections. Table 7 shows the results of the Synchro analysis performed using Highway Capacity Manual (HCM) 2000 methodology. Working Paper 1 contains a description of this methodology and also the LOS calculation sheets for intersection existing conditions.

TABLE 7: INTERSECTION LEVEL OF SERVICE – EXISTING CONDITIONS

Interchange	ID	Intersection	Control	A.M. Peak		P.M. Peak	
				Delay	LOS	Delay	LOS
Lake Mendocino	1	101 SB Ramps	One-Way STOP	14.0 (21.4)	B (C)	9.3 (17.2)	A (C)
	2	101 NB Ramps	One-Way STOP	2.3 (12.7)	A (B)	3.6 (12.0)	A (B)
	3	North State Street	Signal	10.5	B	14.9	B
North State	4	101 NB Ramps	One-Way STOP	4.4 (21.4)	A (C)	4.6 (37.8)	A (E)
	5	101 SB Off-Ramp	One-Way STOP	4.0 (23.0)	A (C)	2.5 (28.6)	A (D)
	6	101 SB On-Ramp	None	0.6 (1.0) ¹	A (A)	1.5 (14.0)	A (B)
	7	Kuki Lane	Signal	15	B	19.9	B
East Perkins	8	Orchard Avenue	Signal	35.7	D	70.5	E
	9	101 SB Ramps	Two-Way STOP	(39.5) ²	(E)	7.4 (> 50)	A (F)
	10	101 NB Ramps	One-Way STOP	15.1 (44.8)	B (E)	3.8 (17.6)	A (C)
East Gobbi	11	Orchard Avenue	All-Way STOP	26.7	D	16.2	C
	12	101 SB Ramps	One-Way STOP	10.4 (41.6)	B (E)	8.6 (25.5)	A (D)
	13	101 NB Ramps	One-Way STOP	5.2 (15.4)	A (C)	3.9 (14.5)	A (B)
	14	Club House Drive	One-Way STOP	0.8 (9.2)	A (A)	1.8 (10.0)	A (A)
Talmage	15	Airport Park Boulevard	Signal	32.8	C	47.1	D
	16	101 SB Ramps	One-Way STOP	5.0 (14.5)	A (B)	8.3 (21.3)	A (C)
	17	101 NB Ramps	One-Way STOP	1.4 (14.3)	A (B)	2.1 (19.4)	A (C)
South State (SR 253)	18	101 NB Ramps	One-Way STOP	3.0 (12.1)	A (B)	2.2 (11.3)	A (B)
	19	101 SB Off-Ramp / Stipp Lane	Two-Way STOP	4.0 (12.3)	A (B)	3.8 (11.2)	A (B)
	20	101 SB On-Ramp / Boonville-Ukiah Road	None	8.7 (12.3) ³	A (B)	8.7 (12.3) ³	A (B)

Notes: ¹ Minor delay is for southbound North State Street left turn.

² Minor delay for southbound off-ramp left turn. Delay on northbound Pomeroy Street (opposite SB ramp terminals) is very high (LOS F), thus overall delay cannot be calculated in the a.m. peak hour.

³ Minor delay for southbound South State Street through movement onto 101 SB On-Ramp

Delay = Average control delay in seconds per vehicle, LOS = Level of Service. Figures in parentheses indicate delay and LOS for the minor left turn. Figures outside parentheses indicate values for the overall intersection.

NB = Northbound, SB = Southbound

A typical service level threshold for intersections is LOS D. Based on this common standard, many study intersections and minor movements are operating acceptably under existing conditions. The exceptions are:

- North State Street / 101 NB Off-Ramp - minor westbound left turn off freeway, p.m. peak only (LOS E)
- East Perkins Street / Orchard Avenue - overall LOS E (p.m. peak only)
- East Perkins Street / 101 SB Ramps / Pomeroy Street - minor southbound left turn off freeway, with LOS E / F (a.m./p.m. peak)
- East Perkins Street / 101 NB Ramps - minor northbound left turn off freeway, a.m. peak only (LOS E)
- East Gobbi Street at 101 SB Ramps - minor northbound left turn off freeway, a.m. peak only (LOS E)

Based on the above LOS analysis, it was also observed that queuing is affecting existing operations at the East Perkins Street / Orchard Avenue and East Perkins Street / 101 Southbound Ramp intersections. As noted earlier, the segment of Perkins Street between Orchard Avenue and the 101 southbound ramps experiences significant congestion during peak hours. The LOS analysis revealed that:

- During the a.m. peak, the westbound through movement at East Perkins Street / Orchard Avenue experiences a maximum queue of about 17 vehicles, with the westbound left turn having a maximum queue of 10 vehicles. The through queue is enough to block the 101 Southbound Ramp intersection. Also, the left turn queue may spill over into the through lane.
- During the p.m. peak, the westbound through movement at Perkins Street / Orchard Avenue experiences a maximum queue of about 27 vehicles, with the westbound left turn having a maximum queue of 5 vehicles. The through queue is enough to block the 101 Southbound Ramp intersection.
- At East Perkins Street / 101 Southbound ramps, the southbound left turn off the freeway experiences a maximum queue of 18 vehicles during the a.m. peak and about two vehicles during the p.m. peak. The v/c being 0.69 for this off-ramp, it deserves attention.
- Field observations have indicated the North State Street off-ramp queue spills over to the freeway during AM peak hours.

Merging and Weaving Analysis – Existing Conditions

TJKM evaluated the merging operations for all six study interchanges using the merging and weaving methodologies contained in HCS software. HCS software utilizes the HCM 2000 Operations methodology. Working Paper 1 contains the LOS calculation sheets for existing merging conditions.

Table 8 illustrates the results of the interchange merging analysis. All merging locations currently operate at LOS C or better during both the a.m. and p.m. peak periods.

TABLE 8: INTERCHANGE MERGING OPERATIONS – EXISTING CONDITIONS

<i>Ramp Junction</i>	<i>Level of Service</i>	
	<i>A.M.</i>	<i>P.M.</i>
Northbound Diagonal on-ramp at Lake Mendocino Drive	B	B
Southbound Diagonal on-ramp at Lake Mendocino Drive	C	B
Northbound Loop on-ramp at North State Street	B	B
Southbound Loop on-ramp at North State Street	B	B
Northbound Loop on-ramp at East Perkins Street	B	B
Southbound Loop on-ramp at East Perkins Street	B	B
Northbound Diagonal on-ramp at East Gobbi Street	B	B
Southbound Diagonal on-ramp at East Gobbi Street	B	B
Northbound Loop on-ramp at Talmage Road	B	B
Southbound Loop on-ramp at Talmage Road	B	B
Northbound Diagonal on-ramp at Talmage Road	B	B
Southbound Diagonal on-ramp at Talmage Road	B	A
Northbound Loop on-ramp at South State Street	B	B
Southbound Loop on-ramp at South State Street	A	A

Weaving operational analysis was also performed only for the northbound freeway section between East Gobbi Street and East Perkins Street. For both a.m. and p.m. periods, LOS was found to be A under existing conditions. However, the weaving length available is only about 1,000 feet and demands attention. No weaving problems are expected for other study area segments as the weaving lengths were found to be sufficient.

Study Interchange Classification

The Caltrans Highway Design Manual designates interchange types according to different ramp configurations. The configurations and their descriptions are contained in Working Paper 1. The designations that most closely match the six study interchanges are as follows:

- Lake Mendocino – Type L-1 (diamond interchange)
- North State – Types L-1 and L-8 (diamond SB side, partial cloverleaf NB side)
- East Perkins – Type L-8 (partial cloverleaf)
- East Gobbi – Type L-8 (partial cloverleaf)
- Talmage – Type L-9 (partial cloverleaf)
- South State – Type L-11 (trumpet interchange)

Geometric Adequacy

TJKM compared existing on-ramp taper lengths with current Caltrans on-ramp design standards. The Caltrans standard is 180 meters (590 feet). The approximate merging distances for each study on-ramp are listed below:

- Lake Mendocino to 101 Northbound – 430 feet
- Lake Mendocino to 101 Southbound – 500 feet
- North State to 101 Northbound – 420 feet
- North State to 101 Southbound – 580 feet
- East Perkins to 101 Northbound – 560 feet

- East Perkins to 101 Southbound – 800 feet
- East Gobbi to 101 Northbound – 445 feet
- East Gobbi to 101 Southbound – 460 feet
- Westbound Talmage to 101 Northbound – 400 feet
- Eastbound Talmage to 101 Northbound – 400 feet
- Talmage to 101 Southbound – 535 feet
- South State to 101 Northbound – 250 feet
- South State to 101 Southbound – 600 feet

As shown in the list above, the majority of on-ramps have taper lengths that are below current design standards. This fact is not surprising since there have been no significant design modifications to the study interchanges since their original construction. The East Perkins to 101 Southbound and South State to 101 southbound on-ramps are the only ramps that currently exceed the standard. The North State to 101 Southbound, East Perkins to 101 Northbound, and Talmage to 101 southbound on-ramps fall short but are very close to the standard.

Interchange Spacing Adequacy

Interchange spacings greater than two miles (10,560 feet) are typical for rural freeways. The study interchange spacings were reviewed to determine their adequacy. TJKM measured approximate spacings by measuring the centerlines of each interchange using aerial photography. The approximate spacings for the interchanges are listed below:

- Lake Mendocino to North State: 7,485 feet (1.4 mile)
- North State to East Perkins: 8,750 feet (1.65 mile)
- East Perkins to East Gobbi: 2,460 feet (0.47 mile)
- East Gobbi to Talmage: 3,265 feet (0.62 mile)
- Talmage to South State: 9,800 feet (1.86 mile)

All interchanges are spaced less than two miles apart, and therefore do not have adequate spacing under the above criteria. In addition, there currently are no auxiliary lanes for weaving and merging traffic. In particular, the East Perkins, East Gobbi, and Talmage interchanges are spaced less than one mile apart from one another. Based on these spacings, these interchanges may have weaving and merging problems, and this is evaluated in subsequent sections of this report.

A likely challenge to adding an auxiliary lane between the East Perkins Street and East Gobbi Street interchanges will be the pedestrian overcrossing between these locations. Currently, there are bridge piers located very close to the pavement edges on either side of the freeway.

Initial Interchange Evaluation

TJKM evaluated each interchange according to costs associated with congestion (based on volume to capacity ratios) and collision rates. Table 9 illustrates the interchanges and annualized delay and collision costs in 2005.

Congestion costs were determined by first identifying turning movements of concern at study intersections that have control delays exceeding those associated with LOS C (25 seconds per vehicle for unsignalized intersections and 35 seconds per vehicle for signalized intersections). Costs were calculated for each turning movement of concern and then aggregated by study interchange. It should be noted that since there are currently no ramps or mainline segments with v/c ratios over 1, these facility types were not included in the congestion cost calculation.

Collision costs were calculated by using excess collision rates, which are the actual rates minus the statewide average rates. Also, these costs assume Caltrans' average cost of \$40,400 per collision.

