
Appendix H

Capacity Improvement Alternatives



**Table H-1
Major Deficiencies and Potential Solutions
Shiloh Interchange - Exit 443**

| Location | Major Deficiency | Potential Solution | Anticipated Timing |
|--|-----------------------------------|--|--|
| <u>CORRIDOR</u> | | | |
| Zoo Dr, I-90 WB ramps to Gabel Rd | Capacity | widen Zoo Dr to 4-5 lanes, including reconfiguration of Zoo Dr on bridge | @ 30% of future growth (est. 2009-2012) |
| Zoo Dr, I-90 EB ramps to S Frontage Rd | Capacity | widen Zoo Dr to 4-5 lanes | @ 70% of future growth or sooner w/ development to the south (est. 2016-2020) |
| Zoo Dr, Gabel Rd to Shiloh Rd | Capacity | widen Zoo Dr to 4-5 lanes | @ 70% of future growth or sooner with development west of Shiloh (est. 2016-2020) |
| <u>INTERSECTIONS</u> | | | |
| Zoo Dr @ Shiloh Rd | Capacity | Add traffic signal and 2nd SB LT lane OR consider roundabout; must maintain "free" WB to NB RT | @ 70% of future growth w/ widening of Zoo Dr between Gabel & Shiloh or sooner with development growth west of Shiloh (est 2016-2020) |
| Zoo Dr @ Gabel Rd | Capacity | Add traffic signal | @ 20% of future growth or sooner with development on Gabel (est 2006-2009) |
| | | Add 2nd SB LT lane | @ 30% of future growth w/ widening of Zoo Dr between Gabel & I-90 WB ramps (est 2009-2012) |
| | | Add 2nd WB & EB thru lane on Zoo Dr; may also need SB RT lane &/or EB RT lane | @ 70% of future growth w/ widening of Zoo Dr between Gabel & Shiloh (est 2020-2023) |
| Zoo Dr @ I-90 WB ramps | Capacity | Widen Zoo Dr to two thru lanes in each direction, add either SB RT lane on Zoo Dr OR "free" RT from WB off-ramp onto Zoo Dr | @ 30% of future growth w/ widening of Zoo Dr between Gabel & I-90 WB ramps (est 2009-2012) |
| | | Add traffic signal | @ 50% of future growth - driven by left turns created with development growth to the south (est 2013 - 2016); alternately, may want to install earlier with widening of Zoo Dr between Gabel & I-90 WB ramps |
| | | May need "free" SB RT and WB ramp RT onto Zoo Dr, requiring either 7 - 11' lanes w/ no median west of WB ramps OR bridge widening | @ 80% of future growth (est 2020-2023); alternately, may want to consider with widening of Zoo Dr between Gabel & I-90 WB ramps |
| Zoo Dr @ I-90 EB ramps | Capacity | Add traffic signal | @ 30% of future growth (est 2009-2012) |
| | | Widen Zoo Dr to two thru lanes in each direction, w/ 2nd LT lane on EB off ramp, and either 2nd SB LT lane on Zoo Dr w/ EB on-ramp widening / lengthening or new SB to EB loop on-ramp | @ 70% of future growth w/ widening of Zoo Dr between I-90 EB ramps and S Frontage Rd or sooner with development growth south of I-90 (est 2016-2020) |
| Zoo Dr @ S Frontage Rd | Capacity | Add traffic signal | @ 50 to 70% of future growth, depending on rate of development growth south of I-90 (est 2013-2020) |
| | | May need two thru lanes in each direction of Zoo Dr, 2nd EB LT lane on S Frontage Rd, & separate NB RT lane on Zoo Dr | @ 70% of future growth w/ widening of Zoo Dr between I-90 EB ramps and S Frontage Rd or sooner with development growth south of I-90 (est 2016-2020) |
| Zoo Dr @ I-90 EB ramps & S Frontage Rd | Capacity / Intersection Proximity | Consider roundabout solution for these two intersections due to intersection proximity & limited vehicle storage, especially if SB to EB loop on-ramp pushes EB off-ramp closer to S Frontage Rd | @ 70% of future growth w/ widening of Zoo Dr between I-90 EB ramps and S Frontage Rd or sooner with development growth south of I-90 (est 2016-2020) |

Note - Consider need for sidewalks along Zoo Drive during development site plan review and MDT widening projects, and accommodate pedestrians with traffic signal installations



**Table H-2
Major Deficiencies and Potential Solutions
S. Billings Blvd Interchange - Exit 447**

| Location | Major Deficiency | Potential Solution | Anticipated Timing |
|---|-------------------|--|---|
| <u>CORRIDOR</u> | | | |
| S Billings Blvd, King Ave to S Frontage Rd / Midland Blvd | Capacity | reconfigure bridge and widen portions of S Billings Blvd to 4 lanes | @ 70% of future growth (est 2016-2019) |
| <u>INTERSECTIONS</u> | | | |
| King Ave @ Southgate Dr | Capacity | Evaluate need for traffic signal, especially if north leg develops and adds SB LT movements to this intersection | @ 70% of future growth or sooner with fill-in development to south and new development to the north (est 2016-2020) |
| | | Encourage access management and interparcel access so land to north has direct access to S Billings Blvd N of gas station to eliminate need for SB LT out | With new development to the north |
| S Billings Dr @ King Avenue | Capacity | Add NB and SB RT lanes on S Billings Blvd (City Ops Traffic Study recommendation) Add NB RT lane & SB Thru/Right lane with conversion of bridge to 4 thru lanes, also add WB RT lane | @ 70% of future growth (est 2016-2019) |
| | Access Management | Install raised median west of S. Billings Ave. to restrict unprotected left turn movements from gas station near signal | |
| S Billings Blvd @ I-90 WB ramps | Capacity | Do Nothing Add second NB and SB thru lanes with conversion of bridge (67' wide) to 4 thru lanes, transition to provide 300' long LT lanes at both ramps Add NB to WB loop ramp Consider roundabout | @ 70% of future growth (est 2016-2019) |
| S Billings Blvd @ I-90 EB ramps | Capacity | Add SB thru lane S of bridge (City Ops Traffic Study recommendation) Add second NB and SB thru lanes with conversion of bridge (67' wide) to 4 thru lanes, transition to provide 300' long LT lanes at both ramps Add SB to EB loop ramp Consider roundabout | @ 70% of future growth (est 2016-2019) |
| S Billings Blvd @ Midland Blvd / S Frontage Rd | Capacity | Install traffic signal Add NB thru lane and convert SB RT lane to Thru/RT lane (City Ops Traffic Study recommendation) Add NB and SB Thru lanes Add EB turn lane, converting to double LT lane and shared thru/right lane, and add WB RT lane (to create exclusive thru lane) (in conjunction with above NB/SB thru lane options) | with opening of City Ops Center @ 70% of future growth (est 2016-2019) |

