Intelligent Transportation System Progress Report/5 Year Plan

City of Loveland

INTELLIGENT TRANSPORTATION SYSTEMS (ITS) PLAN 2010 – EXECUTIVE SUMMARY

According to Clay Carey, USA TODAY (12-30-09) "Drivers are getting more real-time warnings about traffic congestion as states roll out new or expanded systems over the next four years. Federal rules that could take effect as early as February will give states two years to make such information available online or by phone for interstates and four years for major non-interstate roads in cities, according to the Government Accountability Office."

Transportation systems in the US are being strained by the need for funding of major investments to increase capacity and safety. Federal, state and local agencies, including the City of Loveland are expanding the use Intelligent Transportation Systems (ITS) technology and operations as one effective strategy for help.

In Loveland, the prime example of roadway capacity deficiencies is East Eisenhower (US 34) which has completely out grown existing 4 lane roadway capacity. Short and mid-term roadway and intersection improvements have boosted capacity, along US 34 congestion is also for some intersections and made 6 lanes available between Monroe and Denver Avenues. However, Loveland experiences congestion in this corridor and others in part due to lack of capacity and as a result of a 30% summer season increase in traffic volume along US 34 accessing Rocky Mountain National Park from I-25 and other corridors .

Intelligent Transportation Systems (ITS) involve the use of technologies to maximize capacity and safety for travelers. Current technology used in Loveland facilitates the gathering of traffic signals' status, roadway congestion, pavement surface conditions, and weather conditions. ITS also involves the distribution of data via high speed internet communications. In turn, transportation systems and system operators are able to predict travel conditions. Then people and/or computer systems develop and implement strategies and broadcast information to reduce congestion, save time and money for agencies and users.

ITS helps Transportation professionals squeeze a little more juice of out of the lemons to produce a bit more lemonade for all concerned. ITS is a most cost efficient investment for transportation. ITS has a documented history of the

highest cost benefit returns on investment and the added benefit of producing sustainable high-tech jobs.
In the past 15 years, the City of Loveland has implemented a number of ITS systems and strategies. A central traffic signal system is used to optimize traffic signal operations. Roadway weather and information systems, video roadway surveillance cameras, fiber optics with Ethernet communications, a highway advisory broadcast radio station (1610 AM), and variable message sign technologies are systems that have been installed and used. These components gather critical data/information for strategic operational decision making in-house. A key example is when to deploy snow fighting forces and equipment to maximize safety and save overtime and environmental costs.

The Information Age in which we find ourselves requires technology and high speed communications for ITS. Information capabilities require technology to grow on an exponentially increasing path. While new technologies can grow and provide more monitoring of travel conditions, so does the need for traffic operations decision-making in order to anticipate or react to conditions including incident management.

Elementary ITS basics such as signal timing, will need to grow and expand to include interaction with all system users by providing: more efficient traffic signal status and control, gathering roadway/weather and traffic/transit conditions, roadway congestion, mode choice, and trip routing information out to travelers. Smart information with proper high speed communication and control can increases capacity and improve safety for us all.

Key parts of this plan for the next 5 years include:

- Connecting all signals to a new modern central traffic signal system and including replacing out dated traffic signal controllers at over 100 locations
- Completing a more modern TOC via remodel of existing space
- Expanding roadway information services via internet, variable message signing on-street systems, and potentially to new, in-vehicle technologies
- Monitoring roadway information and traffic and weather conditions and making area-wide and system changes from a modern TOC
- Taking advantage of new opportunities in ITS and leveraging grant programs

This report goes into the detail of the fiber optics and Ethernet mesh radio construction phasing needed to support various ITS devices. It outlines the phasing for installations and costs. Resources are outlined and associated with installing and operating the most modern systems in order to share the data with system users and operators.

GENERAL BACKGROUND ITS INFORMATION (History/Progress Report):

History (1995-2009)

ITS has been a top priority for the City of Loveland's Traffic Division and the Public Works Department for the past 15 years. The more effective ITS systems the City has, the better traffic flow. This system results in an informed traveling public that will take advantage of the transportation system available to them. At the heart of an ITS program is a good traffic signal control system. Operations of a signal system and all the component systems and parts take a great deal of engineering and maintenance effort to continue to be successful.

Planning and implementation of a signal system upgrade, within Loveland's local ITS program began long before CDOT's Regional Architecture Plan. Starting in 1995, the Traffic Division focused on engineering and implementing new effective signal timing plans with signal progression on major arterials including; US 34, US 287, and Taft Avenue, other arterials such as 29th Street followed.

Nearly all of the 48 traffic signals in 1995 desperately needed to be re-timed using consistent time-of-day timing plans with common cycle lengths to produce good arterial street progression patterns. With the exception of 10 signals on one-way streets downtown on US 287, there was very little consistent traffic signal progression on any of the arterials streets in Loveland.

Staff used the available time base coordination clock technology that is part of the 170 controller configuration. A few signals had some hard wire interconnect. These systems enabled implementation of some new timing plans city-wide. Clock synchronization of the 170 traffic signal controller clock at each intersection was used for intersections not connected by hard-wire (phone line cable) on the system and continue to be checked and maintained in the field.

1995 Technology

Available technology and resources(170 Controllers and an existing signal/engineering staff of 4 FTE's) were used to establish good arterial progressions on streets such as US 287, US 34, and Taft Avenue. This effort was followed by planning and selection process that included: central signal system software, communications system (radio), and obtaining grant money for the implementation of these pieces into a central traffic control system. After purchasing the first system, spread spectrum radio communication was later added as a tool to communicate to and from existing traffic signals from the central system.

Signal timing plans were changed by time of day via each signal's microprocessor's internal clock, some signals were connected to the system by spread-spectrum radio. Signal timing plan updates were accomplished using good traffic

engineering principals for corridor timing and cross-corridor timing. Adjustments in plans have been made as signals are added, construction traffic controls warrant, and periodically for new corridor-wide plans. Field checks and adjustments have been frequent and once a year travel time studies are conducted for performance measures.

2000 Central Computer System Installation

An Urban Systems Grant (federal money) for approximately $120,000 was obtained in 1999 for a central computer system and spread spectrum communications technology. At one time 40 intersections were connected to the central system using ACT Software in a microcomputer. The new central traffic control system used spread spectrum radios and hard-wire (twisted pairs) for interconnect at 15-20 intersections. Time based coordination via the controller clocks was used as backup to radio interconnect (time based means clocks are manually synchronized). At intersections where radio or hardwire interconnect was not available, signal controller time base clocks continued to be utilized and were checked at least monthly.

Even the best signal systems plus other ITS components with the best signal timing plans incorporated are soon rendered ineffective without proper on-going monitoring and maintenance and operations. Nationally, the Institute of Transportation Engineers rated traffic signals using a "report card" system. This report card took into consideration the amount of effort going into traffic signals city-wide. This included budgets, maintenance schedules, engineering time invested in signal timing, budgets for capital and maintenance efforts and much more. The **City of Loveland received a B+** rating on the 1st report card several years ago compared the rest of the **United States getting D- average.** The city's rating slipped slightly to B- during the past high growth period due to the level of construction efforts that greatly expanded facilities. There are now 94 traffic signals versus 49 that were operating 15 years ago.

To try to keep pace with needs, federal and state funding has been vigorously pursued. Applications for Federal Highway Grants and state funds for signal rebuilds, signal system computers/software, safety improvements to re-build signals, and additional maintenance/operations funding from CDOT has been largely successful. These efforts combined with matching funds from the Streets CIP have shored up some of the gaps in facilities. However the need for responsive traffic signal control to best match conditions is becoming necessary. US 34 east of I-25 was recently counted and had over 60,000 vehicles per day on that section of US 34. Doubling the amount of traffic signals and the installation of ITS devices to help storm fighting efforts and getting information to the public greatly challenge existing resources in regards to operations and maintenance personnel.

2004 CDOT Region IV ITS Plan

Loveland's ITS Program is part of a larger Regional ITS Strategic Plan. The 2004 CDOT document highlights the use of technology and strategies for improving transportation system efficiencies and providing communications with system users. The inventory map on page 6 shows what was done as part of that document. The complete inventory listing of all ITS devices in the study area is available in that strategic plan.