TABLE 9: INITIAL INTERCHANGE EVALUATION AND TOTAL COSTS

<i>Rank</i>	<i>Interchange</i>	<i>Congestion Cost</i>	<i>Collision Cost</i>	<i>Total Cost</i>
1	North State	\$ 20,113	\$ 293,170	\$ 313,283
2	East Perkins	\$ 120,268	\$ 48,292	\$ 168,560
3	Talmage (SR 222)	\$ 39,099	-	\$ 39,099
4	East Gobbi	\$ 2,643	-	\$ 2,643
5	Lake Mendocino	\$ 783	-	\$ 783
6	South State (SR 253)	-	-	-

Notes: Annualized congestion costs assume 250 commute days per year and \$15 per hour of excess delay. Annualized collision costs assume Caltrans' value of \$40,400 per collision.

As Table 9 shows, the North State Street and East Perkins Street interchanges are by far the top two interchanges with the highest cost of excess delay and/or collisions. For the North State Street interchange, the added cost is primarily due to collisions. For the East Perkins Street interchange, the additional cost is primarily due to congestion. Congestion costs are the only costs associated with three other interchanges, while the South State Street (SR 253) interchange has no associated costs.

FUTURE 2025 CONDITION ANALYSIS AND RESULTS

For the year 2005 condition, six study interchanges were evaluated based on three main criteria: 1) collision experience, 2) congestion experience, and 3) geometric adequacy. For year 2025, only congestion is evaluated, since collision and geometric criteria cannot be meaningfully evaluated in the future. Facilities with traffic volume demand equal to or greater than their capacities are given a more detailed examination later in this report, when specific interchange improvements are discussed.

Year 2025 Traffic Forecast

Future 2025 a.m. and p.m. peak hour traffic volumes were developed using the existing peak hour volumes presented in the study's Working Paper No. 1 and a calculated growth factor. The growth factor was developed using the City of Ukiah travel demand model's ADT volumes as well as the historic volumes. This factor was estimated to be 1.5, which represents approximately 50% traffic growth over the next twenty years. Therefore, the existing volumes were multiplied by 1.5 to estimate future 2025 baseline volumes.

There is additional development not currently represented in the model's 2025 forecast ADT volumes. This additional commercial and residential development is located in the vicinity of the North State Street interchange. TJKM compared the list of developments anticipated by the City of Ukiah and Mendocino County with a similar list detailing future developments accounted for in the model. TJKM then singled out those future developments (i.e. near North State Street interchange) not included in the model's 2025 baseline traffic scenario. Trip generation, distribution, and assignment were subsequently performed for these additional future developments. Table 10 shows the anticipated size of the additional development and its trip generation.

TABLE 10: TRIP GENERATION FOR ADDITIONAL FUTURE DEVELOPMENT

<i>Land Use</i>	<i>ITE Code</i>	<i>Size</i>	<i>Daily Trips</i>	<i>A.M. Peak Hour</i>			<i>P.M. Peak Hour</i>		
				<i>In Trips</i>	<i>Out Trips</i>	<i>Total</i>	<i>In Trips</i>	<i>Out Trips</i>	<i>Total</i>
Commercial (Shopping Center)	820	680 ksf	29,199	427	273	700	1,224	1,326	2,550
Single Family Detached Homes	210	1,110 d.u.	10,623	208	624	832	706	415	1,121
Residential Condos / Townhomes	230	93 d.u.	545	7	34	41	32	16	48
Total			40,367	642	931	1,573	1,962	1,757	3,719

Notes: ksf = 1,000 square feet gross floor area
 d.u. = occupied dwelling units
 Source: ITE Trip Generation Manual, 7th Edition (2003)

For the additional developments shown in Table 10, trip distribution was estimated based on discussions with City of Ukiah and MCOG staff and TJKM's knowledge of the study area. Specifically, the distribution is based on existing directional distributions of traffic on North State Street and the Route 101 corridor. As a result, project trip distributions were determined to be the following:

- 50% to Route 101 Freeway – North
- 30% to Route 101 Freeway – South
- 10% to North State Street – North
- 10% to North State Street – South

The resulting trips were assigned to the North Street study intersections and ramps, as well as the Route 101 mainline. This additional future traffic is added to the 2025 baseline traffic (existing traffic X 1.5 growth factor).

Ramp and Mainline Operations Analysis – Future Conditions

Just as was done in the existing conditions report, TJKM evaluated level of service (LOS) for the study freeway ramps and mainline locations under future 2025 conditions. Table 11 illustrates future volume-to-capacity (v/c) ratios at all ramp locations. Table 12 shows future v/c ratios at key mainline freeway locations.

TABLE 11: FREEWAY RAMP VOLUME – CAPACITY RATIOS (FUTURE CONDITIONS)

Interchange	Ramp	Capacity	A.M. Peak Hour		P.M. Peak Hour	
			Volume	V/C	Volume	V/C
Lake Mendocino	NB OFF	900	221	0.25	390	0.43
	NB ON	900	120	0.13	221	0.25
	SB OFF	900	351	0.39	170	0.19
	SB ON	900	345	0.38	414	0.46
North State	NB OFF	900	808	0.90	1,130	1.26
	NB ON	750	747	1.00	1,454	1.94
	SB OFF	900	907	1.01	1,453	1.61
	SB ON	900	651	0.72	1,144	1.27
Perkins / Vichy Springs	NB OFF	900	555	0.62	318	0.35
	NB ON	750	413	0.55	654	0.87
	SB OFF	900	932	1.04	525	0.58
	SB ON	750	270	0.36	252	0.34
Gobbi	NB OFF	750	206	0.27	161	0.21
	NB ON	900	329	0.37	272	0.30
	SB OFF	750	369	0.49	414	0.55
	SB ON	900	248	0.28	245	0.27
Talmage	NB OFF	900	156	0.17	224	0.25
	NB ON (from WB)	900	183	0.20	281	0.31
	NB ON (from EB)	750	417	0.56	534	0.71
	SB OFF (to WB)	900	582	0.65	764	0.85
	SB OFF (to EB)	750	129	0.17	309	0.41
	SB ON	900	164	0.18	174	0.19
South State (SR 253)	NB OFF	900	146	0.16	99	0.11
	NB ON	750	197	0.26	243	0.32
	SB OFF	900	209	0.23	185	0.21
	SB ON	900	93	0.10	90	0.10

*Notes: v/c = volume-to-capacity ratio
 NB = Northbound, SB = Southbound, WB = Westbound, EB = Eastbound
 ON = On-Ramp, OFF = Off-Ramp*

Based on assumed capacities of 750 vehicles per hour for loop ramps and 900 vehicles per hour for all other ramp types, there are five study ramps that are projected to operate at v/c ratios greater than one. During the a.m. peak, the southbound off-ramp at North State Street and southbound off-ramp at East Perkins Street have v/c ratios of 1.01 and 1.04, respectively. During the p.m. peak, all four North State Street interchange ramps have v/c ratios ranging from 1.26-1.94. All other study ramps are projected to operate at v/c ratios less than one.

TABLE 12: FREEWAY MAINLINE VOLUME – CAPACITY RATIOS (FUTURE CONDITIONS)

Mainline Location	A.M. Peak Hour						P.M. Peak Hour					
	Northbound		Southbound		Two-Way		Northbound		Southbound		Two-Way	
	Vol	V/C	Vol	V/C	Vol	V/C	Vol	V/C	Vol	V/C	Vol	V/C
N of Lake Mendocino	1,310	0.33	2,906	0.73	4,216	0.53	3,048	0.76	2,624	0.66	5,672	0.71
N of North State	1,411	0.35	2,900	0.73	4,311	0.54	3,217	0.80	2,868	0.72	6,085	0.76
N of Perkins / Vichy Springs	1,472	0.37	2,644	0.66	4,116	0.51	2,893	0.72	2,559	0.64	5,452	0.68
N of Gobbi	1,614	0.40	1,982	0.50	3,596	0.45	2,557	0.64	2,286	0.57	4,843	0.61
Gobbi Over-crossing	1,285	0.32	1,613	0.40	2,898	0.36	2,285	0.57	1,872	0.47	4,157	0.52
N of Talmage	1,491	0.37	1,861	0.47	3,352	0.42	2,446	0.61	2,117	0.53	4,563	0.57
Talmage Over-crossing	1,308	0.33	1,279	0.32	2,587	0.32	2,165	0.54	1,353	0.34	3,518	0.44
N of South State (SR 253)	1,047	0.26	1,314	0.33	2,361	0.30	1,855	0.46	1,218	0.30	3,073	0.38
S of South State (SR 253)	996	0.25	1,198	0.30	2,194	0.27	1,711	0.43	1,123	0.28	2,834	0.35

Notes: Assumes capacity of 4,000 vehicles per hour per mainline direction
 Vol = volume
 v/c = volume-to-capacity ratio

Intersection Operations Analysis – Future Conditions

TJKM also evaluated future 2025 LOS at the 20 study local street intersections. Table 13 shows the results of the intersection analysis performed using the Highway Capacity Manual (HCM) 2000 methodology contained in Synchro software. Working Paper 2 contains a description of this methodology and also the LOS calculation sheets for future intersection conditions.

TABLE 13: INTERSECTION LEVEL OF SERVICE – FUTURE CONDITIONS

Interchange	ID	Intersection	Control	A.M. Peak		P.M. Peak	
				Delay	LOS	Delay	LOS
Lake Mendocino	1	101 SB Ramps	One-Way STOP	78.6 (>80)	F (F)	17.1 (45.2)	C (E)
	2	101 NB Ramps	One-Way STOP	2.8 (16.8)	A (C)	4.3 (15.2)	A (C)
	3	North State Street	Signal	13.5	B	55.5	E
North State	4	101 NB Ramps	One-Way STOP	> 50 (>50)	F (F)	> 50 (>50)	F (F)
	5	101 SB Off-Ramp	One-Way STOP	> 50 (>50)	F (F)	> 50 (>50)	F (F)
	6	101 SB On-Ramp ¹	None	1.9 (29.2)	A (D)	> 50 (>50)	F (F)
	7	Kuki Lane	Signal	> 80	F	> 80	F
East Perkins	8	Orchard Avenue	Signal	> 80	F	> 80	F
	9	101 SB Ramps	Two-Way STOP	> 80 (> 80)	F	> 80 (> 80)	F
	10	101 NB Ramps	One-Way STOP	> 50 (>50)	F (F)	15.4 (>50)	C (F)
East Gobbi	11	Orchard Avenue	All-Way STOP	> 50	F	> 50	F
	12	101 SB Ramps	One-Way STOP	> 50 (>50)	F (F)	> 50 (>50)	F (F)
	13	101 NB Ramps	One-Way STOP	6.0 (24.8)	A (C)	4.6 (21.8)	A (C)
	14	Club House Drive	One-Way STOP	0.8 (9.8)	A (A)	2.0 (11.2)	A (B)
Talmage	15	Airport Park Boulevard	Signal	72.6	E	> 80	F
	16	101 SB Ramps	One-Way STOP	13.3 (42.6)	B (E)	> 50 (>50)	F (F)
	17	101 NB Ramps	One-Way STOP	2.5 (25.3)	A (D)	9.3 (> 50)	A (F)
South State (SR 253)	18	101 NB Ramps	One-Way STOP	3.3 (15.4)	A (C)	2.5 (13.6)	A (B)
	19	101 SB Off-Ramp / Stipp Lane	Two-Way STOP	5.1 (16.8)	A (C)	4.4 (13.8)	A (B)
	20	101 SB On-Ramp / Boonville-Ukiah Road ²	None	9.4 (15.6)	A (C)	9.5 (15.7)	A (C)

Notes: ¹ Minor delay is for southbound North State Street left turn.

