Rocky Mountain National Park

Dynamic Message Sign/Highway Advisory Radio

Operations Plan

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TABLE OF CONTENTS

Cover Photo – A view from Flattop Mountain Trail (Photo courtesy Kevin Witte.)

LIST OF TABLES

LIST OF FIGURES

GLOSSARY OF ABBREVIATIONS

AADT	Average Annual Daily Traffic
CDOT	Colorado Department of Transportation
CO_2	Carbon Dioxide
DMS	Dynamic Message Sign
FCC	Federal Communications Commission
FHWA	Federal Highway Administration
CFLHD	Central Federal Lands Highway Division
HAR	Highway Advisory Radio
ITS	Intelligent Transportation Systems
MUTCD	Manual on Uniform Traffic Control Devices
ROMO	Rocky Mountain National Park
SR	State Road
TRIPTAC	Paul S. Sarbanes Transit in Parks Technical Assistance Center
WTI	Western Transportation Institute

1. INTRODUCTION

1.1. Background

Visitation to Rocky Mountain National Park (ROMO) has remained consistent over the last few years, with approximately 3 million annual visitors (1). It is the most visited National Park site in Colorado (2). The Town of Estes Park is the gateway community to ROMO for visitors who arrive on the east side of the park. A large portion of visitors arriving from the east are from the "front range" cities, which include Denver, Boulder, Loveland, and Fort Collins, as shown in Figure 1; visitors from the front range make up approximately 40 percent of the annual visitation (2).

Figure 1: Front Range Visitors (3)

The majority of visitors who access ROMO on the east side are drawn to the Glacier Gorge and Bear Lake Trailheads, which are located within the Bear Lake Road corridor. On weekends during the peak summer season, the parking lots at these trailheads were at capacity by 8 and 10 am, respectively, according to a study funded through the 2007 Paul S. Sarbanes Transit in Parks Programs (previously the Alternative Transportation in the Parks and Public Lands program) (4). Additional parking is found at the Bear Lake Park-and-Ride; however, it also reaches capacity on summer weekends as early as 11:30 am (4). In fact, these trailheads are so popular that the author observed the Glacier Gorge Trailhead near capacity at 9 am on Saturday, February 19, 2011, which is the winter season for ROMO. By 2 pm that same day, visitors were parking outside of designated spaces. Figure 2 shows congestion within the Bear Lake Trailhead parking lot at 2 pm on February 19, 2011.

Figure 2: Bear Lake Trailhead Parking Lot, 2/19/2011, about 2pm

A future planning study funded through a 2010 Paul S. Sarbanes Transit in Parks Program Grant, will pursue a wide array of mechanisms to reduce congestion and thereby increase visitor satisfaction, including spatially and temporally redistributing visitation, modifying the transit routes, and implementing a larger network of Intelligent Transportation Systems (5). These long-term initiatives are in the planning stages, as ROMO studies factors such as which resources can handle redirected visitation. As an interim solution, ROMO is hoping to alleviate some of the congestion experienced within the park by intercepting visitors with a new park-and-ride lot in the Town of Estes Park and potentially temporally redistributing visitors. The anticipated completion date of the new park-and-ride in Estes Park is May 27, 2011. Figure 3 shows the spatial locations of the Bear Lake Trailhead parking, Glacier Gorge Trailhead parking, Bear Lake Park-and-Ride, Beaver Meadows Visitors Center, and the new Estes Park Park-and-Ride lot.

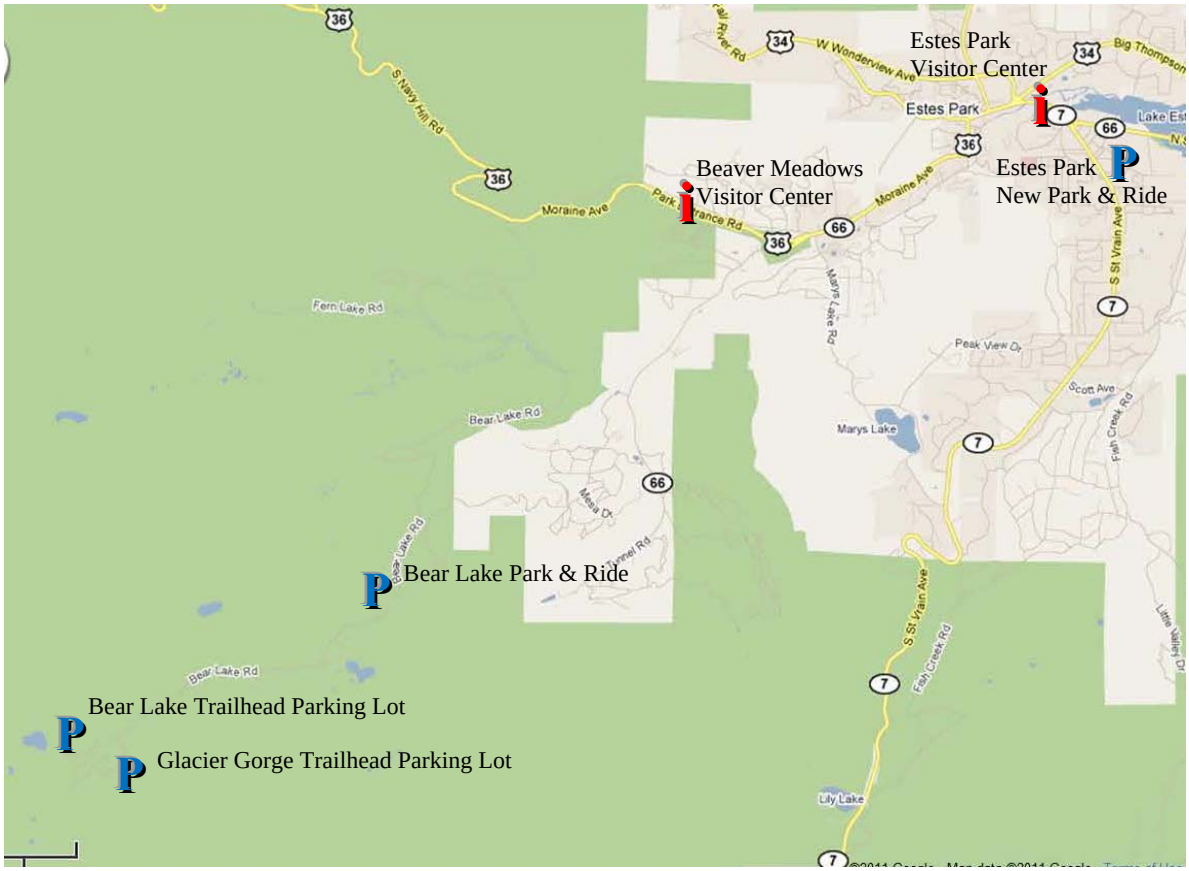

Figure 3: Bear Lake Corridor (3)

The new park-and-ride lot in the Town of Estes Park, located within the Fairgrounds at Stanley Park, is being constructed with $956,000 received from the Congestion Mitigation and Air Quality (CMAQ) Improvement Program and $250,000 contributed by the Town (7). Therefore, the Town of Estes Park is interested in quantifying the reduction in air pollution resulting from the diversion of visitors to the new park-and-ride lot.