Intelligent Transportation System
5 Year Plan – Update 2010

The following Intelligent Transportation System (ITS) Plan is a comprehensive review and course setting update since the last update was done in 2007. Since that time, a number of key projects outlined in that update report have been completed. Below is a list of related documents that led up to the 2007 report:

- Strategic Signal System Plan (April of 2000)
- Communications plan by WL Contractors
- 2006 Loveland ITS Project Overview, and Loveland ITS System
- Status Report – May 2007

VMS – BUTTERFLY STRUCTURE – US 34/DENVER AVE. – Back to back signs for east/west traffic

Key project and objectives completed or underway in accordance with the 2007 Status Report will be highlighted below:

The City currently has **93 traffic signals and 27 school flasher zones**, which is **nearly double** the 48 signals and the 14 school zones that were in operation 15 years ago. These large expansions were due to the need to accommodate a very high growth period, as wall as the City taking over all CDOT signals and flashers located on the state highways within Loveland.

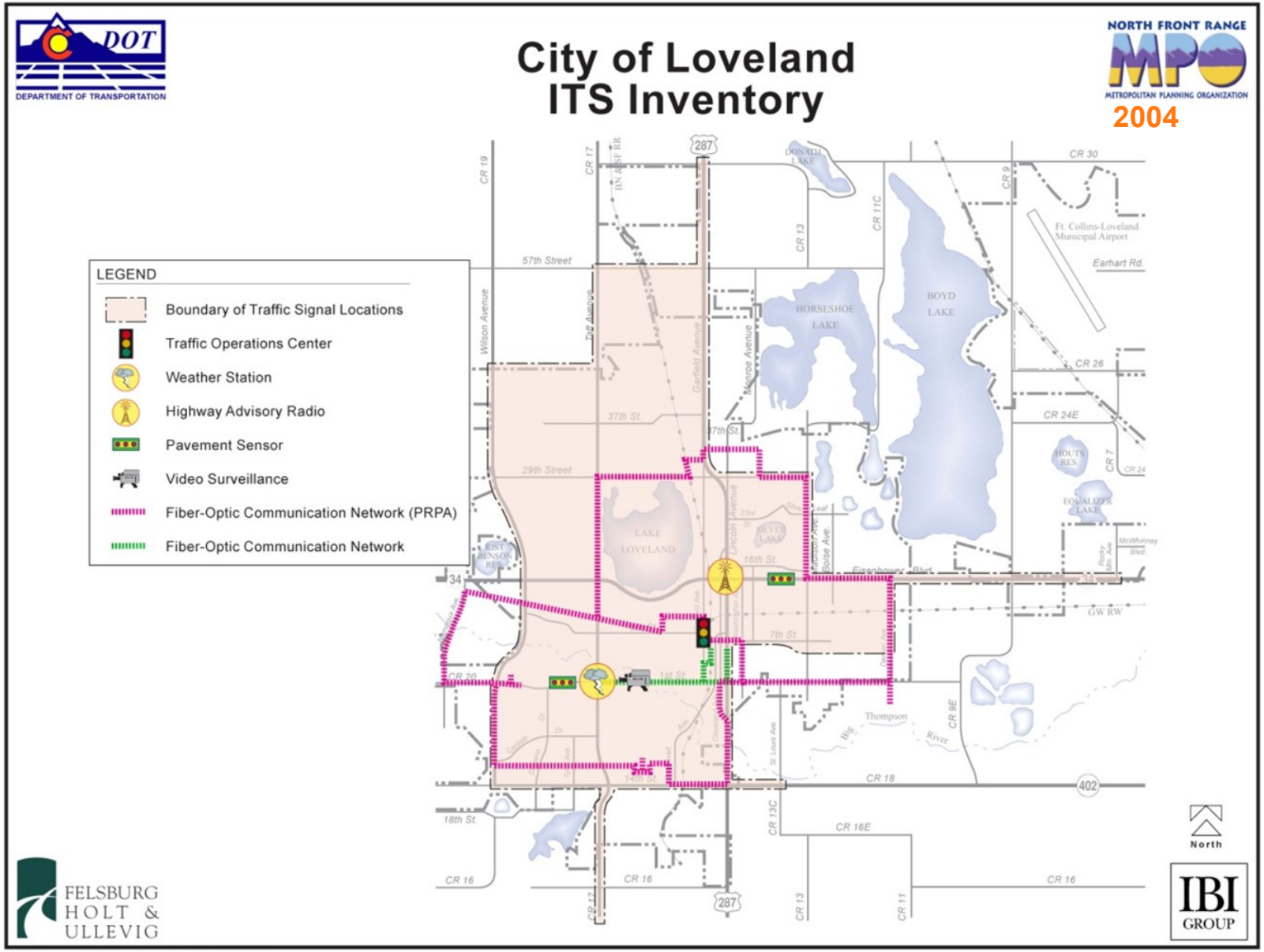
Under a new 5 Year Colorado Department of Transportation (CDOT) Maintenance Agreement (approved by City Council in 2008), the Public Works Traffic Division increased revenue to the city for maintenance of signals, signs and markings by $240,000 per year. With this has also come substantially increased number of miles and devices to maintain.

During this recent rapid growth and development period, there have been a number of related **ITS "Firsts" for Northern Colorado in the City of Loveland** as follows:

1. First Triple Left Turn Lanes in Northern Colorado, Centerra Parkway/US 34.
2. First Permanent Variable Message Signs off of I-25 installed (US 34/Denver Avenue in the median) and are shared with CDOT via COTRIP.ORG.
3. First CCTV surveillance system for real time roadway observations in Loveland (I-25/US 34/Centerra, I-25/Crossroads -Share Remote Weather Information Site (RWIS) site with CDOT).
4. First Snap Shot Video on COTRIP.ORG from a northern Colorado City Roadway shared with the CDOT Traffic Operations Center (At Taft/1st and I-25/Crossroads).
5. First continuous, year round broadcast of the Loveland Road Report for construction/critical traffic conditions citywide (1610 AM radio).

Additional City of Loveland ITS accomplishments:

1. Establishment of **cooperative relationship with CDOT** of a Roadway/Remote Weather Information Site (RWIS); sharing CCTV snap shot video images (city camera and roadway sensors) and weather data (CDOT atmospherics and roadway sensors) with CDOT's Statewide Traffic Operations Center in Golden(2003).
2. **Interconnected all Downtown signals with central signal system** via fiber optics and on US 34 East near Centerra Pkwy (2007)
3. **US 34 East – Re-timed corridor** signals from Monroe Ave. to Centerra Pkwy – using new daytime cycle Length (Spring 2009).
4. **Centerra Parkway- Installed Signals**, Timed and Re-timed corridor after 2 years of operation and opening of roadway north to Crossroads (2006-2009)
5. **Wilson Avenue Signal Coordination** – Installed new signal timing for entire corridor from 1st Street to 43rd Street for good progression along corridor (Summer 2009).
6. **Initial Traffic Operations Center (TOC) phase completed** with a second TOC Remodel design underway.
7. New RWIS **Remote Processing Client (RPU) on US 287 near 19th Street S.E.**(Derby Hill) (Spring 2009).
8. Tested and now collecting data from a **low cost alternative RWIS/RPU** station at Wilson/50th Street that utilizes the Storm water alert system(2007).
9. **East First Street Corridor- constructed 4 traffic signals** and a school flasher zone as well as establishing traffic signal **progression** in the corridor (Completed 2008)


DOT
DEPARTMENT OF TRANSPORTATION
City of Loveland
ITS Inventory
NORTH FRONT RANGE
MPO
METROPOLITAN PLANNING ORGANIZATION
2004
LEGEND
Boundary of Traffic Signal Locations
Traffic Operations Center
Weather Station
Highway Advisory Radio
Pavement Sensor
Video Surveillance
Fiber-Optic Communication Network (PRPA)
Fiber-Optic Communication Network
57th Street
29th Street
37th St.
7th St.
16th St.
7th St.
1st St.
18th St.
Wilson Avenue
Taft Avenue
Garfield Avenue
Monroe Avenue
Lincoln Avenue
Boise Ave
Eisenhower Blvd
HORSESHOE LAKE
BOYD LAKE
LAKE LOVELAND
Ft. Collins-Loveland Municipal Airport
Earhart Rd.
HOUTS RES.
EQUALIZER LAKE
McWhinney Blvd
GW RW
Thompson
Big
River
CR 19
CR 17
CR 13
CR 11C
CR 9
CR 30
CR 26
CR 24E
CR 7
CR 24
CR 34
CR 30
CR 9E
CR 18
CR 13C
CR 16E
CR 16
CR 11
287
402
North
FELSBURG HOLT & ULLEVIG
IBI GROUP
CDOT Region 4 ITS Planning Services 03-185 12/3/03

Loveland is part of the North Front Range Metropolitan Planning Organization (NFRMPO) and as such part of the ITS Regional Architecture Plan and Strategic Plan completed for CDOT Region IV. These plans are required for federal funding for these types of projects. The City of Loveland receives federal transportation funding through the NFRMPO.