² Minor delay for southbound South State Street through movement onto 101 SB On-Ramp

Delay = Average control delay in seconds per vehicle, LOS = Level of Service. Figures in parentheses indicate delay and LOS for the minor left turn. Figures outside parentheses indicate values for the overall intersection.

NB = Northbound, SB = Southbound

A typical intersection service level threshold is LOS D. Based on this common standard, the following study intersections are anticipated to operate unacceptably under future 2025 conditions:

- Lake Mendocino Drive at 101 Southbound Ramps (a.m. and p.m. peak)
- Lake Mendocino Drive at North State Street (p.m. peak only)
- North State Street at 101 Northbound Ramps (a.m. and p.m. peak)
- North State Street at 101 Southbound Off-Ramp (a.m. and p.m. peak)
- North State Street at 101 Southbound Off-Ramp (p.m. peak only)
- North State Street at Kuki Lane (a.m. and p.m. peak)
- East Perkins Street at Orchard Avenue (a.m. and p.m. peak)
- East Perkins Street at 101 Southbound Ramps (a.m. and p.m. peak)
- East Perkins Street at 101 Northbound Ramps (a.m. and p.m. peak)
- East Gobbi Street at Orchard Avenue (a.m. and p.m. peak)
- East Gobbi Street at 101 Southbound Ramps (a.m. and p.m. peak)
- Talmage Road at Airport Park Boulevard (a.m. and p.m. peak)
- Talmage Road at 101 Southbound Ramps (p.m. peak only)
- Talmage Road at 101 Northbound Ramps (p.m. peak only)

Merging and Weaving Analysis – Future Conditions

TJKM evaluated future 2025 merging operations for all six study interchanges using the merging and weaving methodologies contained in HCS software. HCS software utilizes the HCM 2000 Operations methodology.

TABLE 14: INTERCHANGE MERGING OPERATIONS – FUTURE CONDITIONS

<i>Ramp Junction</i>	<i>Level of Service</i>	
	<i>A.M.</i>	<i>P.M.</i>
Northbound Diagonal on-ramp at Lake Mendocino Drive	B	D
Southbound Diagonal on-ramp at Lake Mendocino Drive	D	D
Northbound Loop on-ramp at North State Street	B	D
Southbound Diagonal on-ramp at North State Street	D	C
Northbound Loop on-ramp at East Perkins Street	B	D
Southbound Loop on-ramp at East Perkins Street	C	C
Northbound Diagonal on-ramp at East Gobbi Street	B	C
Southbound Diagonal on-ramp at East Gobbi Street	C	C
Northbound Loop on-ramp at Talmage Road	B	C
Northbound Diagonal on-ramp at Talmage Road	B	C
Southbound Diagonal on-ramp at Talmage Road	B	B
Northbound Loop on-ramp at South State Street	B	C
Southbound Diagonal on-ramp at South State Street	B	B

Table 14 above illustrates the results of the future 2025 interchange merging analysis. Using a typical service level threshold of LOS D, no on-ramps are anticipated to exceed acceptable LOS during either or both peak periods. All merging locations are anticipated to remain operating at LOS D or better during both the a.m. and p.m. peak periods.

Weaving operational analysis for future conditions was also performed only for the northbound freeway section between East Gobbi Street and East Perkins Street. This weaving section is expected to operate at LOS B during the a.m. peak and LOS C during the p.m. peak. No weaving problems are expected under future conditions for all other study area segments as current weaving lengths are sufficient. Working Paper 2 contains the LOS calculation sheets for future merging conditions.

PRELIMINARY IMPROVEMENTS

Analysis Methodology

The operational concerns identified during the analysis were examined in more detail. These concerns include high collision rates for on- and off-ramps, ramp junctions with cross streets, and mainline locations; and traffic volume demand at or greater than mainline, ramp or intersection capacity. Other criteria include the geometric adequacy of on- and off-ramps, warrants for signals at ramp and ramp-related intersections, interchange spacing, and observations from field checks of the interchanges.

In the following section, TJKM has expanded the analysis of the interchanges of concern. Locations identified with high collision rates were evaluated in more detail by creating collision diagrams and tabulating collisions by specific features at each interchange. The purpose was to determine how collision patterns may suggest design or operational problems at a given mainline, ramp, or intersection location.

In terms of congestion, ramps or intersections with the potential for excessive queuing and queue spillover onto mainline or past upstream intersections were identified. Ramps and ramp-related intersections were also evaluated for adequacy of capacity. Signal warrants were conducted under existing and future conditions to determine possible short-term and long-term needs for signals. Freeway merging and weaving areas were also identified for possible improvements based on previous level of service (LOS) analysis.

Specific Concerns and Preliminary Improvements

In this section, specific problems and operational concerns are identified for each interchange under both 2005 and 2025 traffic conditions. These problems and concerns are based on all study analyses performed, including collision, congestion, and geometric analysis and field checks. Based on the identified concerns, graphics are provided to illustrate the details of the recommended improvements at each interchange.

All improvements described herein are preliminary and were evaluated further in terms of conceptual engineering and cost estimation where appropriate.

Figures showing operational concerns and preliminary improvements for all six interchanges follow this report section. Figures 1a and 1b depict existing operational concerns. Figures 2a and 2b show preliminary improvements for existing conditions. Figures 3a and 3b depict future operational concerns. Figures 4a and 4b show preliminary improvements for future conditions.

Interchange 1: Route 101 at Lake Mendocino Drive

Concerns

- Inadequate merge capacity for northbound and southbound on-ramps (2025)
- Inadequate overall intersection capacity at 101 Southbound Ramp / Lake Mendocino Drive and North State Street / Lake Mendocino Drive (West Leg) intersections (2025)

Improvements

- 2025: Install signal at 101 Southbound Ramp / Lake Mendocino Drive intersection
- 2025: Increase acceleration lengths for both northbound and southbound on-ramps

Interchange 2: Route 101 at North State Street

Concerns

- Excess collision rate on both northbound and southbound off-ramps (2005)
- Excess collision rate on northbound on-ramp (2005)
- Excess collision rate at northbound ramp intersection (2005)
- Excess collision rate on freeway mainline in vicinity of ramp merging areas - northbound in particular (2005)
- Congestion at northbound and southbound ramp intersections (2005 and 2025)
- Congestion on all on- and off-ramps (2025), including queuing on both off-ramps leading to near capacity or over capacity (queue spillover to mainline) in 2025 p.m. peak hour
- Congestion and queue spillover for southbound North State left turn onto 101 Southbound on-ramp without signal (2025)
- Congestion at nearby Kuki Lane intersection south of interchange (2025)
- Inadequate merge length and tight/substandard radius for northbound on-ramp (2005)
- Inadequate merge capacity for northbound and southbound on-ramps (2025)

Improvements

- 2005: Install signals at northbound and southbound ramp intersections, and coordinate with existing nearby North State Street / Kuki Lane signal
- 2005: Provide three lanes on northbound Route 101 mainline structure to accommodate extended acceleration lane by re-striping the bridge area and adding pavement to the north and south of the bridge.

TJKM also examined a potential alternative to increase the radius of the 101 Northbound loop on-ramp, which would lengthen the on-ramp and thereby increase the merge taper length. This alternative would have the following constraints:

- Potential land takings – there is a large building located only 145 feet away from the pavement edge of the 101 Northbound off-ramp to North State. Therefore, the possibility exists that the building may need to be taken, since increasing the loop on-ramp radius would also move the adjacent off-ramp closer to this building. This could significantly increase the overall cost of improvements at the North State interchange.
- The on-ramp taper length, currently 420 feet, would still not likely meet Caltrans standards even with loop ramp lengthening. Current Caltrans standards are 180 meters (590 feet) of on-ramp taper length. Because of the nearby building constraint, increasing taper length to a minimum of 590 feet is difficult.
- 2025: Realign southbound on- and off-ramps to meet at a single signalized intersection
- 2025: Increase acceleration length for southbound on-ramp merge onto southbound mainline
- There has been a recent proposal to create a driveway access for a private property at a midpoint of the 101 Northbound ramps. The access would be located only approximately 400 feet from the ramp terminals at North State Street. This access is not recommended for two reasons: Caltrans standards require at least 600 feet between ramp terminals and any mid-ramp access, and Caltrans only permits mid-ramp access for public streets, not private roadways.

Interchange 3: Route 101 at East Perkins Street

Concerns

- Excess collision rates at northbound and southbound ramp intersections (2005)
- Excess collision rates on northbound on-ramp (2005)
- Congestion at northbound and southbound ramp intersections and nearby East Perkins Street / Orchard Avenue intersection (2005 and 2025)
- Queuing from westbound vehicles at East Perkins Street / Orchard Avenue intersection causing blockages of nearby southbound ramp intersection (2005 and 2025). Queue extends past intersection to East Perkins Overcrossing in 2025 p.m. peak
- Queuing of southbound off-ramp vehicles (2005 and 2005), with queue spillover to mainline in 2025, without signal
- Queuing of northbound off-ramp vehicles with queue spillover to mainline in 2025 a.m. peak, without signal
- Inadequate merge length for northbound on-ramp
- Merging congestion for northbound on-ramp (2025)
- Poor sight distance at both northbound and southbound ramp intersections due to sharp vertical curvature of the East Perkins Street Overcrossing (2005)
- Tight / substandard radii for both northbound and southbound loop on-ramps. Right turns onto these on-ramps have poor channelization (2005)

Improvements

- 2005: Add signal to southbound ramp intersection and coordinate with optimized East Perkins / Orchard signal. Add signal to northbound ramp intersection and coordinate with nearby signals. There is also potential to add a roundabout to the northbound ramp intersection, as was outlined in the May 2003 *Brush Street Triangle Study*.
- 2025 (preliminary alternative): A preliminary alternative would be to close the southbound ramps at East Perkins and relocate them to Orchard Avenue at Brush Street, north of the current ramp location. A signal at the Brush Street / Orchard Avenue intersection would be recommended along with the ramp relocation. There is also potential to add a roundabout to the Brush Street / Orchard Avenue intersection, as was outlined in the May 2003 *Brush Street Triangle Study*. It should be noted that while congestion at the East Perkins interchange would decrease, it is likely that congestion would increase at the East Perkins Street / Orchard Avenue intersection due to the redistribution of ramp trips to / from the Brush Street / Orchard Avenue intersection.