Visitors to Rocky Mountain National Park have the option of utilizing transit between Estes Park and Rocky Mountain National Park. The Hiker Shuttle operated by ROMO and the Brown and Red Route operated by the Town of Estes Park provide a connection between Estes Park and ROMO.

The Hiker Shuttle currently stops at the Bear Lake Park-and-Ride, the Beaver Meadows Visitor Center, and the Estes Park Visitor Center, as shown in Figure 4. The Hiker Shuttle begins running at 6:30 am leaving from the Estes Park Visitor Center, with its last run leaving from the Bear Lake Park-and-Ride at 8 pm. The Hiker Shuttle runs hourly early and late in the day, and runs every 30 minutes from 10 am to 6 pm.

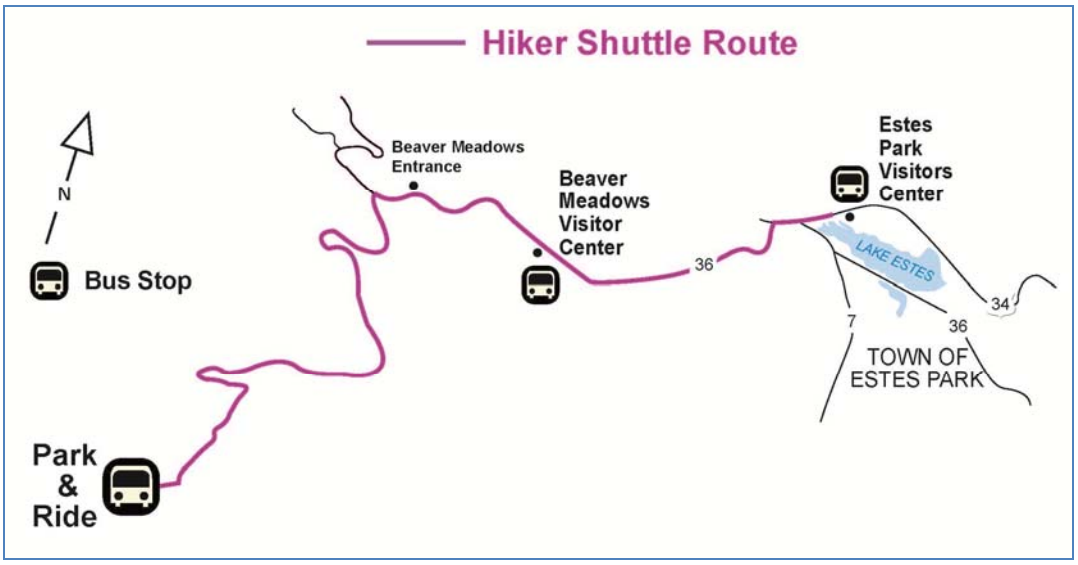

Figure 4: Hiker Shuttle Route (8)

The Town of Estes Park has three shuttles: the Red, Blue and Brown routes, as shown in Figure 5. The Red and Blue Routes are sometimes called the "Shopper Shuttles," and the Brown Route is sometimes referred to as the "Campground Shuttle." For the 2011 season, the shuttle operating schedule has been extended to offer longer service than the 2010 schedule. The Red Route service begins at 10 am leaving from the Estes Park Visitors Center, running every half an hour through 7:30 pm. After 7:30, it does two more loops, one at 8:30 pm and one at 9:30 pm. The Red Route provides a connection to ROMO through the Fall River Visitor Center. However, the Fall River Entrance to the park is not nearly as popular as the Beaver Meadows Entrance, which is serviced by the Town's Brown Route. The Brown Route operates hourly from 10 am through 8 pm. The Blue Route service begins at 10 am leaving from the Estes Park Visitors Center, running every half hour through 7 pm. After 7 pm, it does two more loops, one at 8 pm and one at 9 pm.