The Regional ITS Plan was completed and adopted as required by Federal Planning Documents for federal money to be used for ITS in Loveland's planning area. Projects were submitted and prioritized with this process and submitted to the NFRMPO to be included in the applicable funding/grant processes (Transportation Improvement Plan (TIP) and State -wide Transportation Improvement Plan (STIP)). At the time of the Strategic Plan with local entities included were invited to develop the plan.

Projects requesting funding at that time, included new or expanding existing ITS technologies and were prioritized during the process. Some of the specific projects included: traffic surveillance cameras, variable message signs, roadway/ weather information systems (RWIS), new communications links between Traffic Operations Centers (TOCs) including communications between State Traffic Operations Centers and local TOC's such as Greeley, Loveland, and Ft. Collins. The ITS Regional Architecture Plan was completed in 2004 by team comprised of the following:

- CDOT ITS and Region IV personnel
- Felsburg Holt & Ullevig Transportation consultant for CDOT
- IBI Group – Transportation consultant for CDOT
- NFR MPO local government Technical Advisory Committee (TAC)

Loveland city limits contain portions of **4 of the top 5 regional priority corridors**. According to the "Colorado Department of Transportation Region 4 ITS Strategic Plan (Figure 8)", these top regional priority corridors in Loveland are:

1. I-25
3. US 287
4. US 34 East of US 287
5. US 34 West of US 287.

Only one of the top 5 priority corridors, US Hwy. 85 (#2), is outside of Loveland.
Contracts are in place with CDOT to maintain state and US Highways in these high ITS priority corridors within Loveland

(except for I-25). Maintenance duties the city performs under the contracts include: snow plowing, street sweeping, weed mowing, and pot hole patching, as well as traffic signs, signals and markings.

Coordination between CDOT ITS efforts have been on-going. Meetings were held in Golden, Colorado at the Traffic Operations Center (TOC) and at Loveland's TOC to work on sharing data and future communications. There is a current plan in place to bring fiber optics to northern Colorado along I-25 that is now awaiting funding. This project would help bring communications together for the major cities in the NFRMPO as well as connect Colorado and Wyoming ITS efforts. There are additional major ITS efforts on-going along I-80 east of Cheyenne, Wyoming.

Currently roadway and weather information system RWIS data is shared with CDOT's TOC in Golden and some of the data is displayed from three City RWIS locations on COTRIP.ORG. Planning efforts have been underway to add RWIS, VMS signs, and CCTV in coordination with the CDOT Region IV Traffic Operations Engineers.

Since the plan was adopted, CDOT has also added ITS devices near Loveland. These include two VMS signs along I-25 north near the Harmony Road Exit and VMS Signs plus CCTV south of Loveland near the Berthoud Exit. The near term plan calls for CDOT to spend $4.2 million on ITS in the 4 corridors which are partially in Loveland, only portions of this plan are done.

PHASE I – LOVELAND ITS (Completed 2009)

The initial federally funded, Loveland ITS Update Project received a grant for a total project cost of $300,000 (80% Federal/20% city). This project completed the following primary elements:

1. Fiber Optics Communications system upgrade for communication to traffic signals on US 34 East to Centerra Parkway and along Centerra Parkway.
2. CCTV Camera additions for traffic surveillance at the interchange of US 34/I-25 and at Centerra Parkway/ US 34 Intersection.
3. Variable Message Sign construction (back to back VMS signs) on US 34 west of Denver Avenue.
4. Traffic signal system software upgrade (to Pyramids Software).

Objectives Completed:

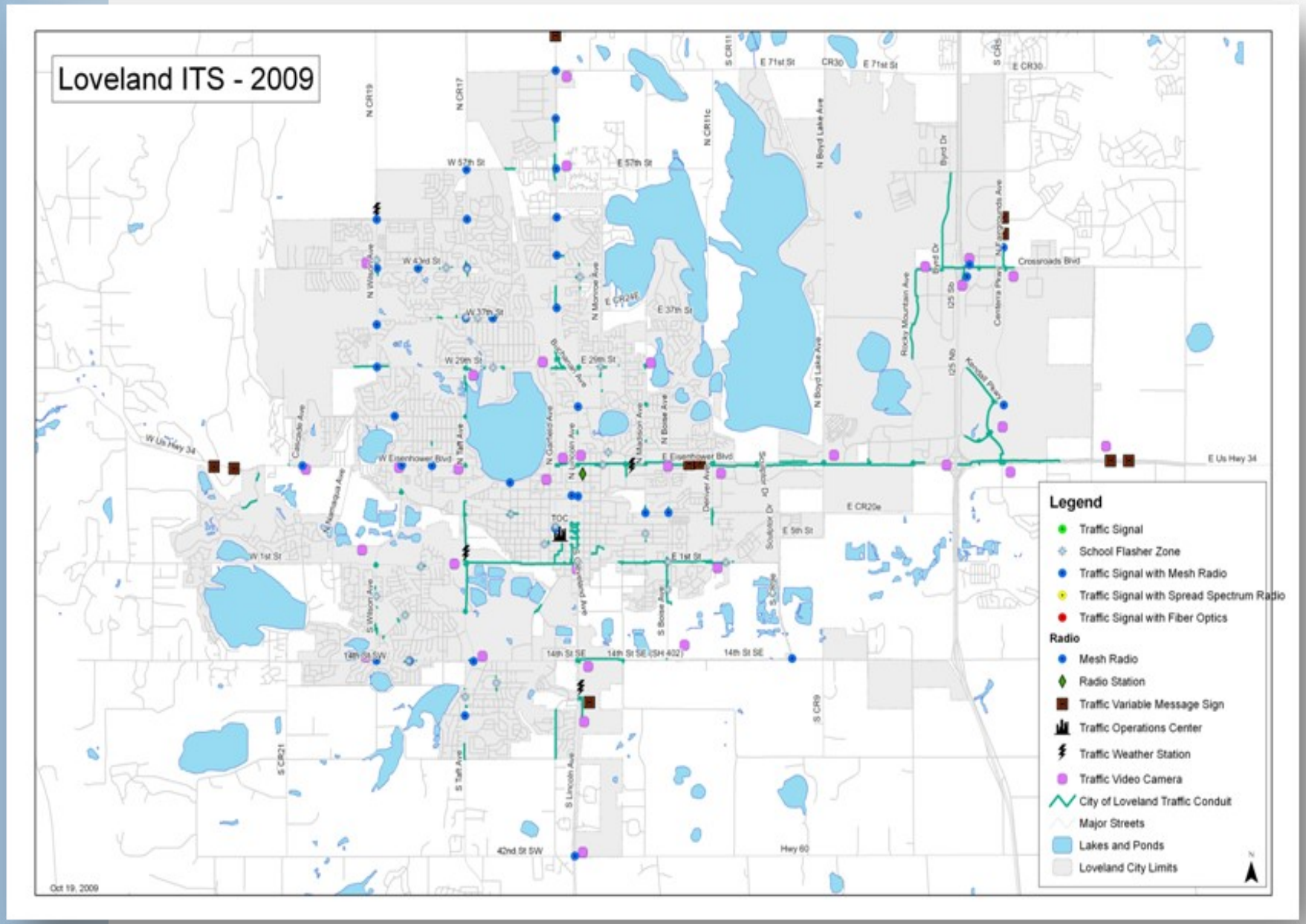
- Established system equipment for major traffic signal additions for fiber optics communications via Ethernet technology.
- Observations of real time traffic patterns via new CCTV cameras at I-25/US 34 Interchange now underway
- Automatic counts available for US 34 traffic
- Use traffic data collected from US 34 East and Centerra/Skypond video count stations to select area wide signal timing plans along US 34 east corridor automatically. (Work in progress)

PHASE II – ITS COMMUNICATIONS:

This element of the plan is to connect signals and other ITS devices in Loveland to the central computer system. The latest fiber optics communications using Ethernet Communications Technology is being utilized. Approximately 15% of the total fiber optics communications system is in place. Today 15% of traffic signals are using fiber optic communications with 35% of all signals now under central computer control.