However, some modifications to the East Perkins Street / Orchard Avenue intersection by adding lanes could alleviate congestion at this intersection. Preliminary analysis indicates that adding a westbound through-left lane and a southbound right turn lane would improve the level of service to acceptable levels. Following are some of the pros and cons of this improvement:

- Pros: Removal of southbound Perkins ramps would improve traffic operations for East Perkins Street and its nearby intersection with Orchard Avenue. It would also eliminate the current queuing concern on the southbound Perkins ramps, the need for a signal at those ramps, and potentially the need to widen the East Perkins Overcrossing. Furthermore, the improvement could potentially reduce collisions.
- Cons: Potential new ramps at the Orchard Avenue / Brush Street intersection provide new operation and collision concerns, including those related to a new non-standard interchange configuration. Caltrans does not support splitting interchanges in this way. Also, the new configuration would add turning movement traffic to the East

Perkins Street / Orchard Avenue intersection, which already has operational concerns.

It also should be noted that the proposed preliminary configuration for new Brush Street ramps at 101 Southbound would be a partial diamond, or half of a standard diamond interchange. To address driver orientation for a newly split interchange, TJKM recommends that “trailblazing” signage supplement the new configuration, so that clear routes are indicated to the relocated ramps and the existing northbound Perkins ramps.

- 2025: Increase acceleration length for northbound on-ramp
- 2025: Add auxiliary lane connecting northbound off-ramp with upstream northbound on-ramp from East Gobbi Street interchange to improve merging and weaving operations
- 2025: Widen East Perkins Street Overcrossing as needed to accommodate queued vehicles at newly signalized ramp intersections

Interchange 4: Route 101 at East Gobbi Street

Concerns

- Congestion at East Gobbi Street / Orchard Avenue and East Gobbi Street / 101 Southbound Ramp intersections (2005 and 2025)
- Southbound off-ramp near capacity in 2025
- Poor sight distance at both northbound and southbound ramp intersections due to sharp vertical curvature of the East Gobbi Street Overcrossing (2005)

Improvements

- 2005: Add signals at East Gobbi Street / Orchard Avenue and East Gobbi Street / 101 Southbound Ramp intersections and coordinate their operations. The City of Ukiah has programmed signal installation at the East Gobbi Street / Orchard Avenue intersection for its 2005-06 Fiscal Year. There is also potential to add a roundabout to the East Gobbi Street / Orchard Avenue intersection, as was outlined in the May 2003 *Brush Street Triangle Study*.
- 2025: Add auxiliary lane connecting northbound on-ramp with downstream northbound off-ramp at East Perkins Street interchange to improve merging and weaving operations
- 2025: Widen East Gobbi Street Overcrossing as needed to accommodate queued vehicles at newly signalized southbound ramp intersection

Interchange 5: Route 101 at Talmage Road (S.R. 222)

Concerns

- Congestion at nearby Talmage Road / Airport Park Boulevard intersection (2005 and 2025)
 - 2005 p.m. westbound left turn queue spillover – could block southbound ramp intersection
 - 2025 westbound queues could block southbound ramp intersection
- Congestion at northbound and southbound ramp intersections (2025)
- Southbound off-ramp to westbound Talmage Road – queue spillover to mainline in 2025 p.m. peak
- Excess collision rate at nearby Talmage Road / Airport Park Boulevard intersection
- Poor sight distance at both northbound and southbound ramp intersections due to sharp vertical curvature of the Talmage Road Overcrossing

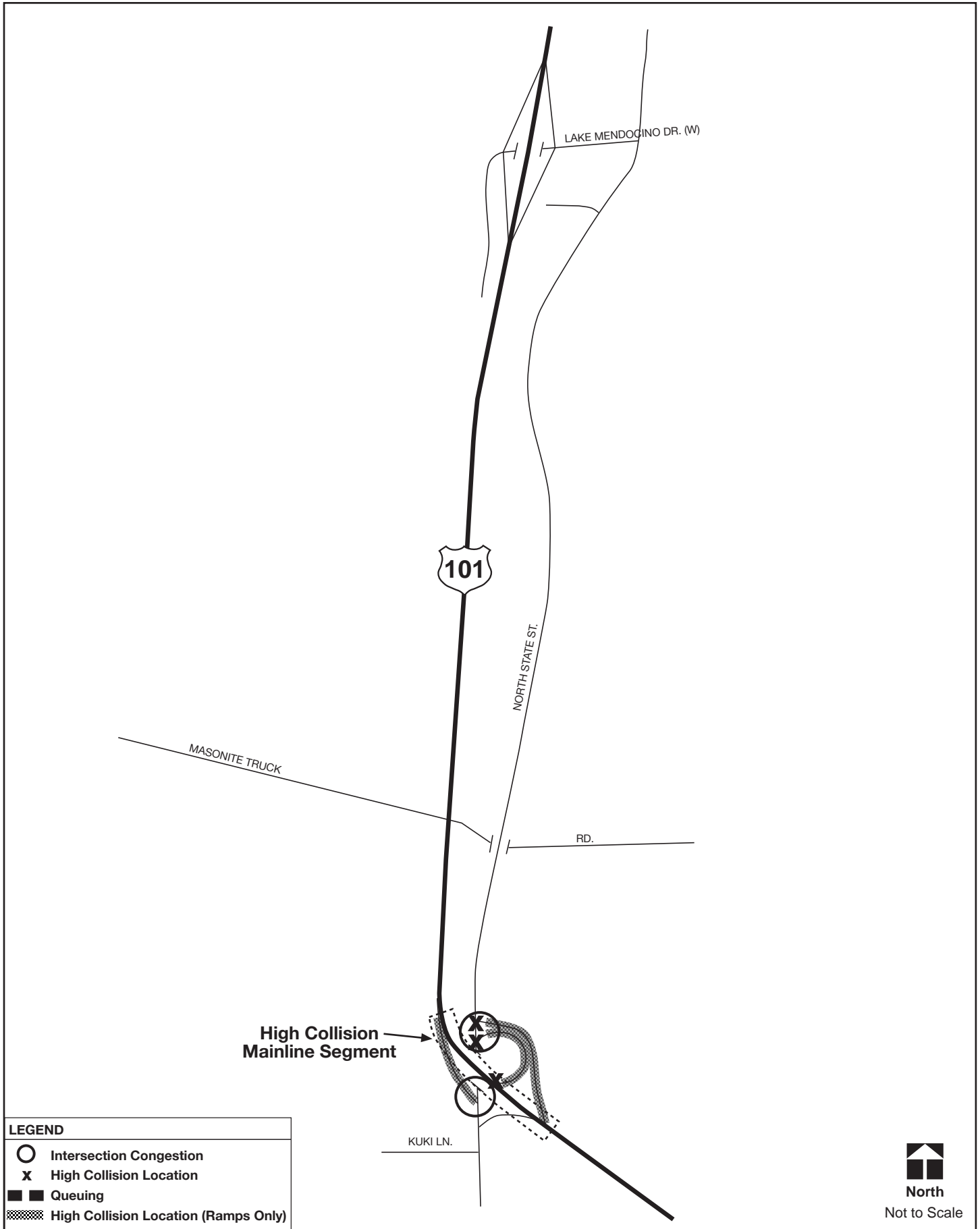
Improvements

- 2025: Add signals to northbound and southbound ramp intersections. This would very likely require modification of the entire interchange to a tight diamond (Type L-1) configuration. Coordinate new signals with optimized existing signal at Talmage Road / Airport Park Boulevard intersection. A second option would be to modify the existing interchange to a partial cloverleaf design utilizing existing right-of-way.
- 2025: Widen Talmage Road Overcrossing as needed to accommodate queued vehicles at newly signalized ramp intersections

Interchange 6: Route 101 at South State Street / Boonville-Ukiah Road (S.R. 253)

Concerns: No significant concerns in 2005, and no significant concerns anticipated in 2025

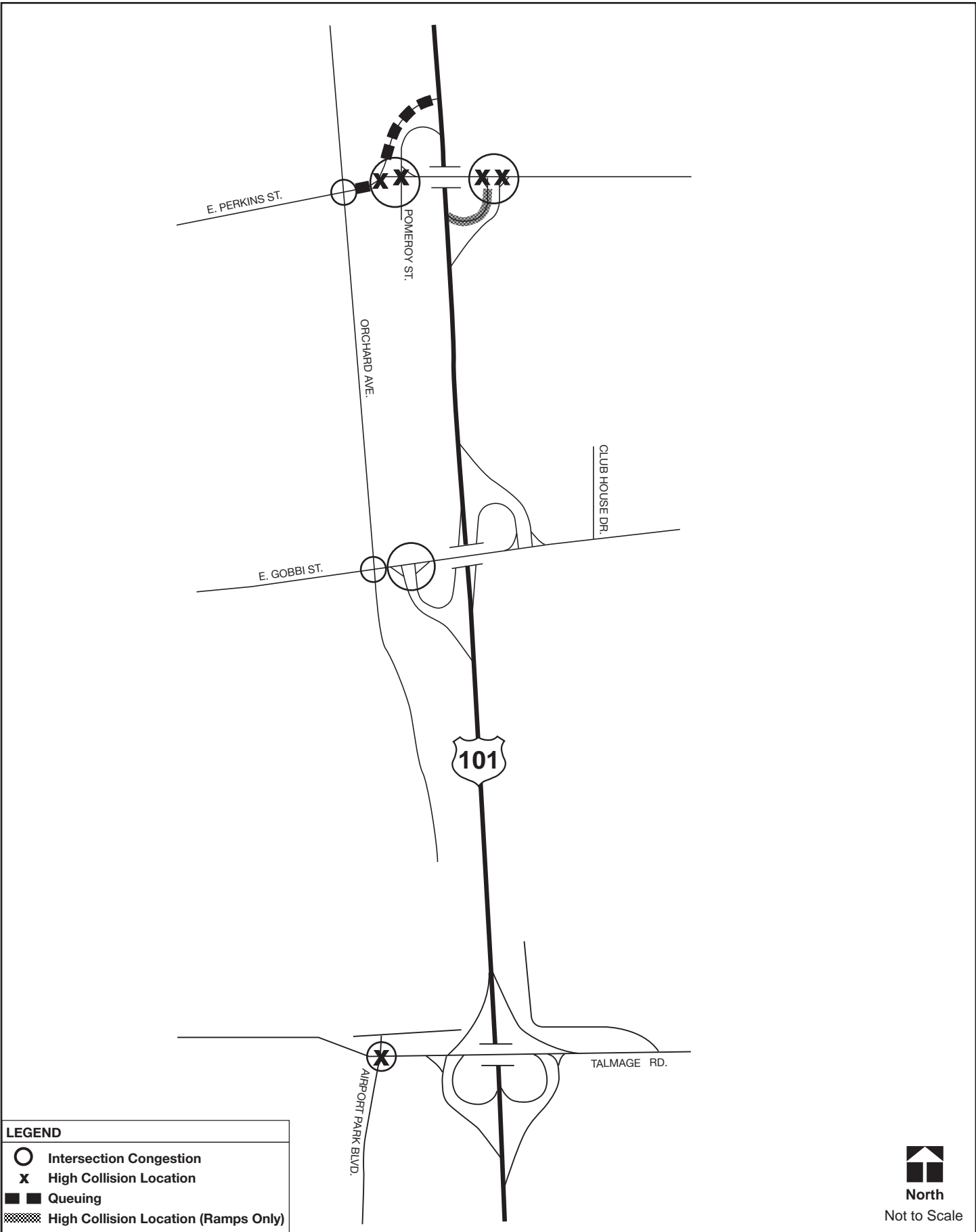
Improvements: No improvements considered at this time.