Note - Consider need for sidewalks along S Billings Blvd between King Avenue and Midland Blvd / S Frontage Rd with reconfiguration/widening of S Billings Blvd to 4 thru lanes, and accommodate pedestrians at traffic signals



**Table H-3
Major Deficiencies and Potential Solutions
27th Street Interchange - Exit 450**

| Location | Major Deficiency | Potential Solution | Anticipated Timing |
|---------------------------------------|---------------------------|---|--|
| <u>CORRIDOR</u> | | | |
| 27th Street | None Identified | None | |
| <u>INTERSECTIONS</u> | | | |
| 27th Street @ State Ave / Belknap Ave | Access Management | May need better access management on State Ave and Belknap Ave (especially if additional development occurs) | @ 70% of future growth or sooner with new development on State Ave (est 2016-2020) |
| 27th St @ I-90 WB ramps | Sight Distance | Reconfigure jersey barrier / railing which protects sidewalk on bridge but limits sight distance | Existing |
| | Capacity / Sight Distance | Consider roundabout to minimize sight distance limitations, reduce off-ramp delay, and eliminate need for future traffic signal | Existing |
| | Truck Turns | Widen on-ramp for truck turns | Existing |
| | Capacity | Widen off-ramp for separate right turn lane | @ 50% of future growth (est 2013-2016) |
| | Capacity | Widen off-ramp for separate right turn lane and add accel lane for "free" right turn from off-ramp onto 27th St | @ 50% of future growth (est 2013-2016) |
| | Capacity | Evaluate need for traffic Signal | @ 50% to 70% of future growth (est 2013-2020) |
| 27th St @ I-90 EB ramps | Sight Distance | Reconfigure jersey barrier / railing which protects sidewalk on bridge but limits sight distance | Existing |
| | Capacity / Sight Distance | Consider roundabout to minimize sight distance limitations, reduce off-ramp delay, and eliminate need for future traffic signal | Existing |
| | Geometrics | Reconfigure SB 27th approach to single LT and single thru lanes | Existing |
| | Truck Turns | Widen on-ramp for truck turns | Existing |
| | Capacity | Widen off-ramp for separate right turn lane | @ 50% of future growth (est 2013-2016) |
| | Capacity | Evaluate need for traffic Signal | @ 50% to 70% of future growth (est 2013-2020) |
| 27th St @ Garden Ave | None Identified | None | |

Note - Consider need for sidewalks along 27th Stret between Garden Avenue and State Avenue, and accommodate pedestrians at traffic signals



Table H-4
Major Deficiencies and Potential Solutions
US 87 Lockwood Interchange - Exit 452