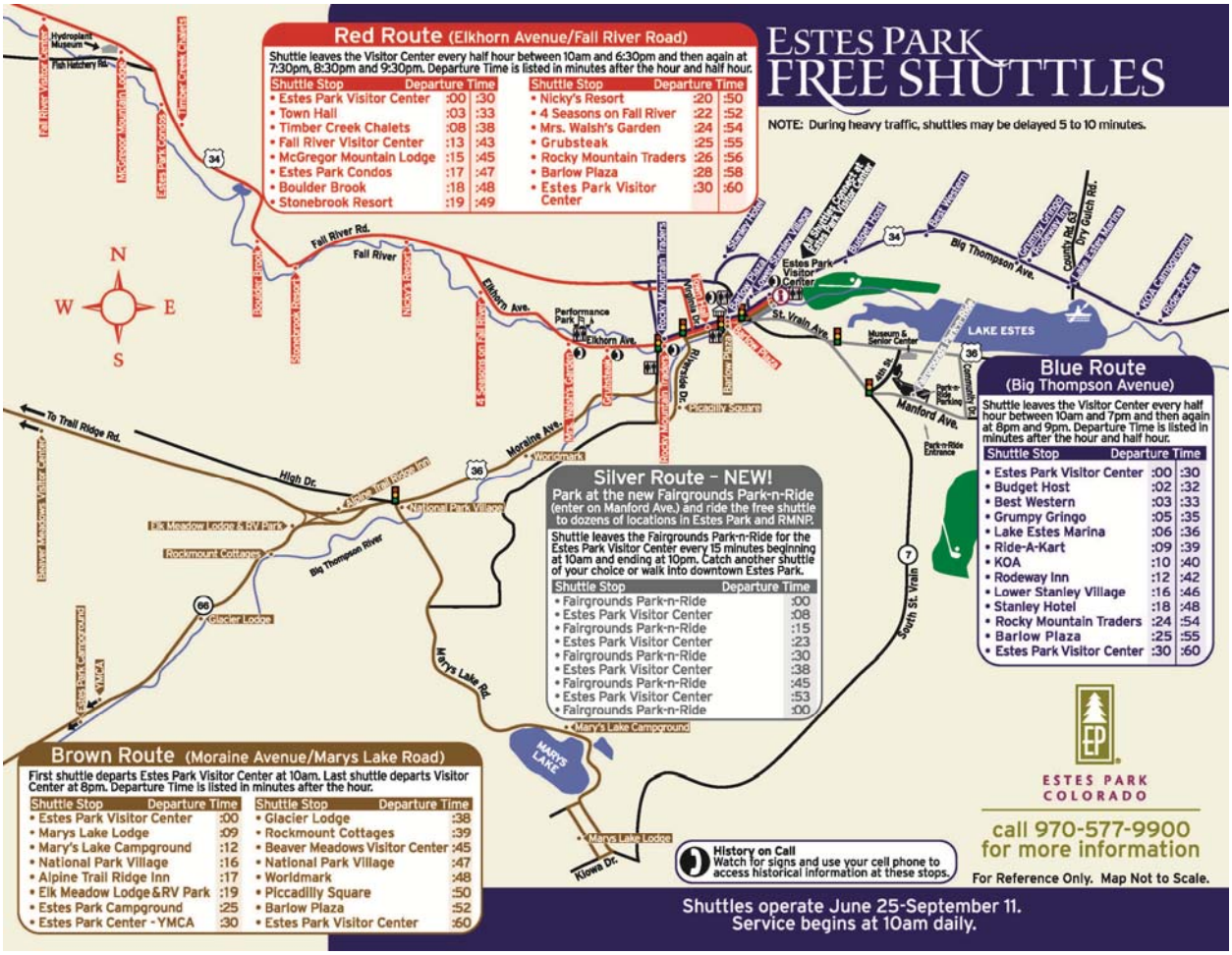

Figure 5: Town of Estes Park Shuttles (8)

During the pilot Intelligent Transportation System deployment, no changes will be made to the Hiker or Shopper Shuttle stops. Instead, to connect the new park-and-ride lot with the Estes Park Visitor's Center, an additional shuttle called the Silver Route will run between the two locations from 10 am until 10 pm, leaving from the Estes Park Park-and-Ride approximately every 15 minutes.

1.2. Goals, Objectives, and Performance Measures

This project will deploy and test Dynamic Message Sign (DMS) and Highway Advisory Radio (HAR) technologies, as an interim solution to the congestion issues in the Bear Lake Corridor. Central Federal Lands Highway Division (CFLHD), working in collaboration with Rocky Mountain National Park, recommended pursuing an interim solution until the planning effort from the 2010 Paul S. Sarbanes Transit in Parks grant is complete.

The goals of the interim Intelligent Transportation System (ITS) for Rocky Mountain National Park are to:

1) Shift visitors' travel mode from private vehicles to shuttle buses,
2) Quantify the reductions in emissions pollution as a result of the mode shift,
3) Intercept visitors east of their arrival to the Town of Estes Park,

4) Peak spread the arrival of people and vehicles into ROMO using an "Insider's Tip" on the HAR,
5) Improve the visitor experience through better dissemination of traveler information,
6) Successfully collaborate with the Town of Estes Park, the Colorado Department of Transportation (CDOT), and CFLHD,
7) Introduce ROMO to ITS Systems, and
8) Select ITS devices easy to operate and maintain.

To help determine whether the goals of the project have been achieved, the research team has established objectives and performance measures for each goal. The following sections identify each goal and the supporting objectives and performance measures.

Table 1: Goal One

GOAL: Shift visitors' travel mode from private vehicles to shuttle buses		
1	**OBJECTIVE:** Increase daily ridership of shuttles when the 2011 ITS system is operable as compared to the periods when the ITS is not operable	
	PERFORMANCE MEASURE: Predicted daily ridership counts when the ITS is and is not operable	
2	**OBJECTIVE:** Demonstrate that the 2011 ITS system has influenced visitors to utilize the shuttle system	
	A	**PERFORMANCE MEASURE:** Percent of survey users influenced by the DMS/HAR to utilize the shuttles
	B	**PERFORMANCE MEASURE:** Percent of survey users that learned about the shuttle through the DMS/HAR

Table 2: Goal Two

GOAL: Quantify the reductions in emissions pollution as a result of the mode shift
OBJECTIVE: Reduce the carbon dioxide (CO_2) emissions during the 2011 ITS deployment
PERFORMANCE MEASURE: Amount of CO_2 reduction during the 2011 ITS deployment

Table 3: Goal Three

GOAL: Intercept visitors east of their arrival to the Town of Estes Park	
OBJECTIVE: Increase usage of the new park-and-ride lot in the Town of Estes Park during the 2011 ITS deployment	
A	**PERFORMANCE MEASURE:** Silver Route ridership counts with and without ITS
B	**PERFORMANCE MEASURE:** Occupancy of the Estes Park Park-and-Ride lot with and without ITS
C	**PERFORMANCE MEASURE:** Percent of survey users influenced by the DMS/HAR to utilize the Silver Route

Table 4: Goal Four

GOAL: Peak spread the arrival of people and vehicles into ROMO using an "Insider's Tip" on the HAR	
OBJECTIVE: Delay the arrival of some visitors to ROMO by providing an "Insider's Tip," which tells visitors the best time to visit to avoid congestion, in the HAR message	
A	**PERFORMANCE MEASURE:** Percent of survey respondents that delayed their visit to ROMO due to the "Insider's Tip" on the HAR*
B	**PERFORMANCE MEASURE:** Opinions of stakeholders on the effectiveness of the "Insider's Tip" to persuade visitors to delay their visit to ROMO*

*Utilizing the "Insider's Tip" is not recommended on days where afternoon thunderstorms are expected.

Table 5: Goal Five

GOAL: Improve the visitor experience through better dissemination of traveler information
OBJECTIVE: Document a statistical correlation between a positive visitor experience and utilization of the information from the 2011 ITS
PERFORMANCE MEASURE: Visitor rating of visitor experience and use of 2011 ITS

Table 6: Goal Six

GOAL: Successfully collaborate with the Town of Estes Park, CDOT, and CFLHD
OBJECTIVE: • Show support from stakeholders in the Town of Estes Park for the 2011 and future ITS • Show support from CDOT for the 2011 and future ITS on the corridor to ROMO • Show support from CFLHD for the 2011 ITS deployment
PERFORMANCE MEASURE: Stakeholder opinions on the benefits of collaboration, challenges experienced while collaborating, satisfaction with 2011 ITS deployment, effectiveness of DMS/HAR to affect driver behavior, and support for future ITS deployments

Table 7: Goal Seven

GOAL: Introduce ROMO to ITS Systems
OBJECTIVE: Introduce ROMO employees to the use of ITS by implementing DMS/HAR during the summer of 2011
PERFORMANCE MEASURE: Entries on the DMS and HAR logs showing the equipment was implemented and utilized

Table 8: Goal Eight

GOAL: Select ITS devices easy to operate and maintain	
1	**OBJECTIVE:** Allow ROMO remote access to the DMS for the 2011 ITS
	PERFORMANCE MEASURE: Acknowledgment by stakeholders that rented equipment allowed ROMO to remotely access and change messages on all of the DMS
2	**OBJECTIVE:** Allow ROMO remote access to the HAR for the 2011 ITS
	PERFORMANCE MEASURE: Acknowledgment by stakeholders that rented equipment allowed ROMO to remotely access and change any messages on all of the HAR
3	**OBJECTIVE:** ROMO staff spends less than 4 hours to apply for the temporary FCC license for the 2011 ITS
	PERFORMANCE MEASURE: Amount of time spent to complete the FCC license for the 2011 ITS
4	**OBJECTIVE:** ROMO has no perceived difficulty in operating DMS and HAR
	PERFORMANCE MEASURE: Stakeholder opinions on ease or difficulty of DMS and HAR operations and maintenance

1.3. Project Overview

For traveler information, DMS and HAR function best in tandem. DMS catch travelers' attention. However, the amount of information that can be conveyed through DMS is very limited. HAR, in contrast, may go unnoticed if either static signs or in particular DMS are not utilized. HAR provides significantly more information than DMS. Together, these two devices can catch, engage and inform a traveler.