Mendocino County
 Route 101 Corridor Interchange Study (Ukiah Area)
Existing Operational Concerns (2005)

Figure
1a

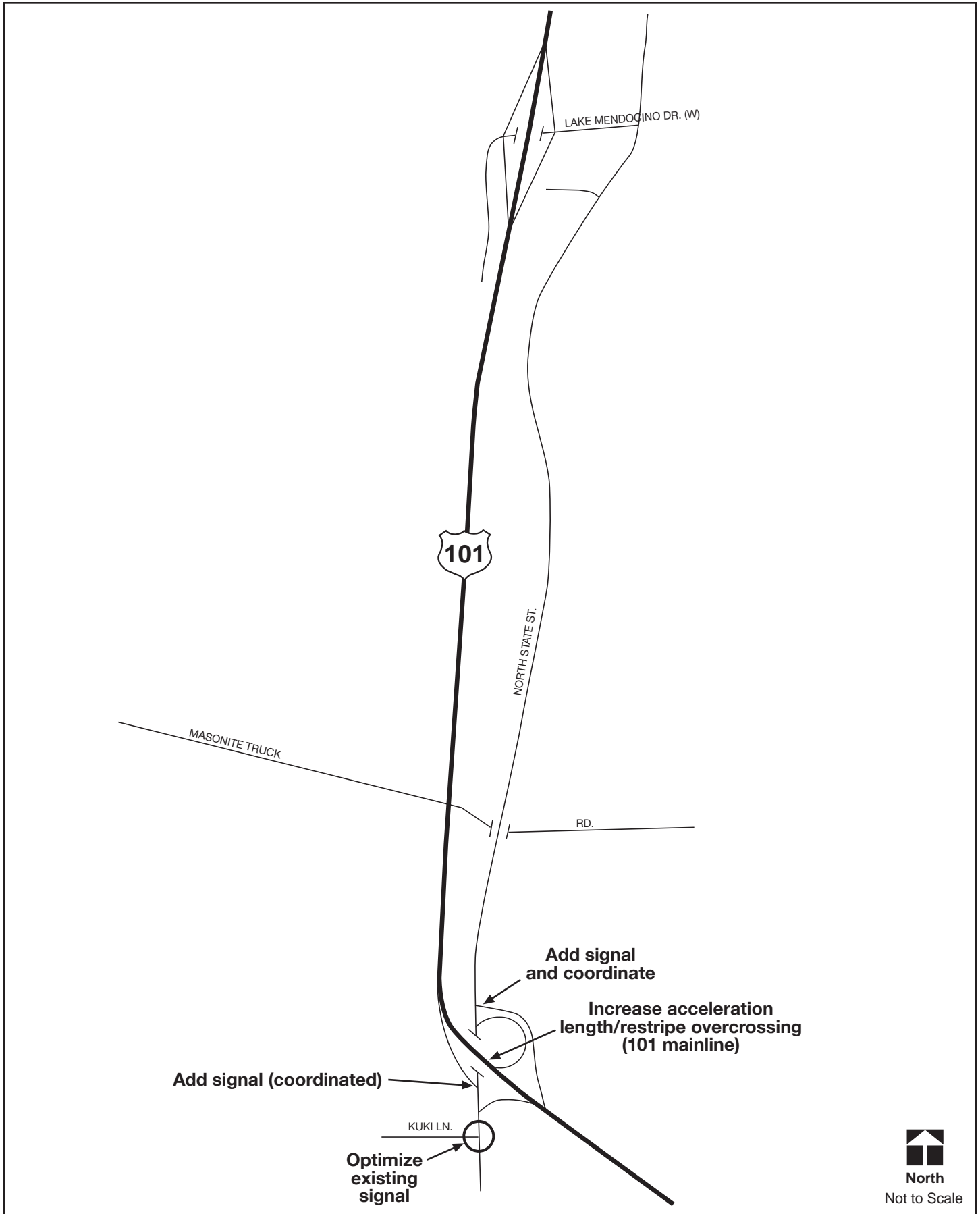




Mendocino County
 Route 101 Corridor Interchange Study (Ukiah Area)
Existing Operational Concerns (2005)

Figure
1b

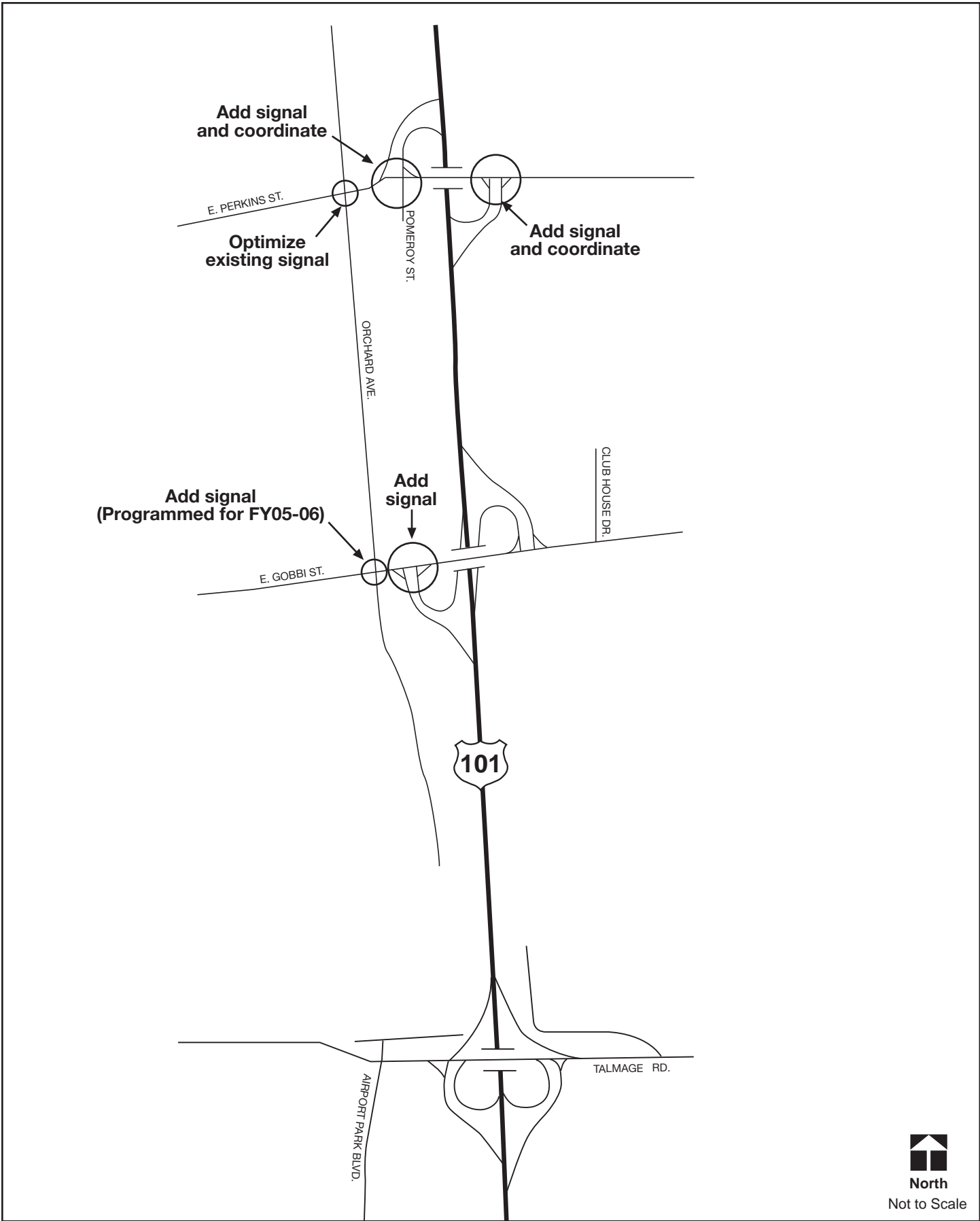




Mendocino County
 Route 101 Corridor Interchange Study (Ukiah Area)
**Proposed Near-Term Improvements—
 Existing Conditions (2005)**