Fiber optic cable services 14 signals (Downtown, near Centerra, and at Taft/1st). Fiber optic cable has just been installed on US 34 from Garfield to just east of Rocky Mountain Ave. This system backbone will be completed in 2010 and will allow for a City controlled fiber backbone along US 34 east.

This fiber optics backbone will make possible fiber connections to signals, cameras, VMS signs, and RWIS equipment along US 34. Ethernet and mesh radios are extending communications to cameras and 3 signals north of Kendall Parkway near the I-25/ Crossroads Interchange.


Loveland ITS - 2009
Legend
Traffic Signal
School Flasher Zone
Traffic Signal with Mesh Radio
Traffic Signal with Spread Spectrum Radio
Traffic Signal with Fiber Optics
Radio
Mesh Radio
Radio Station
Traffic Variable Message Sign
Traffic Operations Center
Traffic Weather Station
Traffic Video Camera
City of Loveland Traffic Conduit
Major Streets
Lakes and Ponds
Loveland City Limits
Oct 19, 2009

PHASE III – LOVELAND TOC (Original Plan):

Phase III will create a modern traffic operations center (TOC) in Loveland at the Maintenance Operations Center (MOC) located at 105 West 5th Street in Downtown Loveland. It will be connected to the other regional and statewide TOC facilities. This includes the City of Greeley, CDOT Region IV, and the City of Ft. Collins, as well as CDOTS's statewide TOC in Golden. A summary of the benefits is as follows:

- Establish a modern TOC
- Allow for peak hour and special events monitoring and traffic control and variable message sign control
- Add 1 technician to operate the TOC for daily peak hours and special events with no field tech and use the on-call tech for field work instead and use existing equipment (1 of 3 Traffic Division bucket trucks).

The capital cost for both the building remodel and upgrade of the current signal system is approximately $280,000.

Signal Systems/TOC/Communications Plan 2010-2014

SIGNAL SYSTEM COMPONENTS OF ITS

There have been a number of federal grants received to upgrade Loveland's system in the past 15 years to supplement on-going city funding. Currently Econolite's - Pyramids central system software is being used to communicate to nearly 40 signalized locations. This signal system software/technology is at least 10 years old and is being phased out by the company in favor of newer systems.

Most recently, a $130,000 federal Stimulus Money grant was awarded for upgrading the signal system software and computers. The central signal system computer and its software will be replaced with these funds in 2010.

The newest technology allows for "virtual" servers to be used on this type of project if desired and depending upon the system configuration. Coordination is currently underway with the City's IT Department to update the computers and software for the signal system. This is the heart of the City's ITS system.

Traffic Operations Center

An architectural plan for upgrading the Loveland Traffic Operations Center (TOC) building is now underway. A $150,000 project with the majority of funding from a Federal Highways Administration, this grant was received to complete a remodel/upgrade of the TOC located in the Traffic Offices at 105 W.5th Street. This project will reconfigure the current space and add 2 permanent work stations.

Currently the final architectural plans and specifications for bidding the project have been delayed (since September of 2009). This action has been necessary due to other Public Works Division moves from the MOC to the Service Center. The potential relocation of PW Divisions from the MOC has been made possible at the Service Center due to the recent vacation of the TV School District Transportation Operations and personnel at the Service Center.

Virtual traffic operations center is a new term that has been discussed recently. Technology continues to improve to

make this more possible. That is, the tapping into ITS data and systems by users from remote locations can be considered a "virtual TOC". This is not a new concept for traffic operations people; as more and more information with open access is made available to signal systems, RWIS data, CCTV, and other information can be used to make system operations decisions from remote locations.

The new signal system software was recently purchased utilizing federal funds. It will upgrade the system and allow running the signal system using a "virtual server" option. In other words, the system software would be contained on a computer that has other applications running on it and would not be housed at the TOC.

The virtual world of processing introduced will not eliminate the need for a TOC, as communications to and from field devices such as traffic signal controllers, CCTV, and RWIS equipment will need to come to a central point. Most communications will be done via fiber optics and then distributed via IP addressing to authorized users. Staff foresees the need for a small central command center now being designed for monitoring, maintenance and operations/management.

The upgrade of the TOC is now scheduled for completion in 2010. The expansion of the high speed communications systems (fiber and radio) to and from the TOC to traffic signals and other ITS devices should continue at a faster pace after TOC construction is complete. This communications portion of the City's ITS plan will promote communications for coordination of signals in key corridors and add ITS existing and proposed system components such as CCTV and RWIS devices.

Key communications will be established utilizing existing assets as much as possible. This includes the PRPA fiber ring of 12 fibers (shown on existing and future Loveland ITS maps) and City of Loveland Traffic conduit and fiber runs.

First- Priority will be to maximize the use of several existing conduits and/or fiber facilities to interconnect traffic signals and other ITS devices now deployed in the field. The Traffic Division owns a number of conduit and conduit with fiber in place. Existing fiber includes the 12 fibers available in the PRPA fiber rings around the city. These fibers are dedicated for use by the Traffic Division and encompass the city as shown on the drawing "Future Loveland ITS 2010-2014" in this document.

Second- Short communications system gaps/extensions will be completed to connect system components. Develop-

ment projects and other construction have provided conduit for future communications. Now is the time to take advantage of the utilities by adding conduit in the gaps and completing some fiber runs.

Third- Mesh/Ethernet radios will extend the fiber backbone of communications. This is done from mesh radio nodes installed at fiber end points including some on the PRPA ring. In this way Ethernet communications may be extended wirelessly. It is estimated that up to 30 mesh radios will be needed to complete communications to traffic signals in the next 5 years. The cost for these radios would be $52,000 plus modems and switches at an additional cost of $60,000.

Fourth - The existing spread spectrum radio system has all of the base yagi antennas on the roof of the MOC. Currently there are 12 signalized intersection that communicate with the central traffic signal system (Pyramids) via this system. They will be maintained for up to 5 years on the new system until fiber optics or mesh radios replace them as detailed further in this portion of the plan.

Fifth - Developer installation of the required 2" conduit/pull boxes/locate wire will continue to be installed along all arterial streets as per the Larimer County Urban Area Standards (LCUAS). This will extend the ability to have more fiber optics capabilities and eventually replace mesh radios in 10-20 years.

Proposed 5 Year Schedule

2010:

1. Complete fiber optics communications to traffic signals along US 34 from Garfield Avenue to Centerra Parkway.
2. Complete communications to VMS (2) west of Denver Avenue and RWIS (Scan Detector at Redwood/US 34.
3. Install Tropos mesh radio at Byrd Drive/Crossroads Blvd (and add CCTV).
4. Extend fiber from Cleveland and 1st Street on US 287 south to Colorado Highway 402 via PRPA Ring/City fiber and then east along 402 through St. Louis Avenue to the Boise Avenue signal.
5. Extend existing fiber east along 1st Street from US 287 (Lincoln Ave.) to Denver Avenue and connect signals.
6. Complete interconnect to Taft/8th Street using existing fiber on Taft Avenue from 1st Street north to Taft/8th

2011:

1. Connect the US 287 Triangle (Near 29th Street) area using PRPA fiber loop/City fiber to include the intersections of Madison/29th, Monroe/ 29th
2. Extend communications north on US 287 via mesh radios from 29th Street to 71st Street including all intersections along the way; Orchards-Wal-Mart, 37th Street, Knobcone, 50th , 57th, and 65th as well as connecting 29th/Lincoln, Monroe, Madison using PRPA fiber interconnect and including Madison/Silverleaf, Madison/Redwood

2012:

1. Extend fiber optics communication north from Taft Avenue/US 34 to 29th Street using the PRPA Ring/City Fiber.
2. Install Tropos mesh radio communications to extend communications north along Taft Avenue from a mesh radio node at 29th with radios to go in at Taft/57th and include the intersections at 22nd Street, 37th Street, 43rd Street, and 50th Street.
3. Extend City fiber to the north along Taft Avenue from 8th Street to US 34 in conjunction with the Phase II Taft Avenue street widening project.