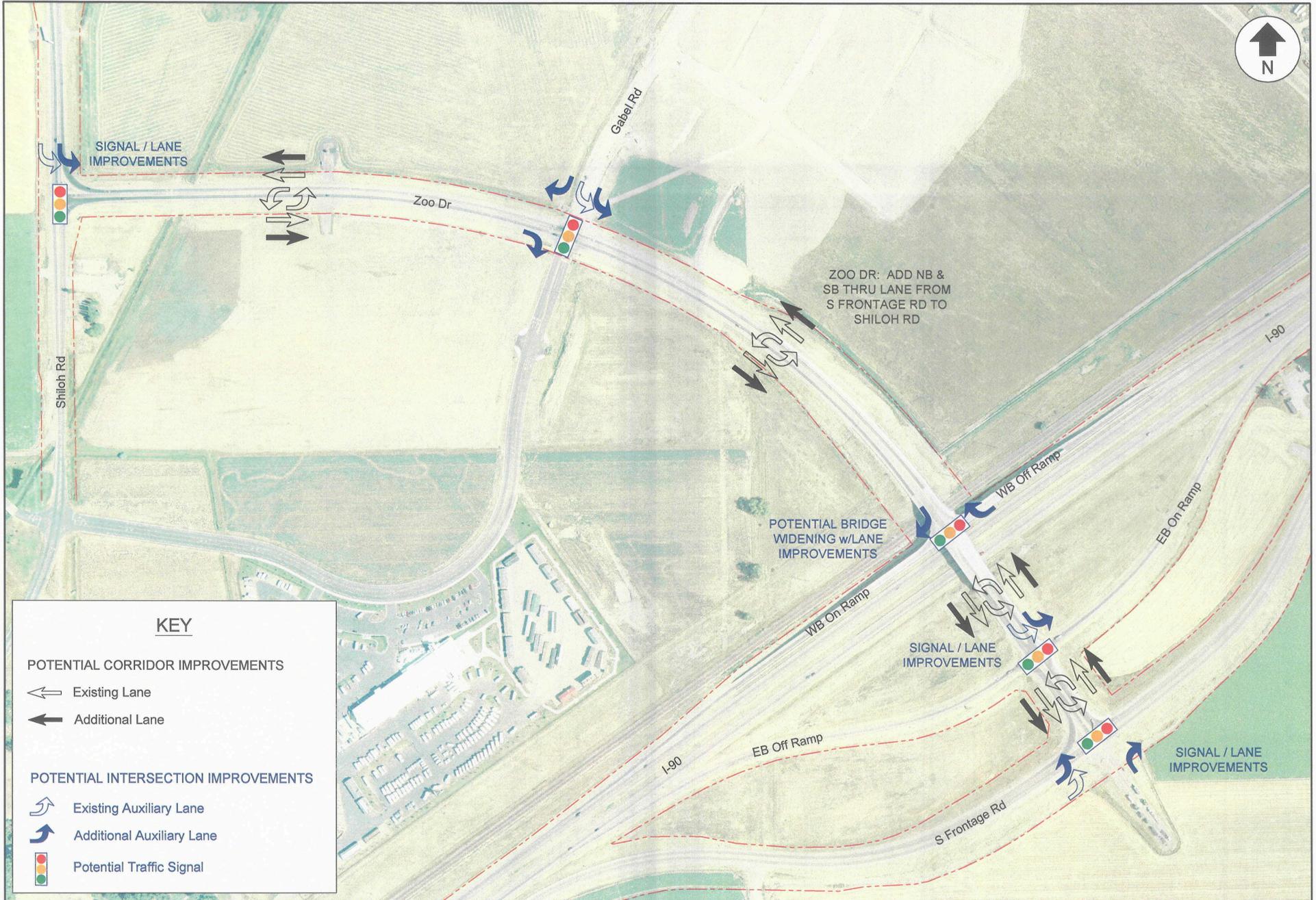
| Location | Major Deficiency | Potential Solution | Anticipated Timing |
|-----------------------------------|--|--|--|
| <u>CORRIDOR</u> | | | |
| US 87 | None Identified | None | |
| <u>INTERSECTIONS</u> | | | |
| US 87 @ N Frontage Rd | Geometrics, SB RT Storage, Truck Turns | Reconfigure intersection to better accommodate truck turns, reduce skew angle, extend SB RT lane (on N Frontage Rd). | @ 50-70% of future growth, though geometric deficiencies currently exist (est 2013-2020) |
| | SB RT Storage | Extend SB RT lane on N Frontage Rd | @ 50-70% of future growth (est 2013-2020) |
| US 87 @ I-90 WB ramps | Capacity / Truck Turns | Widen off-ramp for separate right turn lane, maybe lessen off-ramp skew angle | @ 30-50% of future growth (est 2009-2016) |
| | Capacity / Truck Turns | Widen off-ramp for separate right turn lane and add accel lane for "free" right turn from off-ramp onto 27th St, maybe lessen off-ramp skew angle | @ 30-50% of future growth (est 2009-2016) |
| | Truck Turns | Widen on-ramp for truck turns, maybe lessen on-ramp skew angle | Existing |
| | Capacity | Add US 87 RT lane at on-ramp | @ 30-50% of future growth (est 2009-2016) |
| | Capacity | Construct roundabout to reduce off-ramp delay & eliminate existing traffic signal | |
| US 87 @ I-90 EB ramps | Safety | Consider changing EB LT from permissive only to protected - permissive or protected only signal phasing | Existing / Short Term |
| | Safety | Consider advance flashing signal ahead sign for WB approach before curve | Existing |
| | Capacity / Intersection Proximity | Construct roundabout to reduce off-ramp delay, eliminate existing traffic signal, and reduce impacts of close proximity to Coburn Rd | @ 30-50% of future growth (est 2009-2016) |
| | Capacity | Add 2nd SB LT lane (widen bridge structure to accommodate) | @ 30-70% of future growth (est 2009-2020) |
| | Capacity | Add SB to EB loop ramp | @ 30-70% of future growth (est 2009-2020) |
| | Truck Turns | Widen on-ramp for truck turns, maybe lessen on-ramp skew angle | Existing |
| | Capacity | Widen off-ramp for separate right turn lane, maybe lessen off-ramp skew angle | @ 30-50% of future growth (est 2009-2016) |
| US 87 @ Coburn Rd | Capacity | Evaluate need for traffic Signal | @ 70% of future growth (est 2016-2020) |
| | Access Management | May need better access management on US 87 and/or Coburn Rd (especially with traffic signal or other improvements) | @ 70% of future growth (est 2016-2020) |
| | None Identified | May need to adjust current lane drop &/or lane add configuration to east with traffic signal installation | @ 70% of future growth (est 2016-2020) |
| US 87 @ I-90 EB ramps & Coburn Rd | Capacity / Intersection Proximity | Consider roundabout solution for these two intersections due to intersection proximity, especially if SB to EB loop on-ramp pushes EB off-ramp closer to Coburn Rd | @ 30-70% of future growth (est 2009-2020) |

Note - Consider need for sidewalks along US 87 between N Frontage Rd and Coburn Rd, and accommodate pedestrians at traffic signals