Considering the effectiveness of DMS and HAR in tandem, the proposed ITS will include two portable HARs and four portable DMS. The DMS will be placed on SR 66 and US 36 before their junction (Location 1), on US 36 near Pinyon Trail (Location 2), and prior to Community Drive (Location 3), as shown in Figure 6. The DMS will only face westbound traffic.

Figure 6: DMS & HAR Locations (3)

One HAR will be placed on the east end of Lyons inside the City of Longmont Water Treatment Plant (see Location 1, Figure 6) to function in tandem with the DMS along SR 66 and US 36; a second HAR will be placed west of Pinyon Trail as US 36 enters Estes Park (see Location 2, Figure 6) to function in tandem with the DMS. The DMS/HAR systems will be used to inform travelers about the new park-and-ride lot in Estes Park, the shuttle bus service, general park information/fee options, and less congested times of the day to visit Rocky Mountain National Park. Figure 7 and Figure 8 show the DMS and HAR, respectively, that will be deployed for this pilot Intelligent Transportation System.

Figure 7: Highway Advisory Radio (HAR) Trailer

Figure 8: Portable Dynamic Message Sign (DMS)

Generally, the ITS implementation period extends from July 15, 2011 through September 5, 2011. However, the next few paragraphs elaborate on factors which affect the exact implementation dates for some of the specific equipment.

The HAR contractor requires a three month minimal rental period; therefore, it is recommended that the HAR be rented from June 16, 2011 through September 15, 2011. Of the available HAR vendors, this requirement still resulted in the most cost-effective deployment. The research team will use the additional time period between rental and operation to test the equipment. Testing the equipment to find the optimal location is beneficial for this application because of the mountainous topography, which may obstruct the HAR transmission.

For this project, CDOT is scheduled to loan two DMS from July 6, 2011 through September 6, 2011. The additional time period between the loan date and the operation start date (from July 6 to July 14) will allow Rocky Mountain National Park staff members to be trained on the equipment and test the remote capabilities.

Two additional DMS will be rented from a vendor from July 14, 2011 through September 6, 2011. It is expected that the vendor will place the DMS at its location on the rental start date and remove the DMS on the rental end date.

Figure 9 summarizes the information discussed in the previous paragraphs in a timeline.

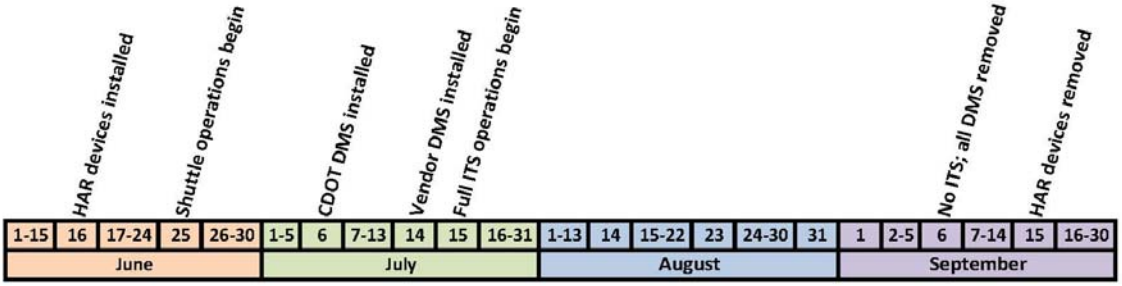

Figure 9: ITS Implementation Timeline

The research team recommends that the DMS and HAR be turned on at 9:45am on days of operation and turned off at 6pm. This schedule coordinates with the operations of the Silver Shuttle, which begins at 10am daily and the Hiker Shuttle, which ends at 8pm daily. Both of these shuttles are discussed on the HAR.

The Evaluation Plan will provide further information about the data collection process. Data including ridership, traffic counts, and Beaver Meadows Entrance counts will be utilized. In addition, surveys will be administered during full ITS operations to evaluate the effectiveness of the system. The Paul S. Sarbanes Transit in Parks Technical Assistance Center (TRIPTAC) will be analyzing the data collected during the ITS pilot study.

2. OPERATIONAL GUIDELINES

2.1. Conditions for Use

The HAR system is designed to disseminate traveler information. Individual broadcast messages are selected based on the priority of events associated with different conditions (e.g., traffic, weather, and hazardous conditions, transit service, general park information/fee options).

When DMS and HAR are coordinated and used in tandem, the DMS is designed to display a summary of the specific condition (e.g., parking availability, traffic congestion), an action to be taken by the motorists (e.g., park-and-ride), and a reference to an HAR frequency that motorists can tune to for more information. When no specific safety advisories are necessary (under "normal" conditions), the DMS system will advise motorists to tune to the HAR frequency for transit service and transportation-oriented park information/fee options, in order to maximize the use of DMS/HAR systems. In every case, the HAR should be programmed before the message is displayed on the DMS. The DMS should be deactivated before the message is taken off the HAR.

2.2. Coordination and Deployment

Placement of the DMS/HAR within the right-of-way along SR 66 and US 36 requires permit/authorization from the Colorado Department of Transportation (CDOT). The deployment, operations, and maintenance of the DMS/HAR system require interagency cooperation, as discussed in more detail below.

2.3. Personnel and Responsibilities

This section lists the agencies and departments that will be taking part in the operations and execution of the operations plan, and their respective responsibilities. A list of personnel and contact information is located in Appendix A.