Figure
2a

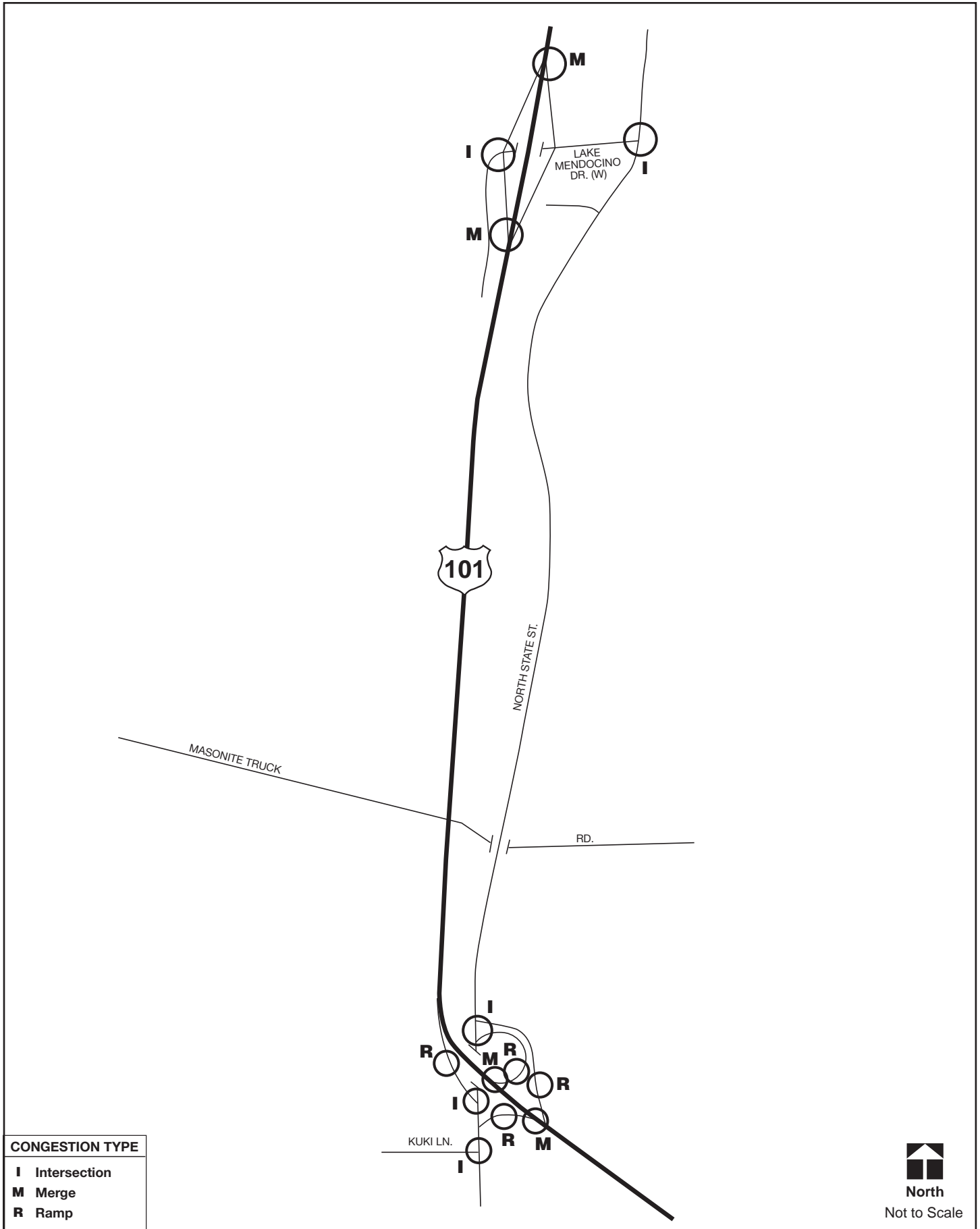




Mendocino County
 Route 101 Corridor Interchange Study (Ukiah Area)
**Proposed Near-Term Improvements—
 Existing Conditions (2005)**

Figure
2b

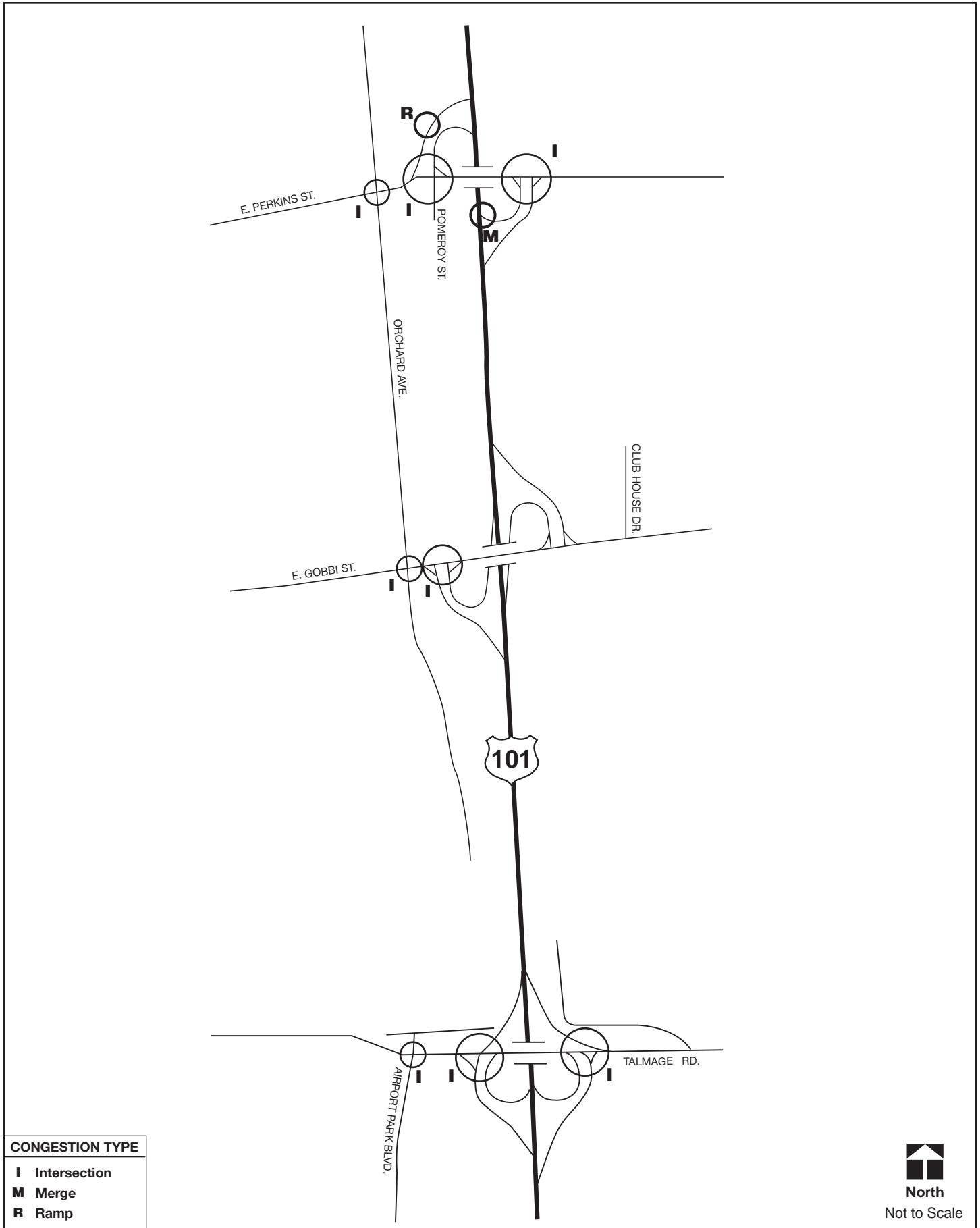




Mendocino County
 Route 101 Corridor Interchange Study (Ukiah Area)
Future Operational Concerns (2025)

Figure
3a

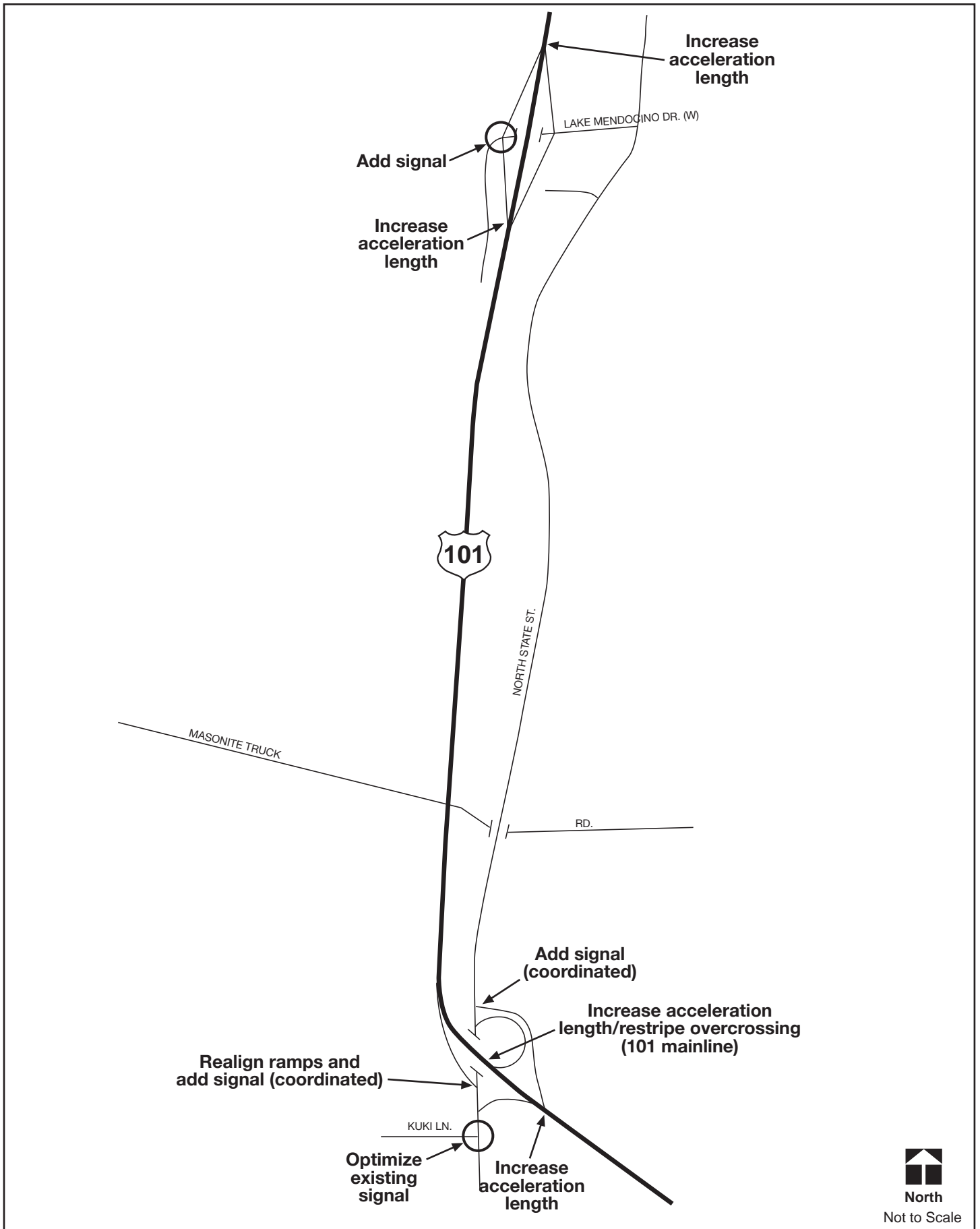




Mendocino County
 Route 101 Corridor Interchange Study (Ukiah Area)
Future Operational Concerns (2025)