**Table H-5
Major Deficiencies and Potential Solutions
Johnson Lane Interchange - Exit 455**

| Location | Major Deficiency | Potential Solution | Anticipated Timing |
|---|---|---|---|
| <u>CORRIDOR & BRIDGE STRUCTURE</u> | | | |
| Johnson Ln | Sight Distance, Vertical Clearance and limited roadway width under bridge | Explore roundabouts at ramp intersections, changing Johnson Lane to two lane cross-section under bridge, and lower "narrower" Johnson Lane to achieve adequate vertical clearance | @ 30-50% of future growth or sooner as geometric deficiencies currently exist (est 2009-2016) |
| | | Rebuild interchange | @ 50-70% of future growth or sooner as geometric deficiencies currently exist (est 2013-2020) |
| I-90 WB ramps / Johnson Ln / Old Hardin Rd | Access Management & Truck Queues | Explore options to reduce impacts of Flying J truck storage along Old Hardin Rd, including modifying site entrances and internal site configuration, realigning I-90 EB off-ramp to Old Hardin Rd, installing raised median along Old Hardin Rd | @ 30-50% of future growth (est 2009-2016) |
| <u>INTERSECTIONS</u> | | | |
| Johnson Ln at N Frontage Rd | Capacity | Monitor need for traffic signal, especially due to new development along N Frontage Road | @ 50-70% of future growth or sooner with new development along N Frontage Rd (est 2013-2020) |
| | Capacity | Evaluate need for auxiliary lanes on all approaches, especially due to new development along N Frontage Rd, and improve truck turns | @ 50% of future growth or sooner with new development along N Frontage Rd (est 2013-2020) |
| | Capacity / Intersection Proximity | Consider roundabout w/ I-90 WB ramps | Existing due to I-90 WB ramp Sight Dist, or @ 30-70% of future growth (est 2009-2020) |
| Johnson Ln at I-90 WB ramps | Capacity / Sight Dis | Consider roundabout | Existing |
| | Capacity / Sight Dist / Intersection Proximity | Consider combined roundabout w/ N Frontage Rd | Existing |
| | Capacity / Sight Dist | Install traffic signal, though there is limited NB LT storage due to bridge structure | Existing |
| | Capacity / Sight Dist | Install traffic signal with adequate auxiliary lanes and interchange reconstruction | @ 30-70% of future growth or sooner with new development along N Frontage Rd (est 2013-2020) |
| | Capacity / Sight Dist | Install loop ramp for NB to WB traffic; realign WB off-ramp to N Frontage Rd | Existing |
| Johnson Ln @ I-90 EB ramps | Capacity / Storage | Install RT lane on I-90 EB off-ramp and continuous SB RT lane on Johnson Lane from I-90 EB off-ramp to Old Hardin Rd. | Existing |
| | Capacity / Storage | Install continuous NB RT lane on Johnson Lane from Old Hardin Rd to I-90 EB on-ramp | Existing |
| | Capacity / Storage | Consider roundabout | Existing w/ WB ramps or @ 30-50% of future growth (est 2009-2020) |
| | Capacity / Storage | Evaluate traffic signal, though there is limited SB LT storage due to bridge | @ 30-50% of future growth (est 2009-2016) |
| | Capacity / Storage | Install traffic signal with adequate auxiliary lanes with interchange reconstruction | @ 30-70% of future growth or sooner with new development along N Frontage Rd (est 2013-2020) |
| | Capacity / Storage | Install loop ramp for SB to EB traffic | @ 30-70% of future growth or sooner with new development along N Frontage Rd (est 2013-2020) |
| | Capacity / Storage | Realign I-90 off-ramp to Old Hardin Road | @ 30-70% of future growth or sooner with new development along N Frontage Rd (est 2013-2020) |
| Johnson Ln at Old Hardin Rd | Capacity / Storage | Improve SB to WB RT for truck turns in conjunction with continuous RT lane on Johnson Ln from I-90 EB off-ramp | Existing |
| | Capacity / Storage | Improve WB to NB RT for truck turns in conjunction with continuous RT lane on Johnson Ln to I-90 EB on-ramp | Existing |
| | Capacity / Storage | Install auxiliary lanes (2nd SBLT lane, WBLT lane) | @ 70% of future growth (est 2016-2020) |
| | Capacity / Storage | Consider roundabout | @ 70% of future growth (est 2016-2020) |
| Old Hardin Road W of Johnson Ln | Capacity / Storage | Widen Old Hardin Rd if I-90 EB off-ramp is realigned to Old Hardin Rd | @ 30-70% of future growth or sooner with new development along N Frontage Rd (est 2013-2020) |
| Beecraft Ln at Old Hardin Road | Capacity / Storage | Evaluate need for traffic signal | @ 70% of future growth (est 2016-2020) |
| | Capacity / Storage | Evaluate new neighborhood connection to Johnson Lane south of Old Hardin Rd in order to eliminate need for traffic signal | @ 70% of future growth (est 2016-2020) |

Note - Consider need for sidewalks along Johnson Lane N Frontage Rd and Old Hardin Rd, and accommodate pedestrians at traffic signals



KEY

POTENTIAL CORRIDOR IMPROVEMENTS

- ← Existing Lane
- Additional Lane

POTENTIAL INTERSECTION IMPROVEMENTS

- ↪ Existing Auxiliary Lane
- ↪ Additional Auxiliary Lane
- 🚦 Potential Traffic Signal



BILLINGS I-90 INTERCHANGE STUDY
CAPACITY IMPROVEMENT ALTERNATIVES - SHILOH RD INTERCHANGE - Signalized Corridor Alternative

| | | | | | | | | | |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|
| Scale | 1"=500' | Date | March 2006 | Drawn by | RAC | Job # | AMTDOT0306 | Figure | H1 |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|