2013:

1. Extend fiber optics communication south along Taft Avenue from Taft/1st to Taft/Carlisle in the existing conduit and establish a mesh radio node at that location.
2. Install Tropos mesh radio communications from Carlisle south to establish communications to all the signals to the south along Taft Avenue up to and including 14th SW, Fire station, 23rd SW, 28th SW, and Dotsero/14th SW.

2014:

1. Replace spread spectrum radios with mesh radios from Taft Ave/US 34 west to Cascade Avenue. This would establish Ethernet communications for signals intersecting with US 34 at Colorado, Van Buren, Wilson, and Cascade Avenues.
2. Install Tropos Radios for communications on Wilson Ave

5 Year Cost Analysis of Signal System/TOC/Communications Plan

Year	Mode(s)	Description	$ Cost
2010	Fiber Optics	US34/Garfield Ave to Rocky Mtn	$15,000
	Fiber/Radio	287S/State Highway 402	$60,000
	Fiber	1st Street – East	$35,000
2011	Fiber/Radio	US 287 North	$50,000
2012	Fiber/Radio	Taft Ave. North	$95,000
2013	Fiber/Radio	Taft Ave. South	$130,000
2014	Radio	US 34/ Taft to Cascade	$20,000
	Radio	Wilson Ave.	$50,000
Total			$455,000

Field Devices Plan 2010-2014

Significant ITS advances have been made in Loveland in the past 15 years. In the past, no in-house traffic/roadway condition data was being gathered remotely for staff analysis or public distribution, and there was no consistent measurement or dissemination of Loveland pavement or weather conditions for storm fighting efforts. Field information was taken by windshield surveys or obtained from broadcast radio and television. At that time, there was one local weather service being used, and no consistent local coverage of traffic conditions in Northern Colorado.

In addition to adding a central traffic signal system, the Traffic Division has added five (5) RWIS remote processing units (RPUs)/weather stations, video traffic surveillance-closed circuit television (CCTV) at six (6) locations, and three (3) permanent, programmable variable message signs (VMS), [also known as changeable message signs (CMS) and dynamic message signs (DMS)].

Road crew members and management may now monitor, via the internet, roadway condition data (wet/dry/chemically treated/temperature) and/or video images from over a dozen locations city-wide. Staff longer needs to rely on Denver News and Weather forecast data or police calls to schedule storm fighting personnel. Automatic custom tailored weather forecasts/reports and key roadway temperature forecasts are melded together to plan, schedule and deploy resources most efficiently, saving precious city general funds and most importantly maximizing safety for our transportation customers.

RWIS SYSTEMS

Roadway/Remote Weather Information Systems (RWIS) are systems that have been developed to gather field information regarding road and weather conditions. Information is used by managers and crews to effectively and efficiently deploy resources for the improved safety of the public. There are also other operations reasons to use data outside of storm fighting such as incident management, floods, windstorms, tornadoes, pavement markings applications, and other needs for data.

The Storm water Division of Public Works and the Parks Department utilize another remote sensing system to monitoring rainfall, stream flow, and soils conditions city-wide for early flood warning and soil moisture content for irrigation systems.

Storm water uses the stream flow/rain-fall gauges to monitor flooding potential on the Big Thompson River and other drainages. The Traffic Division installed a set of gates and warning flashers for the Storm water Division in advance of the Big Thompson low water crossing on Rossum Drive south of US 34. In the event of flooding on the Big Thompson, the gates will be closed and advanced warning flashers activated manually.

Recently, a RWIS remote processing unit (RPU) location with full weather station data, video camera, visibility sensor and road temperature sensors, plus a variable message sign (VMS) were all added on US 287 on Derby Hill. This was part of a federally funded signal/safety project. This location complements existing, older (Quixote) RPU locations at Taft Avenue/1st Street and I-25/Crossroads (shared with CDOT) and roadway and the Scan Detector-road temperature/condition sensor information being gathered on US 34 at Redwood Avenue.

DERBY HILL WEATHER STATION/VMS - Northbound on US 287 South

An experimental RWIS-RPU is currently operating at Wilson/50th. It gathers road temperature via an infrared pavement temperature sensor and has a precipitation sensor (heated rain gage). This uses the same system communications and software as the Storm Water Division and Parks Department use for rainfall and flood warnings.

The Derby Hill location (RPU) is the first to include a small variable message sign. This sign is directly connected to weather information to automatically trigger an icy road message when cold roadway temperature and moisture is sensed (see photos). This location also has an infrared pavement temperature sensor, an in-road sensor, precipitation sensor, wind speed, air temperature visibility and other sensors

Additional pan-tilt-zoom (25-PTZ) cameras will be added with the expansion of high speed communications. The 2010-2014 plan map shows locations for the system expansion of CCTV. Currently PTZ camera locations are monitored intermittently by Traffic Division Staff from office monitors in three locations in the Mainte-

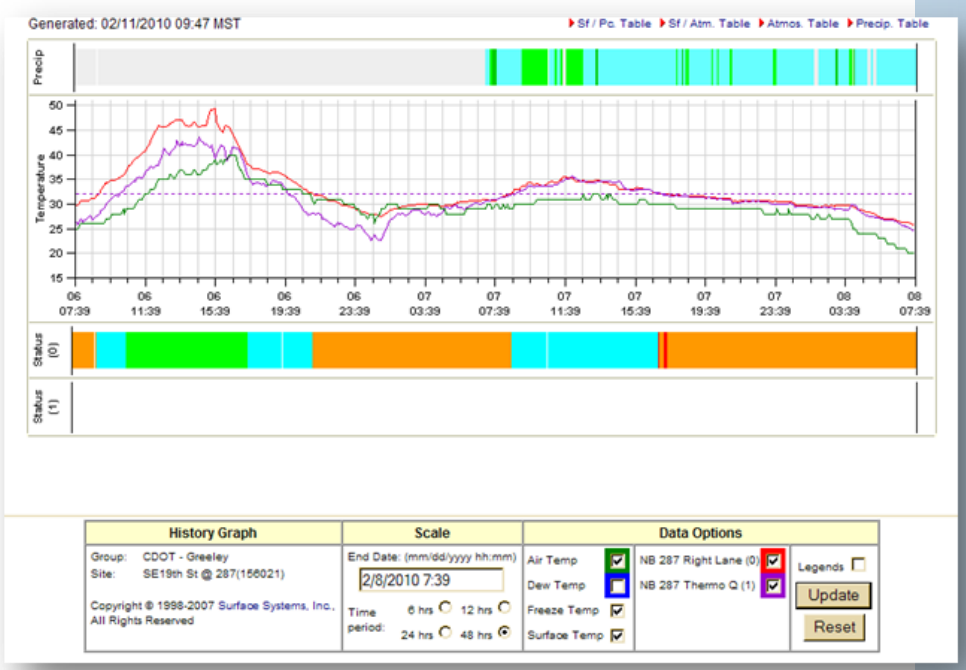
nance and Operations Center (MOC) including the TOC, City Traffic Engineer's Office and Customer Service area. Existing PTZ field cameras being monitored:

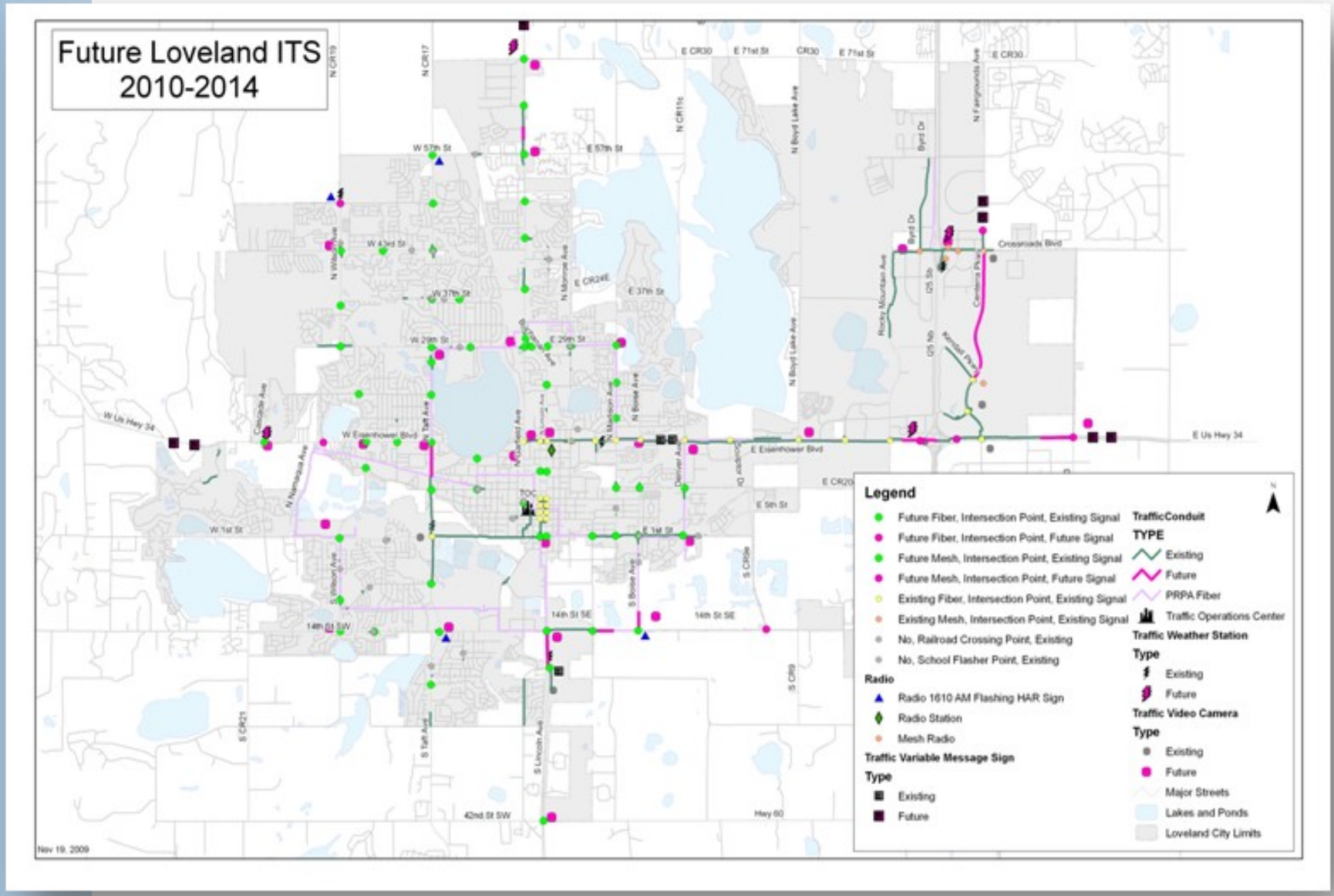
1. US 34/Centerra Parkway
2. I-25/ US 34 overpass
3. Centerra Parkway/Kendall Parkway
4. Fairgrounds/Crossroads Boulevard
5. Downtown Loveland (from the roof of the MOC)

Loveland CCTV cameras are also monitored by CDOT's TOC in Golden Colorado. Snap shot video images are available to the public via the internet at COTRIP.ORG for Loveland locations and may now be viewed for these locations:

- I-25/Crossroads N.B. Off ramp * CDOT RPU
- Taft Ave./1st Street
- US 287/19th Street SE (Derby Hill)

CDOT does not display live streaming video from any of our Loveland locations. They use snap shots of video images taken every 20 minutes and for the public accessible data via the internet http://www.cotrip.org/home.htm.




Future Loveland ITS
2010-2014
Legend
Future Fiber, Intersection Point, Existing Signal
Future Fiber, Intersection Point, Future Signal
Future Mesh, Intersection Point, Existing Signal
Future Mesh, Intersection Point, Future Signal
Existing Fiber, Intersection Point, Existing Signal
Existing Mesh, Intersection Point, Existing Signal
No, Railroad Crossing Point, Existing
No, School Flasher Point, Existing
Radio
Radio 1610 AM Flashing HAR Sign
Radio Station
Mesh Radio
Traffic Variable Message Sign
Type
Existing
Future
TrafficConduit
TYPE
Existing
Future
PRPA Fiber
Traffic Operations Center
Traffic Weather Station
Type
Existing
Future
Traffic Video Camera
Type
Existing
Future
Major Streets
Lakes and Ponds
Loveland City Limits
E CR30
E 71st St
N CR17
N CR15c
N Boyd Lake Ave
Byrd Dr
N Fairgrounds Ave
W 57th St
E 57th St
W 43rd St
W 37th St
E 37th St
E CR24E
N Monroe Ave
W 29th St
E 29th St
N Madison Ave
N Boise Ave
Rocky Mountain Ave
I25 Sb
I25 Nb
Crossroads Blvd
Centerra Pkwy
Arnold Pkwy
W Us Hwy 34
E Us Hwy 34
Cleveland Ave
N Namaqua Ave
N Taft Ave
W Eisenhower Blvd
E Eisenhower Blvd
N Garfield Ave
Denver Ave
E CR20
E 5th St
W 1st St
E 1st St
S Wilson Ave
14th St SW
14th St SE
S Boise Ave
S CR9e
S CR9
S CR21
S Taft Ave
S Lincoln Ave
42nd St SW
Hwy 60
Nov 19, 2009

5 Year Schedule for Field Devices Plan

Year	Mode(s)	Description	$ Cost
2010	CCTV	5 PTZ—Traffic Monitoring Cams(5)	$35,000
	RWIS	I-25/US 34—NEW RPU—Partial Site	$25,000
	VMS	————————————————	————
2011	CCTV	5 PTZ—Traffic Cams(5) + Decoder	$43,000
	RWIS	US 287 North New RPU	$50,000
	VMS	Fairgrounds North of Crossroads(2)	$100,000
	SCHOOL ZONES	Interconnect	$50,000
2012	CCTV	5 PTZ—Traffic Monitoring Cams(5)	$35,000
	RWIS	Wilson Ave. North—Replace	$50,000
	VMS	US 287 North for SB Traffic	————
	SCHOOL ZONES	Interconnect	$50,000
2013	CCTV	5 PTZ—Traffic Monitoring Cams(5)	$35,000
	RWIS	————————————	————
	VMS	US 34 East of High Plains Blvd.	$200,000
	SCHOOL ZONES	Interconnect	$50,000
2014	CCTV	5 PTZ—Traffic Cams(5)+Encoder	$43,000
	RWIS	US 34 West—RPU	$50,000
	VMS	US 34 West (2)	$200,000
	SCHOOL ZONES	Interconnect	$50,000
Total			$1,066000

Sharing ITS Data – Getting the Word Out

ITS is all about gathering transportation system data and sharing it. Information gathered is utilized to operate various components in order to maximize safety, efficiency, and capacity of our transportation system.

Sharing information from the ITS program is the cornerstone for achieving our goal of operating a complete transportation system. ITS in Loveland currently has *five key internal or external customers*. Each of the customers outlined below uses some or most of the available systems' data gathered by equipment installed and maintained by the Traffic Division. Below is a brief summary of key components used by each customer group.

1. Traffic Division Staff – gathers information to make traffic flow and signal system decisions daily and for special events, road construction, storms, and incident management. They use nearly all the systems to acquire data for the day to day operations and/or provide data to others. This includes traffic signal computer system monitoring, closed circuit video monitoring (CCTV), variable message signs (VMS), highway advisory radio (HAR) 1610 AM, remote/roadway weather and information system (RWIS) data, school zone flashers, COTRIP.ORG information, broadcast TV weather forecasting/ video and the city WebPages.
2. Streets Division Staff – needs information about traffic, roadway and weather conditions in order to allocate resources. This includes but is not limited to snowstorm preparation and storm fighting, floods, high winds/ tornados, and other incident management needs. They rely on RWIS, CCTV, Roadway forecasting service, broadcast TV, and early flood warning system data to develop strategies and action plans to address duties.
3. Public Works/Emergency Management/City Management Staff/PIO – accurate, up-to-date data is critical for management's allocation of resources and for the activation and use of the Emergency Operations Center (EOC). Both of these can be critical to the traveling public and community safety needs. Staff uses RWIS, COTRIP.ORG, Broadcast TV to make decisions on allocation of staff and community-wide emergencies and related information.
4. Travelers and the Citizens of Loveland – use broadcast TV, City of Loveland's Cable Channel, COTRIP.ORG, HAR (1610 AM/Loveland Road Report), broadcast radio, VMS signs, outside traffic and roadway condition services via emails, newspapers such as The Reporter Herald, instant messages, and more.
5. CDOT – uses our data and VMS signs to gather data for operations, emergencies, and maintenance decisions and share portions of the data with the public and the news media including weather conditions via the internet and VMS locations.