2.3.1. Rocky Mountain National Park (ROMO)

Responsibilities of ROMO include:

1) Request encroachment permit through CDOT

2) Request permission for placement of HAR within City of Longmont Water Treatment Plant fencing

3) Coordinate with CFLHD to contract a DMS vendor

4) Coordinate with CFLHD to contract a HAR vendor

5) Collaborate with HAR vendor to apply for a temporary FCC license

6) Operate DMS (e.g., turn on/off, change messages)

7) Keep a DMS message log including date, time turned on, location, message utilized, time message changed/DMS turned off (Appendix B)

8) Contact CFLHD if DMS system is not functioning, and maintain log of this information including date, time, location, how long system is inoperable, and when/how restored (Appendix B)

9) Operate HAR (e.g., turn on/off, change messages)

10) Keep a HAR message log including date, time turned on, location, message placed, time message changed/HAR turned off (Appendix B)

11) Contact CFLHD if HAR system is not functioning, and maintain log of this information including date, time, location, how long system is inoperable, and when/how restored (Appendix B)

12) Drive by the DMS/HAR systems (tune into the HAR system) once a week (or more frequently as needed) to ensure that they are working properly. Keep a log of this test including date, time, device, operation, action (e.g., if contractor needed to be contacted through CFLHD), and when/how device fixed (Appendix B)

13) Qualitatively monitor traffic and parking conditions in cooperation with Estes Park; make notes of observations, including dates and times

14) Arrange with CFLHD for contractor to relocate DMS/HAR systems if needed within the rental period

15) Arrange with CFLHD for contractor to pick-up DMS/HAR system at the end of the rental period

16) Provide 2010 Hiker Shuttle ridership data to the Paul S. Sarbanes Transit in Parks Technical Assistance Center (TRIPTAC)

17) Provide 2011 Hiker Shuttle ridership, by day, stop and time of day, to the TRIPTAC

18) Provide 2010 Bear Lake ridership data to the TRIPTAC

19) Provide 2011 Bear Lake ridership data to the TRIPTAC

20) Provide 2010 Moraine Park ridership data to the TRIPTAC

21) Provide 2011 Moraine Park ridership data to the TRIPTAC

22) Provide 2010 Beaver Meadows Entrance Visitor Counts to the TRIPTAC

23) Provide 2011 Beaver Meadows Entrance Visitor Counts to the TRIPTAC

2.3.2. INFOGUYS PBS (HAR Contractor)

The contractor shall be responsible for:

1) Collaborating with ROMO on applying for a temporary FCC license
2) Placement and testing of HAR systems in conjunction with ROMO
3) Training ROMO on the operation of the HAR
4) Relocating HAR systems if needed within the rental period
5) Performing maintenance to HAR systems if needed within rental period
6) Picking-up HAR systems at the end of the rental period

2.3.3. Highway Technologies (DMS Contractor)

The contractor shall be responsible for:

1) Placement and testing of the two DMS in conjunction with ROMO
2) Training ROMO staff on the operation of the two DMS
3) Relocating the two DMS if needed within the rental period
4) Performing maintenance to the two DMS if needed (as requested by ROMO) within rental period
5) Picking-up the two DMS at the end of the rental period

2.3.4. Colorado Department of Transportation (CDOT)

The CDOT shall be responsible for:

1) Setting up and removing two CDOT DMS at Location 2 and 3
2) Training ROMO staff on the operation of the two CDOT DMS
3) Performing maintenance to CDOT DMS system if needed (as requested by ROMO)
4) Relocating the CDOT DMS system if needed within the study period
5) Installing concrete barriers to shield CDOT DMS at Location 2 (Figure 6) [Region 4]

2.3.5. Central Federal Lands Highway Division (CFLHD)

Responsibilities of CFLHD include:

1) Coordinate with ROMO to contract a DMS vendor
2) Coordinate with ROMO to contract a HAR vendor
3) Request permission for placement of HAR within City of Longmont Water Treatment Plant fencing
4) Contact vendor per ROMO request if DMS system is not functioning
5) Contact vendor per ROMO request if HAR system is not functioning
6) Perform traffic counts and provide exports of raw downloaded data to the Paul S. Sarbanes Transit in Parks Technical Assistance Center (TRIPTAC) for analysis

2.3.6. Town of Estes Park

The Town of Estes Park shall be responsible for:

1) Coordinating volunteers to administer the survey developed by the Paul S. Sarbanes Transit in Parks Technical Assistance Center (TRIPTAC)
2) Qualitatively monitoring traffic and parking conditions in cooperation with ROMO; making notes of observations including dates and times
3) Providing 2011 Silver Shuttle ridership, by stop, day and time of day, to the TRIPTAC

2.3.7. Western Transportation Institute (WTI)

WTI shall be responsible for:

1) Providing recommendations on DMS/HAR locations
2) Identifying DMS/HAR vendors
3) Development of pre-approved DMS/HAR messages with ROMO
4) Developing the Evaluation Plan

2.3.8. Paul S. Sarbanes Transit in Parks Technical Assistance Center (TRIPTAC)

TRIPTAC shall be responsible for:

1) Surveying visitors during a select time period to be defined in the Evaluation Plan
2) Training volunteers on methods to be used when administering surveys
3) Analyzing the survey data
4) Analyzing the traffic counter data
5) Analyzing the ridership data

Figure 10 displays the responsibilities of the participants during the execution of the DMS/HAR Operations Plan.