KEY

POTENTIAL CORRIDOR IMPROVEMENTS

-  Existing Lane
-  Additional Lane

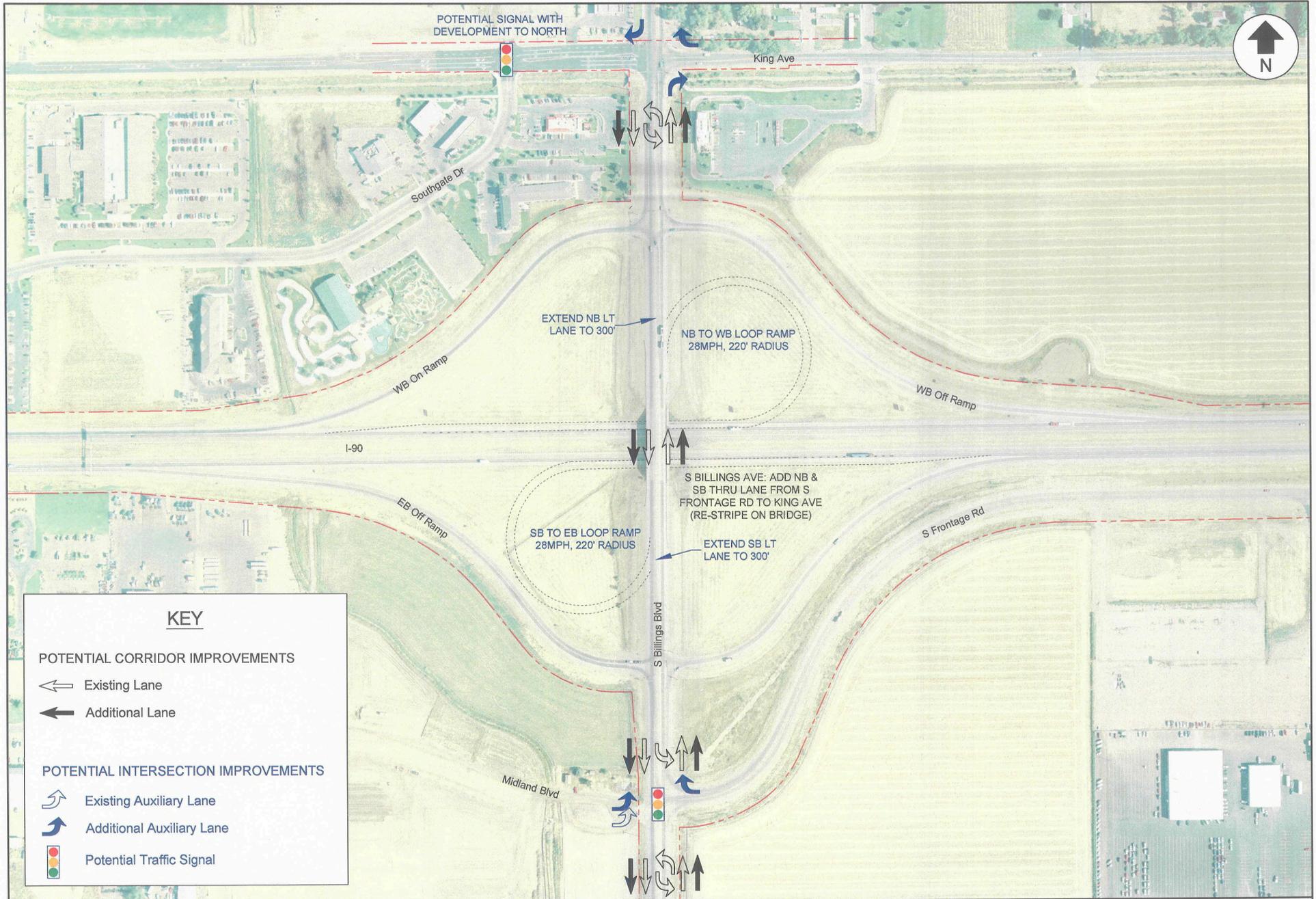
POTENTIAL INTERSECTION IMPROVEMENTS

-  Existing Auxiliary Lane
-  Additional Auxiliary Lane
-  Potential Traffic Signal



BILLINGS I-90 INTERCHANGE STUDY
CAPACITY IMPROVEMENT ALTERNATIVES - SHILOH RD INTERCHANGE - Roundabout & Loop Ramp Alternative

| | | | | | | | | | |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|
| Scale | 1"=500' | Date | March 2006 | Drawn by | RAC | Job # | AMTDOT0306 | Figure | H2 |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|



KEY

POTENTIAL CORRIDOR IMPROVEMENTS

- ↔ Existing Lane
- ← Additional Lane

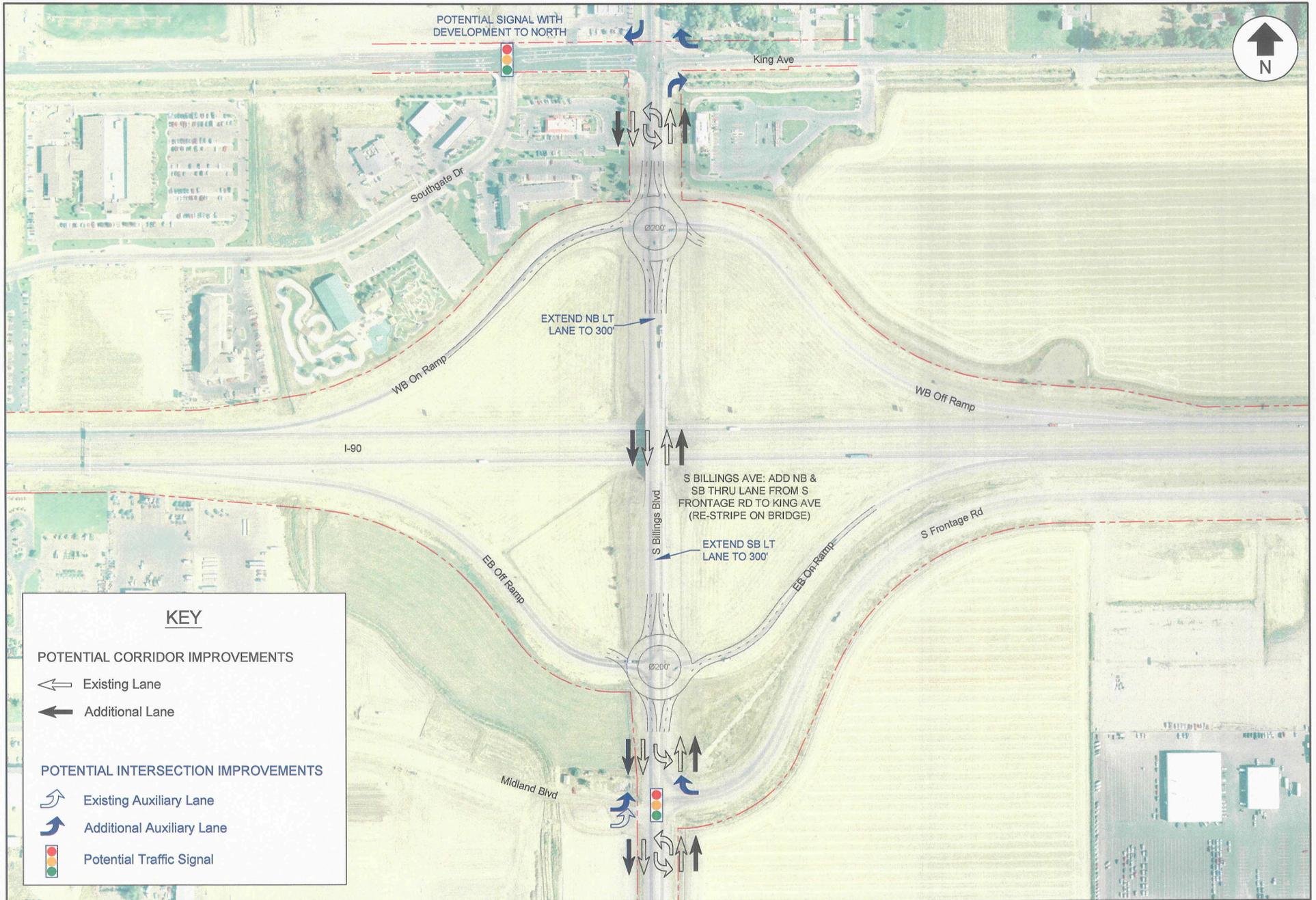
POTENTIAL INTERSECTION IMPROVEMENTS

- ↗ Existing Auxiliary Lane
- ↗ Additional Auxiliary Lane
- 🚦 Potential Traffic Signal