Current Information Program Components/On-going Programs

The most visible components of ITS in Loveland are the back to back VMS signs installed in the median of US 34 near Denver Avenue. Smaller VMS have been installed northbound on US 287 south of 19th Street S.E. on Derby Hill. These signs have been added in the last 2 years to provide information to roadway travelers in these major corridors. They are monitored 24 hours a day, seven days a week, and controlled by CDOT's state-wide TOC located in Golden.

These electronic variable message signs were funded via federal grants and over-matched with City Street CIP money. Highly visible, they are tools to help inform motorists, truckers, buses, bikes and pedestrians. Traffic Division and Street Division staff may request roadway related messages via CDOT's TOC in Golden. The TOC also places messages on these signs when necessary. Full-time Loveland TOC personnel from Loveland's TOC could provide a better level of service by keeping them current as conditions change locally.

The Loveland Road Report is a way to provide information to the media. It is released to the media, placed on the City web page, and recorded (voice only) every Friday for broadcast on the City of Loveland's Highway Advisory Radio (HAR) 1610 AM. During emergencies more frequent information may be made available via Loveland's public information officer (PIO) and using these tools.

Traffic count data is also gathered and published at least one time per year on the Traffic Division web page. This is an area that may be automated to provide real-time counts/travel time map and streaming video on key corridors such as US 34 and US 287 to the internet.

New sign installed by the Traffic Division – Operated by Loveland Fire Dept.

5 Year Schedule for Sharing the ITS Data

Getting the Word Out , Increasing Public Access to Information (5 Year Plan)

Key components for this effort will include:

- Continue Loveland Road Report/Web page (More frequent updates with full time TOC personnel) which includes 1610 AM Radio, local AM radio and RH Newspaper.
- Provide real-time ITS data the public traffic data via the latest (newer) technology web pages on the internet.
- Expand internal ITS including video delivery to management and EOC.

Year	ITEM	Description	$ Cost
2010	UPDATE WEBSITE	MODERIZE WEB PAGE	$10,000
2011	SOFTWARE FOR AR-TERIAL CONDITIONS MAP CCTV MONITORS	SOFTWARE MODULE FOR TRAVEL TIME DISPLAY ON INTERNET + MONITORS for FAB and CITY Hall	$53,000
2012	ARTERIAL TRAVEL TIME	US 34	$25,000
2013	ARTERIAL TRAVEL TIME	US 287	$25,000
2014	CCTV/MAP	CITY WIDE WITH CCTV ACCESS	$50,000
Total			$163,000

FUTURE CHALLENGES FOR ITS INTEGRATION:

Getting the Word Out on the Street

Distribution of travel information to the public is critical. This means utilizing a variety of methods including the internet to reach internal and external customers. To date, updates to the internet have been driven internally via the City's IT Department. Given the budget/personnel cutbacks alternate services delivery modes may be investigated to accommodate customer needs.

The general news media is engaged at this time via the Loveland Road Report which is distributed each Friday by the Traffic Division. Current road closure and road construction information is distributed by this report. More frequent emergency information may be distributed by the City's PIO.

Radio 1610 AM is a City radio broadcast station was purchased by the City (Loveland Police Department) in 1999. It is a 24 hour a day, seven days a week recorded broadcast with information about events in Loveland. As a part of this it is updated weekly on Fridays by Traffic Division Staff with the Loveland Road Report.

Emergency information about events such as snow storms, tornados and floods may be updated more frequently by the PIO or Traffic Division Staff. Flashers and additional signs will be added to existing locations on in-bound routes at Taft Ave/57th, Taft Ave/14th SW. These solar powered flashers to be located on the Emergency Radio 1610 AM signs will be controlled by Loveland Police Dispatch via existing Loveland Fire Department radio equipment. They are activated for emergencies as determined by LFD.

There is an on-going need to keep all roadway condition information current during large events and storms. The City does not have full time staff to monitor/update the information from the Traffic TOC, however, CDOT TOC staff is available 24 hours a day.

VMS signs in Loveland are used as roadway conditions warrant. The US 34/Denver Avenue back-to-back signs are monitored by CDOT at the state-wide TOC in Golden. There is also a small VMS sign on US 287 South near 19th Street SE for northbound traffic. The US 287 sign automatically displays an "Icy Road" message from pavement sensor but is capable of displaying other messages via the CDOT TOC.

Traffic and Street Division Staff may request messages from the CDOT TOC.

New Technology Opportunities

There are a number of rising technologies for transportation systems. One with great potential being tested now is the use of cell phone date with unique vehicle identifiers able to track corridor travel performance measures. This technology may soon be more widely used to accurately give vehicle travel times in corridors which could be useful as congestion increases.

New intersection controls including a new continuous flow intersection (CFI) scheduled for US 34/Madison Avenue in 2010 will present challenges. The Traffic Division will need to integrate this system of three traffic signals for one intersection controller into the signal system. This intersection will be the first of its type to operate in Colorado.

Linking TOC communications and sharing data with CDOT and other neighboring city TOCs is a goal that was identified in the Regional ITS Plan. CDOT currently has a plan to extend fiber optics along the I-25 corridor north into northern Colorado and to WYDOT in Cheyenne, Wyoming. Connecting the TOC in Loveland, Ft. Collins and Greeley will become important to travelers on existing and future transportation modes in Loveland and the North Front Range.

Construction is underway on a new interchange configuration for I-25/US 34. It will eliminate the high speed weaving movement from the current full cloverleaf configuration. This will add two more signal for the new off-ramp configuration which will be timed for vehicle progression on US 34 as well as allow access from I-25 onto US 34 and into Loveland and east to Greeley. This will increase the need to develop monitoring and control of the area from the TOC.

Key to the Traffic Engineering Division's mission will be the establishment of a full-time TOC staff. The future project, approved by the NFMPO for funding, will design, install and monitor a more traffic responsive signal plan for this critical area around the two key interchange areas along I-25 (US 34 and Crossroads). There will need to be on-going monitoring and control from the TOC.

In the next five years it is likely that a new signal on US 34 East at Larimer Parkway/Kendall Parkway will be built. It will require integration with signal system, video surveillance and coordination with the UP Railroad Crossing.

Integration of Street Division anti-icing systems (spray systems) will require utilizing RWIS technologies. Assistance for Street Division's optimum use of resources and anti-icing chemicals is key to their mission. Supply of RWIS/CCTV images and RWIS data is planned in this document and will need to be supported by the addition of TOC staff.

Today there are a number of systems gathering weather data for Public Works, Parks, and Emergency services. Weather forecasting and rainfall/precipitation information is a common area to all parties. Now is the time to plan/develop better, more economical data sharing for Traffic, Streets and Storm Water Divisions, Ft. Collins-Loveland Airport, Fire Department, Police Department, LFD, and PW Management to reduce duplicate systems, associated costs and improve efficiencies.

The Fort Collins-Loveland Municipal Airport is planning a significant dollar investment in an RWIS system at the airport. Before purchase of another system, consideration should be given to coordinating it with existing systems.

Serious planning for sharing ITS data and particularly traffic count data and related information efficiently with CDOT has been underway for two years. Staff members are part of CDOT's state-wide committee for sharing this data. Cost efficiency via coordination of data collection can reduce duplication of traffic data collection for CDOT, cities, and private developers. State-wide traffic count sharing efforts are being established by CDOT's Headquarters Traffic Unit.

Informing the public of transportation system performance is very important. According to The Hill's Congress Blog, 12-040-9, "ITS technologies are beginning to move our transportation network into the digital age, and are already providing major improvements in transportation safety, mobility, efficiency, and the environment." We need to continue to use technology and find additional ways to inform the public of roadway/transportation system conditions and integrate with other systems. Information from COLT, Loveland-Ft. Collins Airport, Saint, and news media will be needed to evaluate and respond to incidents.