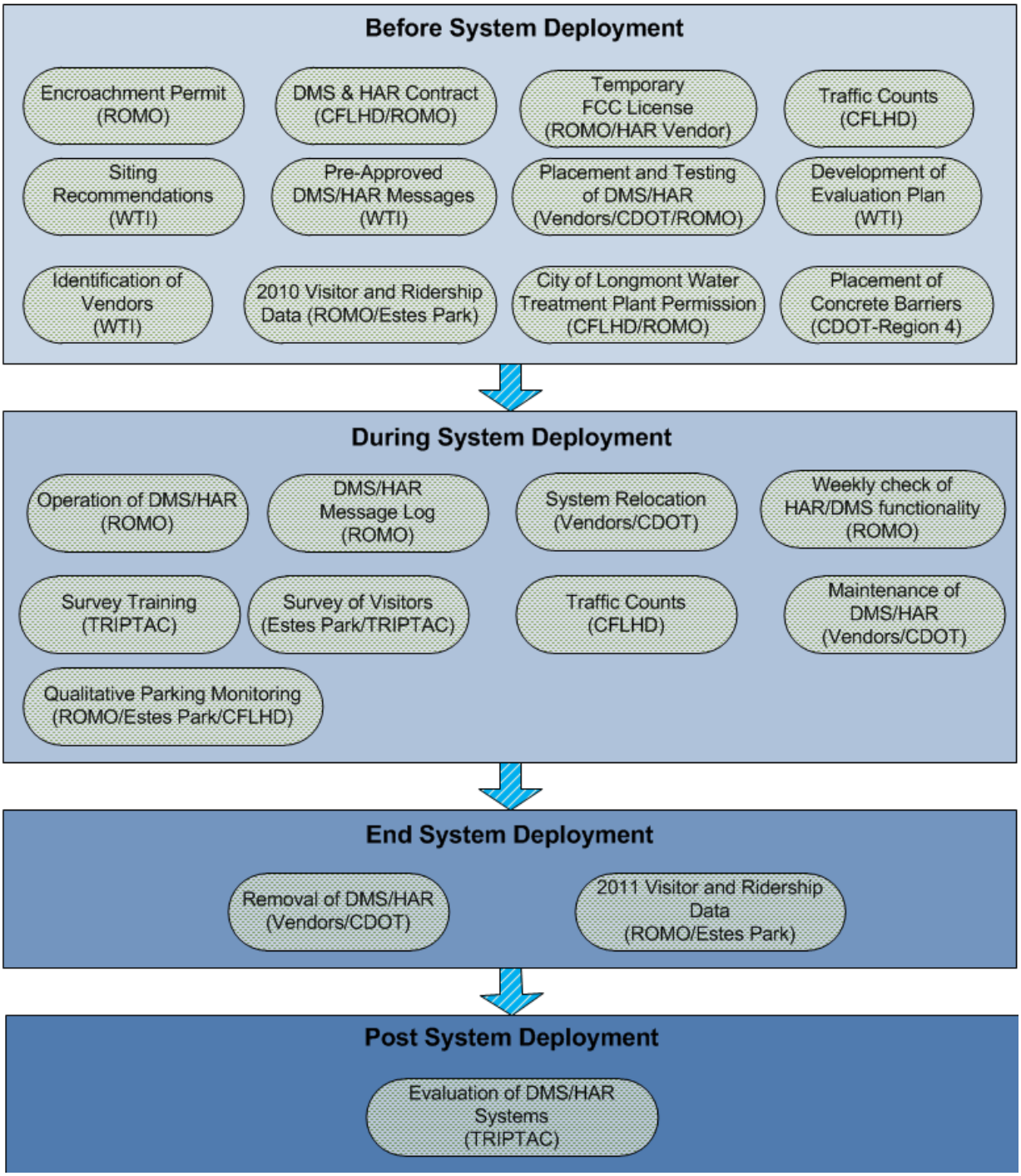

Figure 10: Execution of DMS/HAR Operations Plan

2.4. Site Locations

WTI staff conducted a field visit to identify site locations for the deployment of DMS/HAR systems. The proposed locations were subsequently presented to a ROMO representative, an Estes Park representative, and CDOT representatives for comment. Figure 11 shows the selected locations for the devices in the field. These locations are described in detail in the sections that follow. Refer to Appendix C for more information about all of the candidate locations that were considered for DMS/HAR systems.

Figure 11: Site Locations on SR 66/US 36 (3)

2.4.1. Location 1 – Lyons

Location 1, near the city of Lyons, will have two DMS and one HAR as shown in Figure 12.

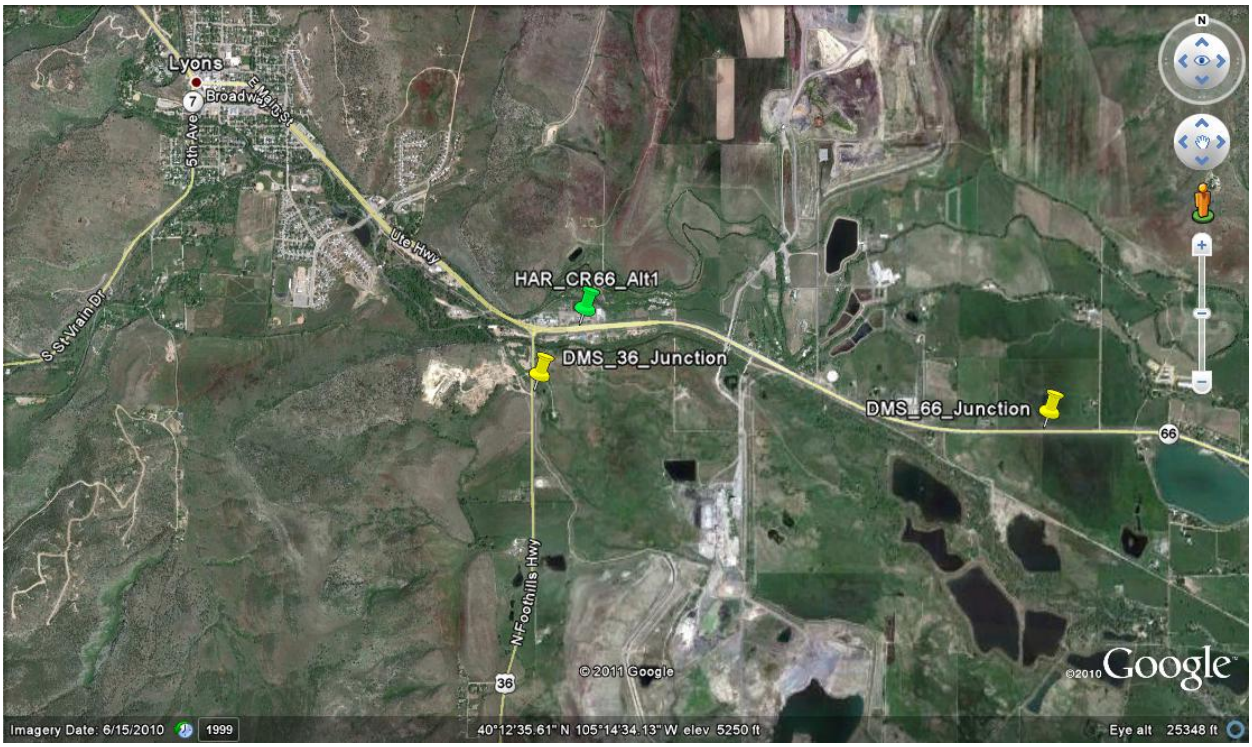

Figure 12: Location 1, Lyons (6)

2.4.1.1. DMS

There will be two DMS installations to the east of Lyons. The first will be located on SR 66, east of its intersection with US 36. Figure 13 shows an overview of the location, which is approximately 0.2 miles west of 61st Street. Figure 14 shows an elevation view of the location. The photo shows that there is sufficient room to install the DMS device more than six feet from the edge line (see Section D.1.1.3).