BILLINGS I-90 INTERCHANGE STUDY
CAPACITY IMPROVEMENT ALTERNATIVES - S BILLINGS BLVD INTERCHANGE - Signalized & Loop Ramp Alt.

| | | | | | | | | | |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|
| Scale | 1"=400' | Date | March 2006 | Drawn by | RAC | Job # | AMTDOT0306 | Figure | H3 |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|

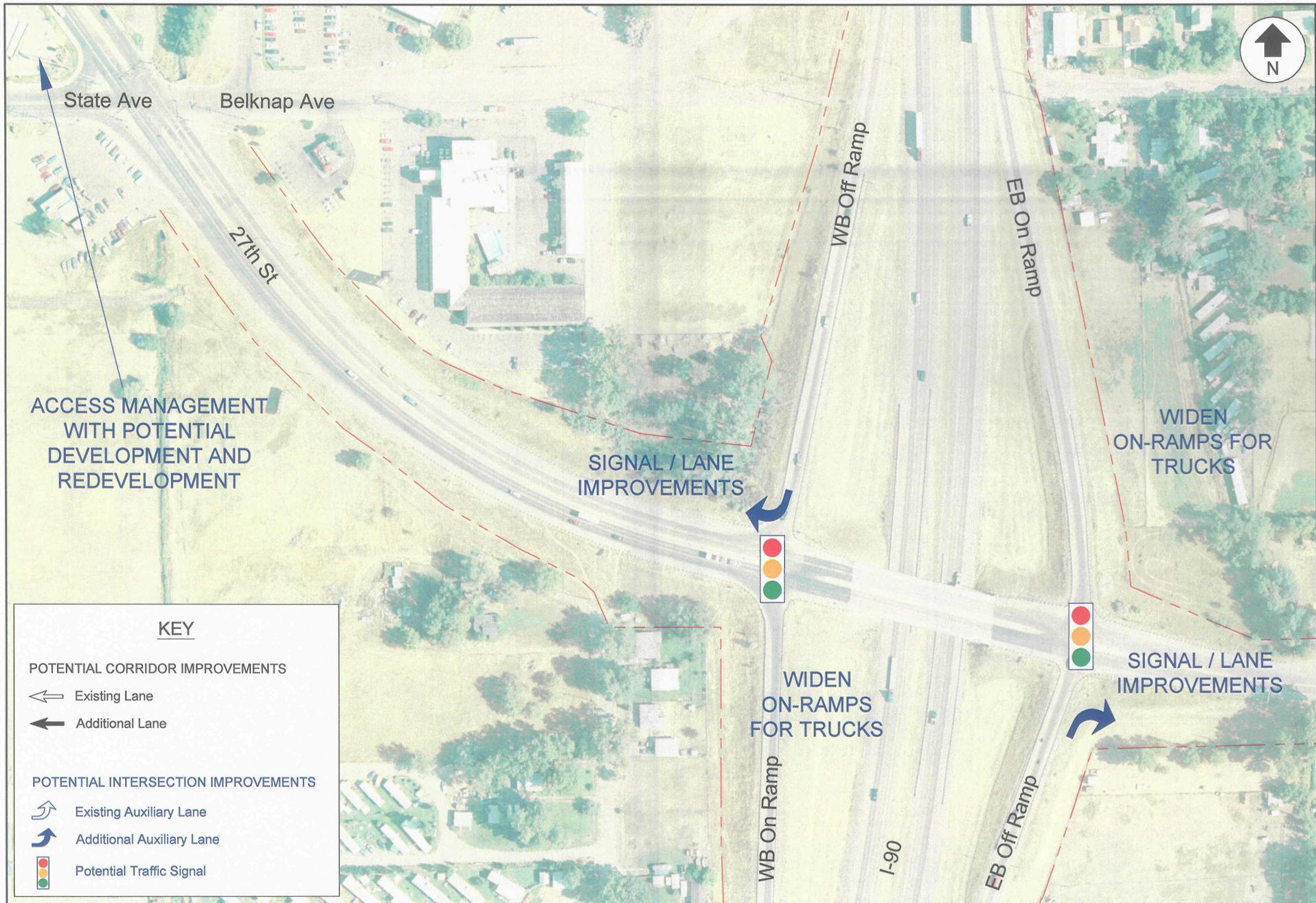


BILLINGS I-90 INTERCHANGE STUDY

CAPACITY IMPROVEMENT ALTERNATIVES - S BILLINGS BLVD INTERCHANGE - Roundabout Alternative