Figure
3b

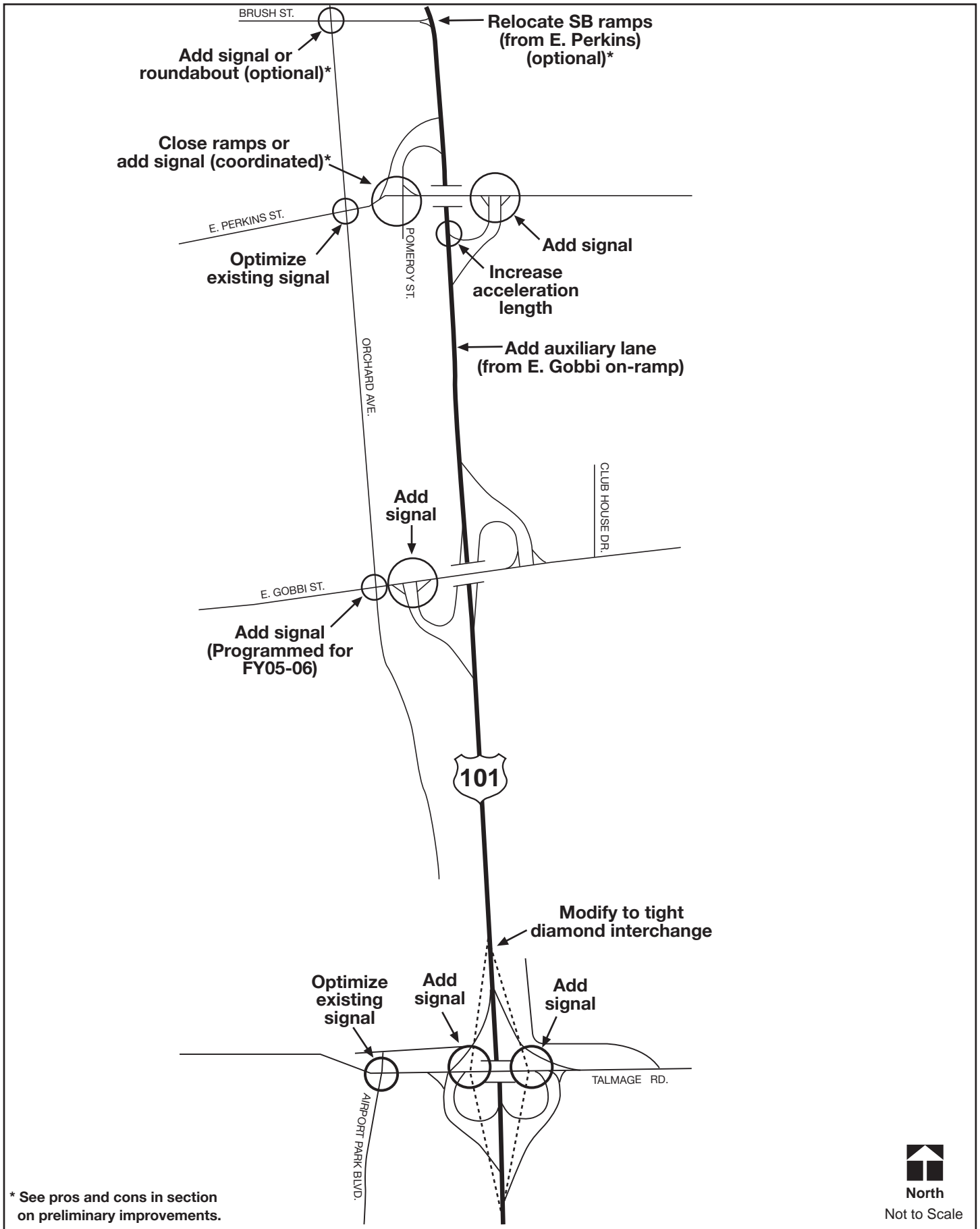




Mendocino County
 Route 101 Corridor Interchange Study (Ukiah Area)
Proposed Future Improvements through 2025

Figure
4a





* See pros and cons in section on preliminary improvements.

North
Not to Scale

Mendocino County
Route 101 Corridor Interchange Study (Ukiah Area)
Proposed Future Improvements through 2025

Figure
4b



Before implementation of the above-recommended improvements, the following points should be considered:

- Proposed new signals that are in close proximity to existing signals must be coordinated to address both State Highway and local street operational concerns. In particular, since some ramp and local street intersections in the study area are spaced less than 500 feet apart, signal coordination will be essential. Proper coordination will help to avoid ramp queuing onto the freeway mainline and also local street queuing.
- All proposed signal design and construction must be reviewed by and coordinated with Caltrans Traffic Operations staff for coordination with State Highway operations in the Ukiah Valley.
- Increasing capacity on local routes parallel to the freeway should be considered as an alternative to freeway improvements. Expanding local street capacity may preclude the need for expensive freeway mainline improvements, such as increasing merging lengths. Furthermore, increasing local street capacity has the potential to divert local trips from the freeway, which is meant to function as a regional facility. This has the potential to improve freeway service levels.

Relative to this final point, Mendocino County currently is evaluating an extension of Orchard Avenue northerly from its current Brush Street terminus to Lake Mendocino Drive. Orchard Avenue is a local roadway that is west of and runs parallel to the U.S. Route 101 freeway. This improvement would add to local street capacity and reduce local trips on the freeway.

**PRIORITIZATION OF NEAR-TERM IMPROVEMENTS / FINAL
RECOMMENDATIONS**

Near-Term Improvement Prioritization

This section represents the final step in the Route 101 Corridor Interchange Study in Mendocino County. TJKM prioritized those near-term improvements that can be implemented easily in the near term. These near-term improvements were prioritized based on a cost-benefit analysis using a 10-year horizon. Annualized benefits from the improvements and their annualized costs were used to calculate the benefit to cost (B/C) ratio. Based on this B/C ratio, projects were prioritized. Table 15 shows the results of the prioritization of proposed near-term improvements.

TABLE 15: PRIORITIZATION OF NEAR – TERM IMPROVEMENTS

<i>Rank</i>	<i>Improvements</i>	<i>Capital Cost</i>	<i>Cumulative Capital Cost</i>	<i>Annualized Capital Cost</i>	<i>Cumulative Annualized Capital Cost</i>	<i>Annualized Benefits</i>	<i>Cumulative Benefits</i>	<i>B/C Ratio</i>
1	E. Perkins St./SB Ramps Signal	\$230,000	\$230,000	\$32,200	\$31,000	\$1,093,421	\$1,093,421	33.96
2	E. Perkins St./NB Ramps Signal	\$230,000	\$460,000	\$32,200	\$63,200	\$87,905	\$1,181,326	2.73
3	Restripe / add lane on Route 101 NB at N. State St. merge	\$160,000	\$620,000	\$22,400	\$85,600	\$48,469	\$1,229,795	2.16
4	N. State St./NB Ramps Signal	\$230,000	\$850,000	\$32,200	\$117,800	\$51,574	\$1,281,369	1.60
5	N. State St./SB Ramps Signal	\$240,000	\$1,090,000	\$33,600	\$151,400	\$32,922	\$1,314,291	0.98
6	Gobbi St./Orchard Ave. Signal	\$230,000	\$1,320,000	\$32,200	\$183,600	\$16,834	\$1,331,125	0.52
7	Gobbi/SB Ramps Signal	\$165,000	\$1,485,000	\$23,100	\$206,700	\$1,518	\$1,332,643	0.07

Notes: 1. B/C Ratio calculation assumptions include a 10-year annualized capital cost, cost of \$41,000 per collision, and \$15/hour cost for lost wages.
2. Gobbi St./Orchard Ave. Signal has been programmed by the City of Ukiah for FY 05-06

The above table illustrates that the proposed signal at the East Perkins Street / 101 Southbound Ramp intersection will realize the most benefits at the least cost in the near term. The East Perkins Street / 101 Northbound Ramp intersection signal and 101 Northbound / North State merge restriping are the next highest in terms of benefit to cost ratios.

The final section outlines preliminary estimates of cost for all proposed improvements, both in the near term and in 2025.

Preliminary Designs and Cost Estimates of Preliminary Improvements

HDR conducted design and cost estimation for all conceptual improvements, both in the near-term and the future. Table 16 provides a cost breakdown for each improvement based on estimated signal, roadway, and bridge structure costs. The technical appendix contains preliminary design layouts for all proposed improvements.

TABLE 16: PRELIMINARY COST ESTIMATES – NEAR-TERM IMPROVEMENTS

Interchange	Year	Construction Cost (2005 Dollars)			Right-Of-Way Take (ft ²)				Total ROW (Acres)	Comments
		Roadway ¹	Structure	Total	NE Quad	NW Quad	SE Quad	SW Quad		
1 - Lake Mendocino Drive	2025	\$ 1,796,000	\$ -	\$ 1,796,000	0	0	0	0	0.00	None
2 - North State Street	2005	\$ 630,000	\$ -	\$ 630,000	0	0	0	0	0.00	See note 2.
	2025	\$ 3,949,000	\$ -	\$ 3,949,000	0	107,900	0	0	2.48	See note 3.
3 - East Perkins Street	2005	\$ 460,000	\$ -	\$ 460,000	0	0	0	0	0.00	None
	2025	\$ 2,010,000	\$ 2,093,000	\$ 4,103,000	0	250	0	3,630	0.09	See note 4.
4 - East Gobbi Street	2005	\$ 395,000	\$ -	\$ 395,000	0	0	0	0	0.00	None
	2025	\$ 2,117,000	\$ 628,000	\$ 2,745,000	0	0	0	6,550	0.15	See note 5.
5 - Talmage (Option 1)	2025	\$ 8,259,000	\$ 2,317,000	\$ 10,576,000	130,000	53,200	26,500	25,200	5.39	See note 6.
(Option 2)	2025	\$ 4,024,000	\$ 1,112,000	\$ 5,136,000	0	0	0	0	0.00	See note 7.

Notes: Quad = quadrant

¹ Roadway cost includes all roadway construction and signal installation costs.

² Two signals (NB and SB Ramps) and restriping of NB On-Ramp acceleration lane.

³ Existing and proposed SB ramp intersection and local road intersection separation does not meet minimum design standards. Considerable ROW taking from junk yard with possible impact to business.

⁴ East Gobbi to East Perkins NB auxiliary lane construction and removal / reconstruction of pedestrian over-crossing included.

⁵ Existing and proposed NB ramp intersection and local road intersection separation do not meet minimum design standards.

⁶ ROW acquisition required in SE and NW quadrant with conflict to commercial and residential structures. Complex staging and ramp closure required.

⁷ Existing and proposed ramp intersections and local road intersection separations do not meet minimum design standard.

STUDY PARTICIPANTS

TJKM Transportation Consultants

Gary E. Kruger, P.E.
Arul K. Edwin
Andrew R. Kluter
Geri Foley
Evi Pagh

HDR

James Labanowski, P.E.
Matt Korve, P.E.

Data Collection

Field Data Services, Inc.

Mendocino Council of Governments (MCOG)

Phillip J. Dow, P.E.
Loretta Ellard

California Department of Transportation (Caltrans)

Dave Carstensen

Mendocino County

Bob Parker, P.E.

City of Ukiah

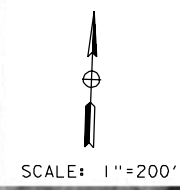
Richard J. Seanor, P.E.