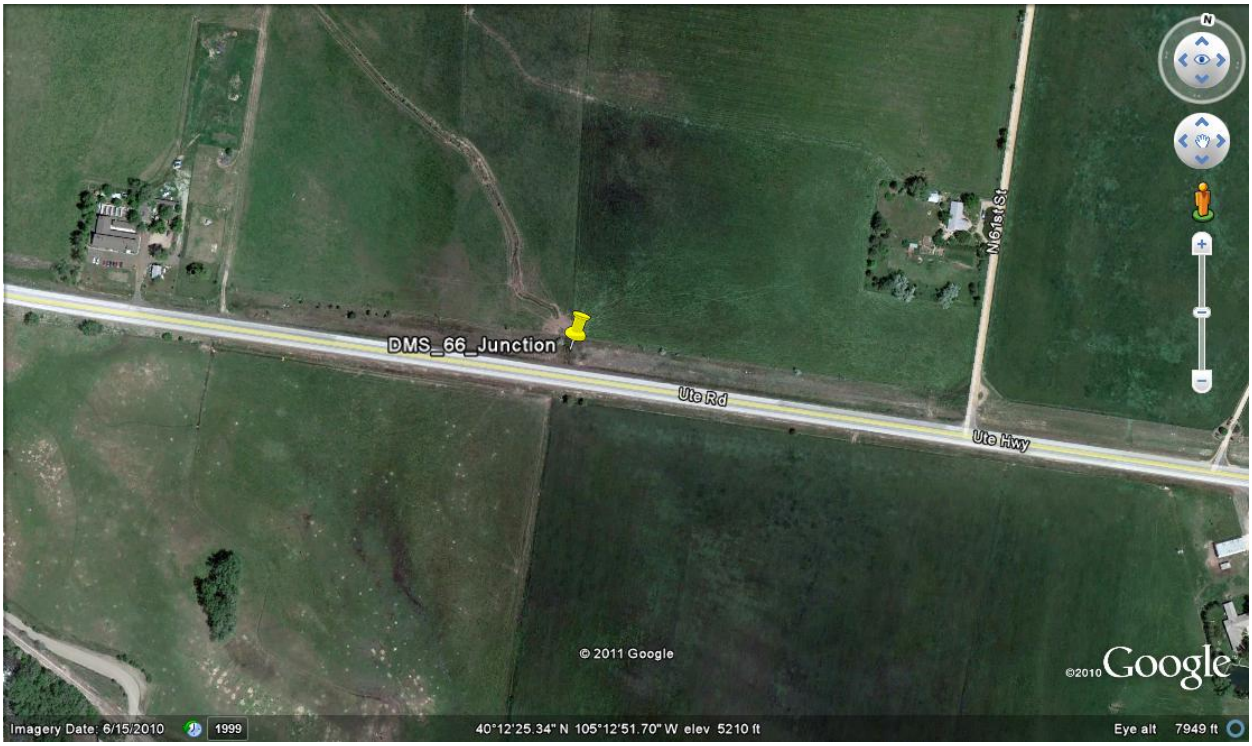

Figure 13: SR 66 DMS Location, Overview (6)

Figure 14: SR 66 DMS Location, Elevation

The second DMS location is on US 36, about 1100 feet south of its intersection with SR 66. Figure 13 shows an overview of the location. Figure 16 shows an elevation view of the location. The photo shows that there is sufficient room to install the DMS device more than six feet from the edge line.

Figure 15: US 36 DMS and SR 66 HAR Location, Overview (6)

Figure 16: US 36 DMS Location, Elevation

2.4.1.2. HAR

One HAR will be located just east of the SR 66/US 36 intersection within the City of Longmont Water Treatment Plant fencing. Figure 15 identifies an overview of the HAR placement with a green peg. Figure 17 shows the area enclosed by a fence. A frequency will have to be identified that can be heard from each DMS at Location 1 and as far downstream as possible. The frequency and range of transmission will have to be tested during installation.

Figure 17: Location 1, HAR, Elevation

2.4.2. Location 2 – Pinyon Trail

Location 2 on US 36 will have one DMS and one HAR, as shown in Figure 18.

Figure 18: Location 2, DMS and HAR around Pinyon Trail (6)

2.4.2.1. DMS

The DMS at Location 2 will be on the north side of US 36, just east of Pinyon Trail Road, as shown in Figure 18. Figure 19 shows an elevation view of the placement for the DMS near Pinyon Trail. As shown in the figure, a sufficient offset is provided.

Figure 19: Location 2, DMS Elevation

2.4.2.2. HAR

The HAR will be located about 850 feet west of Pole Hill Rd on the north side of US 36, as shown in Figure 18. Figure 20 shows that the HAR can be offset sufficiently from the edge line of US 36.

Figure 20: Location 2, HAR Elevation

2.4.3. Location 3 – Estes Park

Location 3 on US 36, just west of Community Drive, will have one DMS as shown in Figure 21. The DMS should be placed north of the guardrail.

Figure 21: Location 3, DMS Overview (6)

2.5. Message Display and Broadcast

All messages must be approved and prioritized according to need, and chosen appropriately when an event occurs.

2.5.1. Prioritized Messages

During the simultaneous occurrence of events, certain events are given priority over others. The priority of event messages should be placed on DMS or broadcasted through HAR in the following order:

- Hazardous Conditions: events happening either inside the park or along US 36
  - Extreme weather conditions
  - Fire
  - Accidents and/or emergency vehicles in a lane or on the shoulder
  - Severe congestion/traffic

- Transit Service and Parking Information
  - Park and ride availability
  - Full parking lots
  - Shuttle bus service
- General Information
  - Fee options
  - General Park Information

For this pilot program, only park-and-ride and shuttle bus messages will be used.

2.5.2. Displaying/Broadcasting Messages

Messages should help motorists be aware of transit service, parking availability, hazardous conditions, and general park information. Messages displayed should convey real-time information and be simple and short in order to accommodate the vast majority of the motorists reading the sign, and help accommodate motorists with low reading skills. Each displayed message should convey a complete thought. Broadcast messages should be concise, accurate, and clear. The appropriate speed of delivery for radio messages is about 175 words per minute (11).

2.5.3. Approved Messages

WTI has developed DMS/HAR messages for this pilot program with the approval of ROMO. The approved messages for DMS and HAR are presented as follows.

2.5.3.1. DMS Messages for Locations 1 and 2

The following are examples of messages which may be displayed on the DMS at Location 1 and 2. (Each vertical column represents a screen message. For example, in *Message 1-1*, the screen would read “BEAR LK PARKING LIMITED” followed by a second screen that reads “PARK AND RIDE IN ESTES.”)

PARKING INFORMATION

Message 1-1:

BEAR LK	PARK AND
PARKING	RIDE IN
LIMITED	ESTES

Message 1-2:

PARKING	BEAR	PARK AND
LIMITED	LAKE	RIDE IN
	RD	ESTES

Message 1-3:

BEAR LK	TUNE
PARKING	TO
LIMITED	AM 1630

Message 1-4:

PARKING	BEAR	TUNE
LIMITED	LAKE	TO
	RD	AM 1630

Message 1-5:

BEAR LK	PARK AND	TUNE
PARKING	RIDE IN	TO
LIMITED	ESTES	AM 1630

TRANSIT INFORMATION

Message 2-1:

PARK AND	TUNE
RIDE IN	TO
ESTES	AM 1630

Message 2-2:

PARK AND	SHUTTLE	TUNE
RIDE IN	TO	TO
ESTES	RKY MTN	AM 1630

Message 2-3:

PARKING	RKY MTN	TUNE
LIMITED	SHUTTLE	TO
	INFO	AM 1630

Message 2-4:

PARKING	ESTES	TUNE
LIMITED	SHUTTLE	TO
	INFO	AM 1630

Message 2-5:

RKY MTN	TUNE
SHUTTLE	TO
INFO	AM 1630

Message 2-6:
ESTES TUNE
SHUTTLE TO
INFO AM 1630

Message 2-7:
SHUTTLE PARK AND
TO ROCKY RIDE IN
MTN ESTES

Message 2-8:
SHUTTLE TUNE
TO ROCKY TO
MTN AM 1630

SPECIAL EVENT

*Message **S**-1:*
SLOW PREPARE
TRAFFIC TO
AHEAD STOP

It is recommended that *Message 2-2* be the default message on the DMS at Location 1 and 2 outside of the peak period. Once the parking in ROMO has become limited, it is recommended that *Message 1-5* should be displayed. *Message 2-8* is an alternative off-peak message. *Message 1-3* is an alternative peak period message.