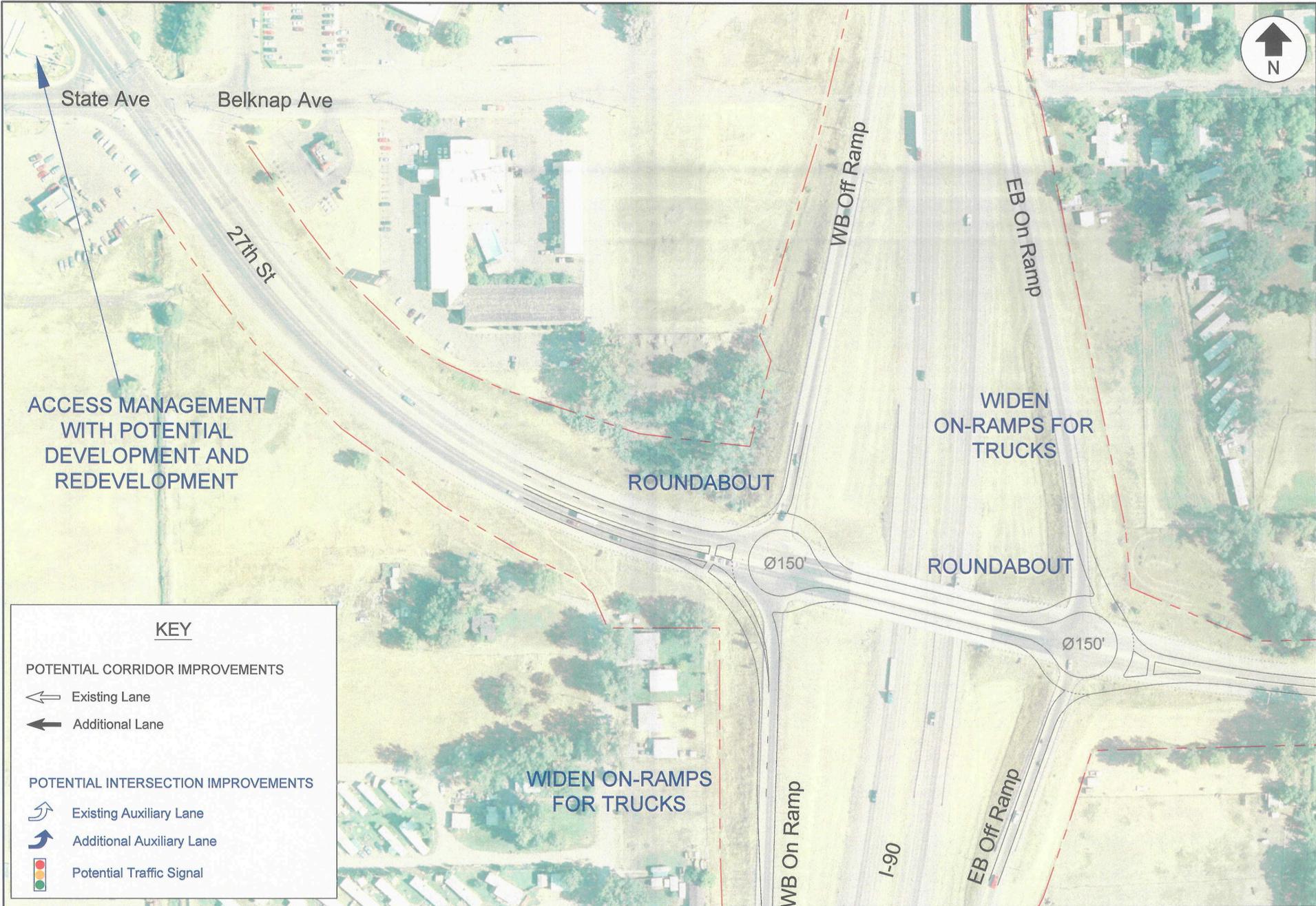
| | | | | | | | | | |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|
| Scale | 1"=400' | Date | March 2006 | Drawn by | RAC | Job # | AMTDOT0306 | Figure | H4 |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|



BILLINGS I-90 INTERCHANGE STUDY

CAPACITY IMPROVEMENT ALTERNATIVES - 27TH STREET INTERCHANGE - Signalized Corridor Alternative

| | | | | | | | | | |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|
| Scale | 1"=200' | Date | March 2006 | Drawn by | RAC | Job # | AMTDOT0306 | Figure | H5 |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|



KEY

POTENTIAL CORRIDOR IMPROVEMENTS

- ← Existing Lane
- ← Additional Lane

POTENTIAL INTERSECTION IMPROVEMENTS

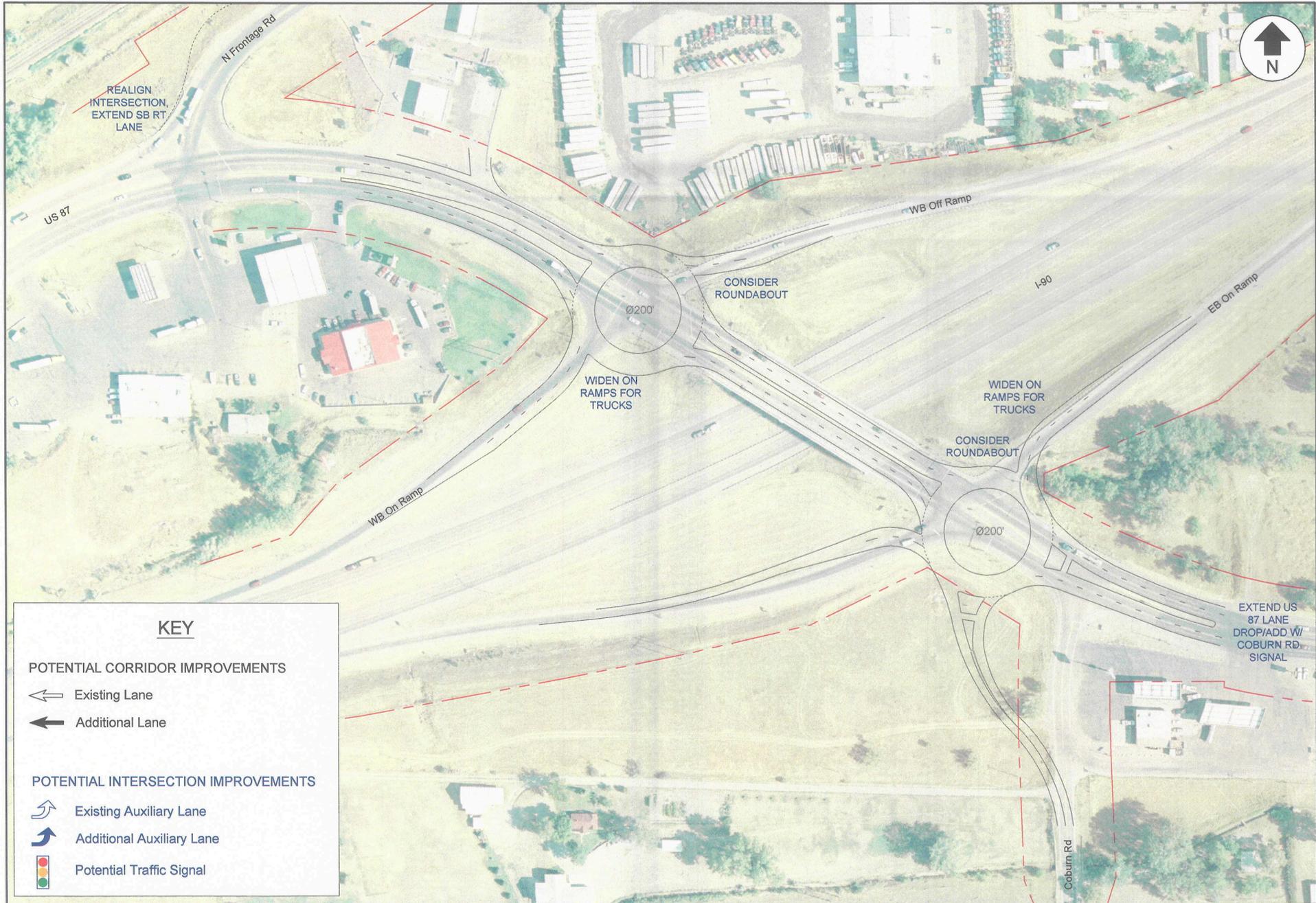
- ↗ Existing Auxiliary Lane
- ↗ Additional Auxiliary Lane
- 🚦 Potential Traffic Signal