PRIORITY GOALS

Below is matrix of major projects and associated costs needed to keep Loveland's ITS program moving forward to best serve the data customers:

5 Year ITS Investment Details

Year	Project	Budget	Potential $ Source	Investment Value
2010	TOC Remodel	$150,000	Fed $100k/City 50k	Video Wall + 2 operator/work and stations
2010	Signal Computer Upgrades	$130,000	100% Fed Stimulus	Modern Signal System-Integrated with ITS Software
2010-2014	Ethernet-Communications completion	$455,000	FASTER/City	High Speed Ethernet Communications Network
2010-2014	New Signal controllers	$260,000	FASTER	Modern Signal Controllers with FHWA standard operating features
2010-2014	Field Devices	$1,066,000	FASTER	25 CCTV, 3 RPUs, 6 VMS
2010-2014	Information Program	$163,000	FASTER	Upgraded website, arterial travel time mapping for US 34, US287
2012	Staff TOC (ongoing)	$65,000/yr	City$45k/FASTER	Staff(1) for TOC for evenings and major events to improve traffic flow
2012	Crossroads Area Signal Timing	$200,000	Fed CMAQ $130/City$70k	Add traffic responsive signal timing for events near The Ranch/I-25
2013	Arterial Travel Time via system	$200,000	FASTER	Add arterials such as Taft Ave to the travel time system map
Total		**$2,689,000**		

APPENDIX A

By SIOBHAN HUGHES

WASHINGTON—The Obama administration set stricter limits on the amount of nitrogen dioxide in the air for short periods of time along busy roads and is requiring states to install monitoring equipment in big urban areas in an effort to crack down on pollution during periods of high traffic.

Vehicles are a major source of nitrogen dioxide, which can cause respiratory problems.

The Environmental Protection Agency issued the new standard Monday, seven months after first proposing new short-term limits. Businesses said the new standard is too strict while environmentalists said it didn't go far enough. The EPA set the acceptable amount of nitrogen dioxide in the atmosphere at 100 parts per billion over any hour-long period. The EPA last year proposed a limit of as little as 80 parts per billion.

The rules are years from having a practical effect. The EPA said that monitoring equipment must be in operation in 2013. After that, three years of data will be needed to determine which areas are out of compliance. Currently, Cook County, Ill., the home of Chicago, is the only urban area that measures emissions on an hourly basis and thus the only urban area known to be out of compliance with the new standard. Failure to comply could lead to the loss of federal highway funds.

Under the EPA rule, monitors must be located near roadways in cities with at least 500,000 residents.

"EPA is over-regulating this air quality standard for political—not health—reasons," the American Petroleum Institute, the oil industry's trade group, said in a statement. "Today's standard is bad public policy and does not justify the additional economic burdens placed on consumers, states and industry."

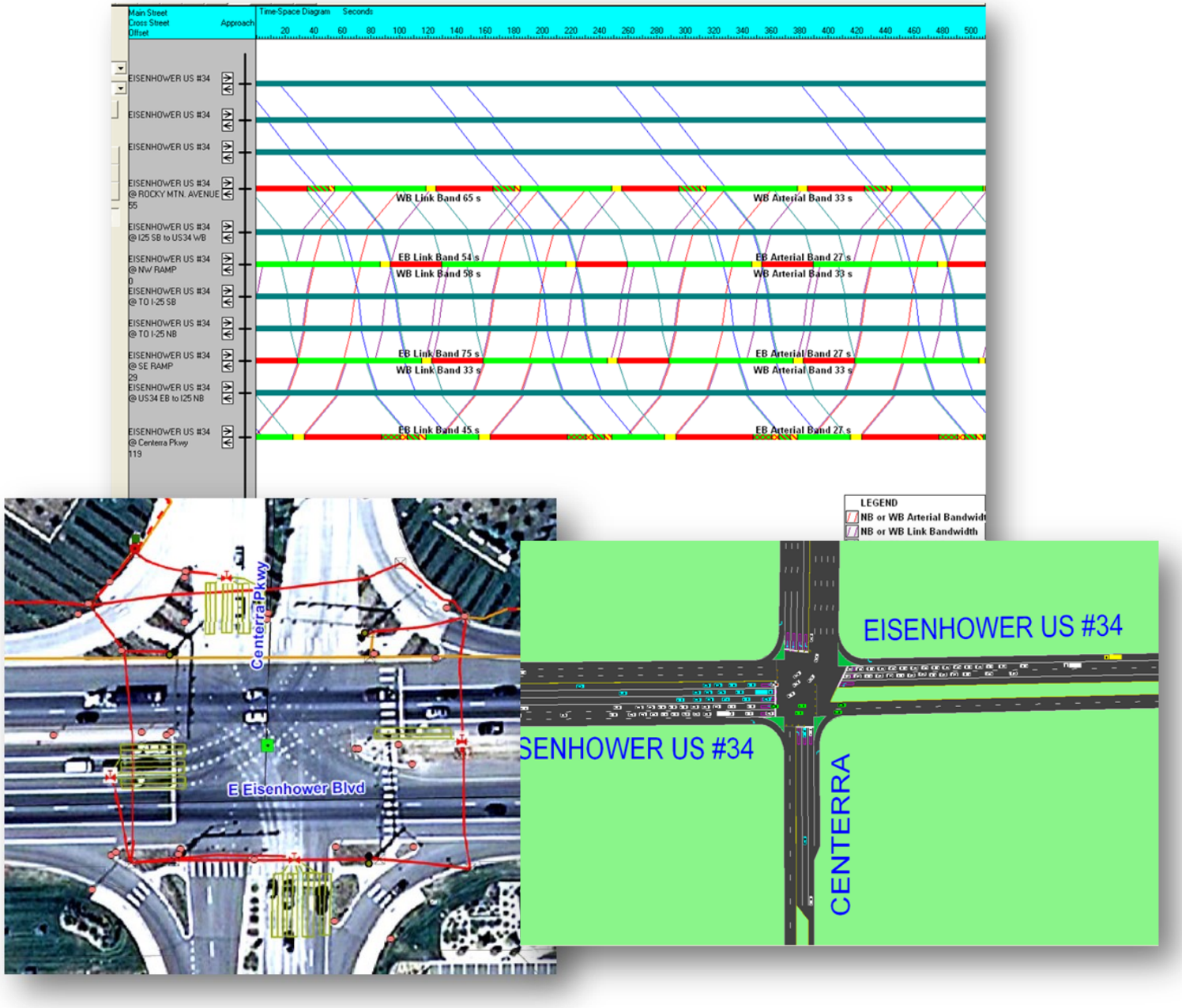
Frank O'Donnell, the president of Clean Air Watch, an environmental group, said, "This standard is a step forward for public health protection, but it is also a missed opportunity to do something better for the breathing public."

The EPA first set standards for nitrogen dioxide in 1971 to protect health and the environment. Until now, the EPA has set only annual limits.

Write to Siobhan Hughes at siobhan.hughes@dowjones.com

Glossary of Terms and Acronyms

ITS = Intelligent Transportation System
TOC = Traffic Operations Center
CDOT = Colorado Department of Transportation
PTZ = Pan Tilt Zoom
CCTV = Closed Circuit Television
RWIS = Roadway /Remote Weather Information System
RPU = Remote Processing Unit
MOC = Maintenance Operations Center
HAR = Highway Advisory Radio
LFD = Loveland Fire Department
IT = Information Technology
COTRIP.ORG = CDOT's Website for statewide roadway information/video
TIP = Transportation Improvement Plan (CDOT Document)
STIP = Statewide Transportation Improvement Plan (CDOT Document)
VMS = Variable Message Sign
DMS = Dynamic Message Sign
CFI = Continuous Flow Intersection
Yagi = Directional (one main direction)


Main Street
Cross Street
Offset
Approach
Time-Space Diagram Seconds
20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500
EISENHOWER US #34
EISENHOWER US #34
EISENHOWER US #34
EISENHOWER US #34 @ ROCKY MTN. AVENUE 55
EISENHOWER US #34 @ I25 SB to US34 WB
EISENHOWER US #34 @ NW RAMP 0
EISENHOWER US #34 @ TO I-25 SB
EISENHOWER US #34 @ TO I-25 NB
EISENHOWER US #34 @ SE RAMP 29
EISENHOWER US #34 @ US34 EB to I25 NB
EISENHOWER US #34 @ Centerra Pkwy 119
WB Link Band 65 s
WB Arterial Band 33 s
EB Link Band 54 s
WB Link Band 58 s
EB Arterial Band 27 s
WB Arterial Band 33 s
EB Link Band 75 s
WB Link Band 33 s
EB Arterial Band 27 s
WB Arterial Band 33 s
EB Link Band 45 s
EB Arterial Band 27 s
LEGEND
NB or WB Arterial Bandwidt
NB or WB Link Bandwidth
Centerra Pkwy
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SENHOWER US #34
CENTERRA