Mendocino County Air Quality Management District (AQMD)

Chris Brown, AICP

TECHNICAL APPENDIX: HDR PRELIMINARY DESIGN DRAWINGS

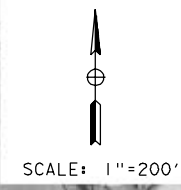
PRELIMINARY SPECIFIC IMPROVEMENTS
TASK 5
RT 101 CORRIDOR INTERCHANGE STUDY
IN MENDOCINO COUNTY (UKIAH AREA)
MAY 2005
INTERCHANGE 01 FOR 2025:
RT 101 AND LAKE MENDOCINO DRIVE



HDR 2365 IRON POINT ROAD
SUITE 300
FOLSOM, CA 95630



PRELIMINARY SPECIFIC IMPROVEMENTS
TASK 5
RT 101 CORRIDOR INTERCHANGE STUDY
IN MENDOCINO COUNTY (UKIAH AREA)
MAY 2005
INTERCHANGE 02 FOR 2025:
RT 101 AND N STATE STREET



HDR 2365 IRON POINT ROAD
SUITE 300
FOLSOM, CA 95630



PRELIMINARY SPECIFIC IMPROVEMENTS
TASK 5
RT 101 CORRIDOR INTERCHANGE STUDY
IN MENDOCINO COUNTY (UKIAH AREA)
MAY 2005
INTERCHANGE 03 FOR 2005:
RT 101 AND E PERKINS STREET



SCALE: 1"=300'

HDR 2365 IRON POINT ROAD
SUITE 300
FOLSOM, CA 95630



PRELIMINARY SPECIFIC IMPROVEMENTS
TASK 5
RT 101 CORRIDOR INTERCHANGE STUDY
IN MENDOCINO COUNTY (UKIAH AREA)
MAY 2005
INTERCHANGE 03 FOR 2015:
RT 101 AND E PERKINS STREET



SCALE: 1"=300'

HDR 2365 IRON POINT ROAD
SUITE 300
FOLSOM, CA 95630



PRELIMINARY SPECIFIC IMPROVEMENTS
TASK 5
RT 101 CORRIDOR INTERCHANGE STUDY
IN MENDOCINO COUNTY (UKIAH AREA)
MAY 2005
INTERCHANGE 03 FOR 2025:
RT 101 AND E PERKINS STREET



SCALE: 1" = 300'

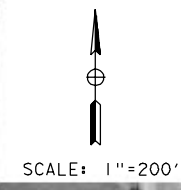
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FOLSOM, CA 95630



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PRELIMINARY SPECIFIC IMPROVEMENTS
TASK 5
RT 101 CORRIDOR INTERCHANGE STUDY
IN MENDOCINO COUNTY (UKIAH AREA)
MAY 2005
INTERCHANGE 04 FOR 2005
RT 101 AND E GOBBI STREET

HDR 2365 IRON POINT ROAD
SUITE 300
FOLSOM, CA 95630



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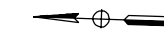
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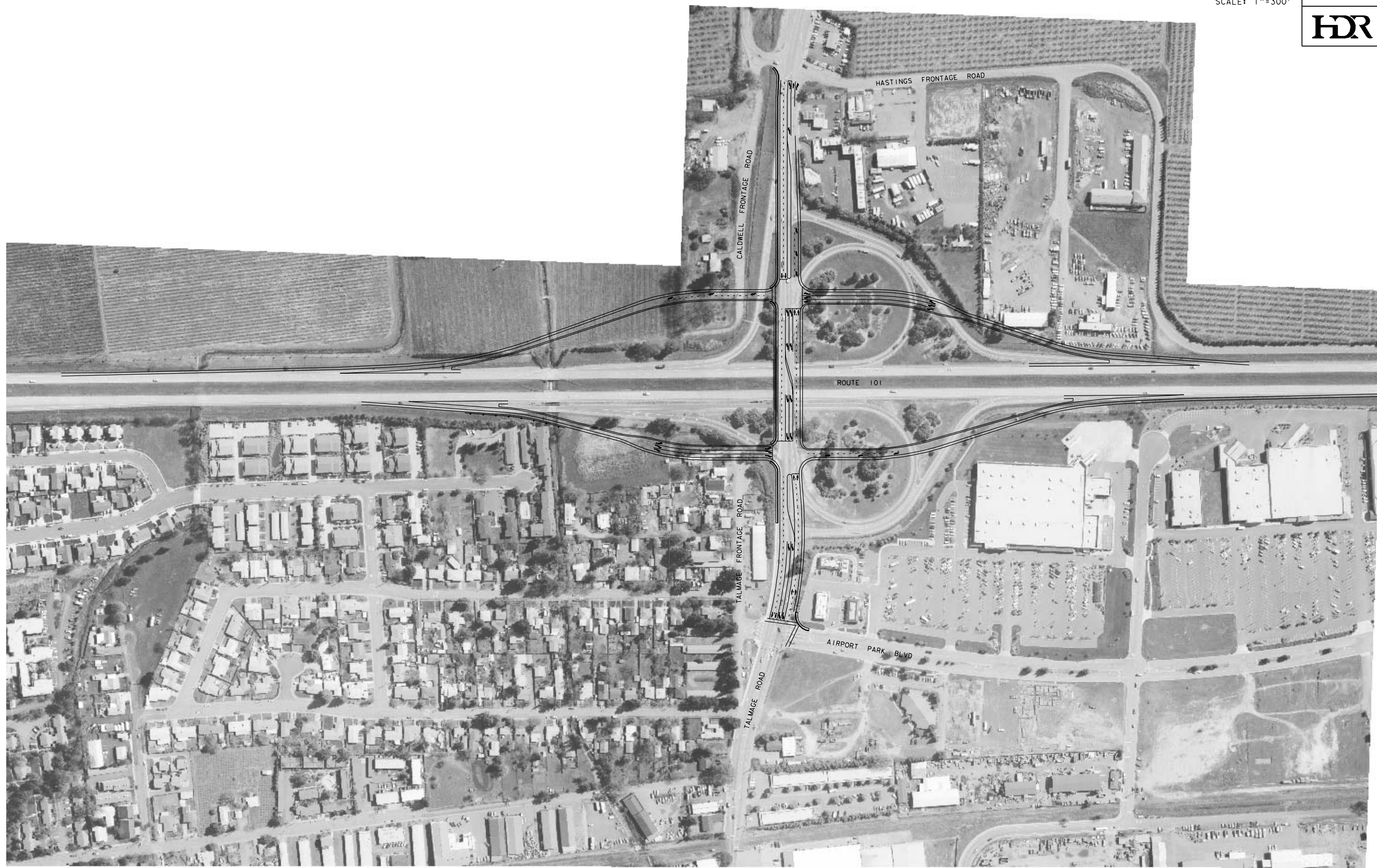
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PRELIMINARY SPECIFIC IMPROVEMENTS
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 RT 101 CORRIDOR INTERCHANGE STUDY
 IN MENDOCINO COUNTY (UKIAH AREA)
 MAY 2005
 INTERCHANGE 04 FOR 2025
 RT 101 AND E GOBBI STREET

HDR 2365 IRON POINT ROAD
 SUITE 300
 FOLSOM, CA 95630

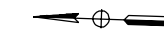


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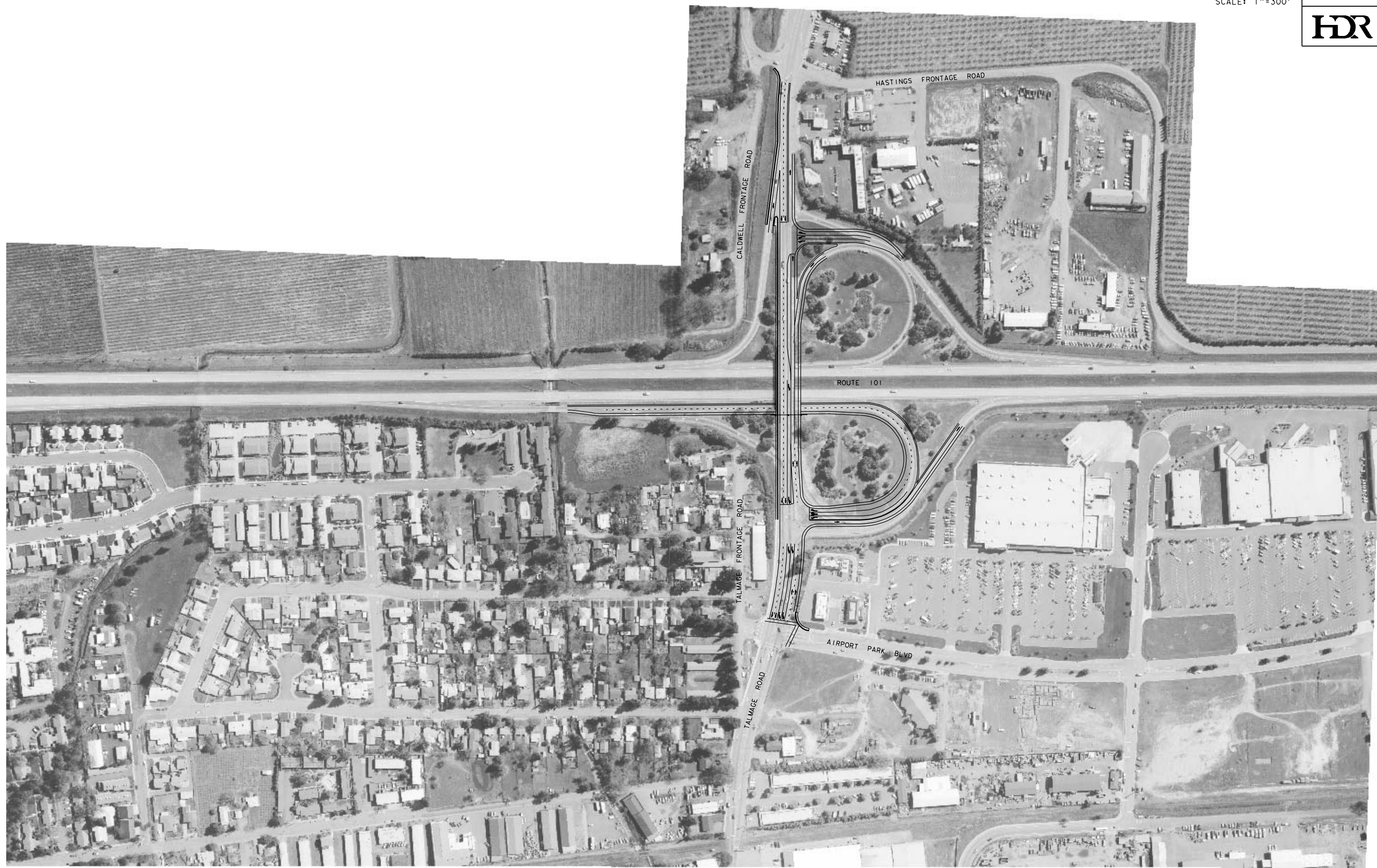
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PRELIMINARY SPECIFIC IMPROVEMENTS
TASK 5
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IN MENDOCINO COUNTY (UKIAH AREA)
MAY 2005
INTERCHANGE 05 FOR 2025-OPT2:
RT 101 AND TALMAGE ROAD



SCALE: 1"=300'

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SUITE 300
FOLSOM, CA 95630



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