BILLINGS I-90 INTERCHANGE STUDY

CAPACITY IMPROVEMENT ALTERNATIVES - 27TH STREET INTERCHANGE - Roundabout Alternative

| | | | | | | | | | |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|
| Scale | 1"=200' | Date | March 2006 | Drawn by | RAC | Job # | AMTDOT0306 | Figure | H6 |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|



KEY

POTENTIAL CORRIDOR IMPROVEMENTS

- Existing Lane
- Additional Lane

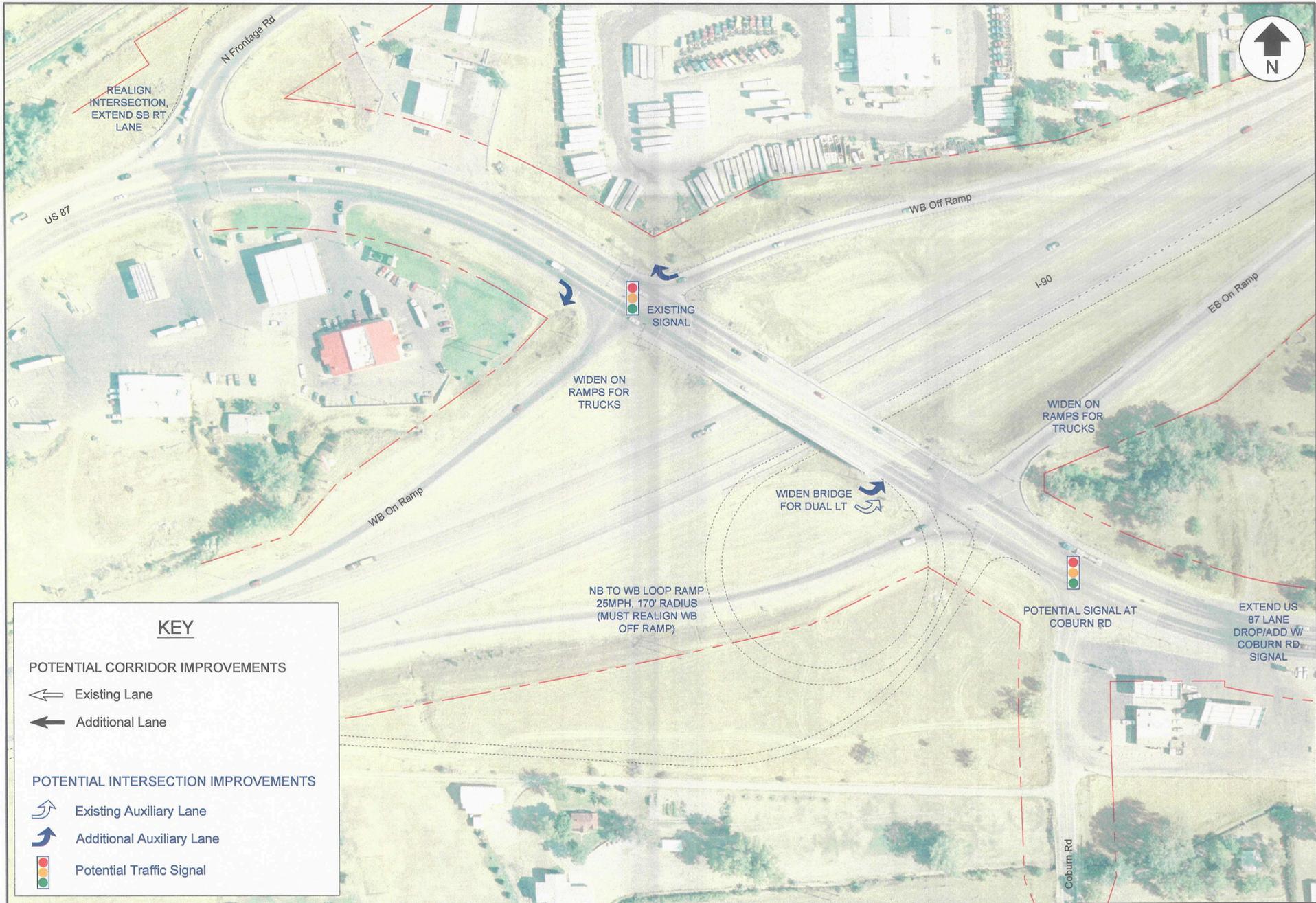
POTENTIAL INTERSECTION IMPROVEMENTS

- Existing Auxiliary Lane
- Additional Auxiliary Lane
- Potential Traffic Signal



BILLINGS I-90 INTERCHANGE STUDY
CAPACITY IMPROVEMENT ALTERNATIVES - US87 LOCKWOOD INTERCHANGE - Roundabout Alternative

| | | | | | | | | | |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|
| Scale | 1"=200' | Date | March 2006 | Drawn by | RAC | Job # | AMTDOT0306 | Figure | H7 |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|



KEY

POTENTIAL CORRIDOR IMPROVEMENTS

- Existing Lane
- Additional Lane

POTENTIAL INTERSECTION IMPROVEMENTS

- Existing Auxiliary Lane
- Additional Auxiliary Lane
- Potential Traffic Signal



BILLINGS I-90 INTERCHANGE STUDY
CAPACITY IMPROVEMENT ALTERNATIVES - US87 LOCKWOOD INT. - Signalized Corridor & Loop Ramp Alt.

| | | | | | | | | | |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|
| Scale | 1"=200' | Date | March 2006 | Drawn by | RAC | Job # | AMTDOT0306 | Figure | H8 |
|-------|---------|------|------------|----------|-----|-------|------------|--------|----|