We do *not* recommend using *Message 1-1*, *Message 1-2*, and *Message 2-7* because they do not identify the highway advisory radio station. If static signs identifying the highway advisory radio station were erected, these messages may be utilized.

2.5.3.2. DMS Messages for Location 3

The following are examples of messages which may be displayed on the DMS at Location 3. *Message 3-1* is recommended as the default message. In order to utilize *Message 3-2*, the distance from the sign to Community Drive would have to be measured to replace the "XX."

Message 3-1:
PARK AND NEXT
RIDE IN LEFT
ESTES

Message 3-2:

PARK AND	NEXT
RIDE IN	LEFT
ESTES	XX FEET

2.5.3.3. HAR Message Sets

The following message will be broadcast on the HAR at Location 1, Lyons, and Location 2, Pinyon Trail:

"The following is traveler information for Rocky Mountain National Park. Rocky Mountain National Park and the Gateway Community of Estes Park invite you to use free shuttle services between the new park-and-ride lot in Estes Park and Rocky Mountain National Park. Riding the shuttle is a relaxed and convenient way to explore the Park; you will not have to wait in entrance lines, find a parking space at each attraction or navigate your own way through the Park. By using this service, you will also help the National Park Service reduce congestion and preserve natural resources.

While the shuttle services are free, be sure to purchase your entrance pass at the Estes Park or Beaver Meadows Visitors Center. You can also pick up maps and information about shuttle services at either visitor center, so stop in and learn about these options for car-free travel within the Park.

"INSIDER TIP" option (see below)

Here is an overview of the shuttle routes available. From the park-and-ride lot, take the Silver Route to the Estes Park Visitors Center, where you can connect to the four shuttle routes that travel to and within Rocky Mountain National Park and Estes Park: the Hiker, Brown, Red and Blue Routes. Shuttle schedules and maps are available at both Visitor Centers.

We hope you will take advantage of the new park-and-ride lot, with its convenient access to Park shuttle services. As you travel west along US 36 into the Estes Park valley, turn left on Community Drive to access the park-and-ride lot. Watch for the electronic message sign just before the turn."

"INSIDER TIP"

Here's an insider's tip that may help you enjoy area attractions even more. Most visitors come to the National Park in the morning. If your schedule permits, explore Estes Park in the morning and come to Rocky Mountain National Park in the afternoon.

As noted previously, it is not recommended that the "Insider Tip" be utilized on days when afternoon thunderstorms are expected.

2.5.3.4. HAR Static Sign Message

HAR advisory signs will not be utilized in this set-up. CDOT, CFLHD, and WTI discussed this option during the 4/11/11 conference call. They concluded that the language within the Manual on Uniform Traffic Control Devices does not mandate the use of the static HAR signs with a "shall." Furthermore, the HAR application used herein is a temporary installation.

2.6. Documenting and Logging Messages

All DMS/HAR messages should be logged. The logged messages may include the following information:

- Message displayed or broadcasted
- Reason for use
- Time message activated
- Time message deactivated
- Name of operator
- Initiating agency

These logs will help demonstrate to what extent the park is utilizing DMS/HAR and for what purposes; the logs will also provide information on whether there were multiple simultaneous requests for messages and, if so, which one received priority.

The forms for logging DMS/HAR messages are presented in Appendix B.

2.7. Deactivating Systems and Relocation

If DMS/HAR are placed in locations with restricted sight distance, weak signal strength or other limitations, the systems may need to be relocated for better performance. The contractors will be responsible for deactivating and relocating the systems. The contractors should log pertinent information, such as the reason for relocation, time deactivated, time re-activated and other details.

3. MAINTENANCE GUIDELINES

3.1. Roles and Responsibilities

As mentioned earlier, the contractors will be responsible for the maintenance of DMS/HAR systems during the pilot program. This section provides general guidelines for the maintenance of DMS/HAR systems. Maintenance of systems should strictly follow the specific device instructions provided by vendors.

3.2. Maintenance of DMS

Refer to the Wanco maintenance manuals for in-depth maintenance instructions (12). The following is a brief summary of preventative maintenance requirements to keep the DMS, hydraulic lift, batteries and trailer in good working condition.

3.2.1. Hydraulic lift

With the sign lowered, periodically check the hydraulic fluid reservoir and add the appropriate fluid as necessary. Reference the Wanco guidelines as needed.

3.2.2. Batteries

Periodically inspect the battery terminals; clean and tighten as necessary. Check the battery fluid level monthly and fill with distilled water when needed.

3.2.3. Trailer

Check brake fluid (if applicable), tires and lug nuts, and lubricate the jack. Maintain tire pressure according to the manufacturers' recommendations. Periodically inspect for loose connections and hardware, and tighten as required.

3.2.4. Communications and Controller

Ensure all connections for Central Processing Unit cabinet are seated. It is convenient and generally helpful to place labels on switches and positions. Placing warning labels such as "SWITCH TO OFF POSITION TO AVOID BATTERY DRAIN" may avoid some unnecessary maintenance.

3.3. Maintenance of HAR

Maintaining the HAR system includes regular inspection of radio signal, batteries, transmitter, and related components. Maintenance of HAR systems should follow the maintenance guidelines provided by the vendor. The general guidelines for maintenance are briefly described in the sections that follow.

3.3.1. Signal Inspection

Periodically (e.g., once a week) tune in to the radio frequency when traveling through the desired coverage area, especially on the edges of the area (where DMS or HAR static signs are placed), to make sure that the radio system is on the air and functioning. If the radio signal drops off

when approaching the HAR station (e.g., within ½ mile away), or if there is no signal at all, the transmitter needs to be checked and adjusted.

3.3.2. System Inspection

Regularly inspect the transmitter, power supply (e.g., solar panel), batteries, and recording device to observe any physical damage to the system or lightening damage to the antenna and other external components. Look for cables and wires that may have been damaged.

3.3.3. System Cleaning

After shutting down the system, clean dust and dirt from the surfaces of panes and components with a damp cloth or spray cleaner. If insects or other pests are in the cabinet, check for holes/entryways and seal them with silicone, or duct seal.

3.4. Contact Information

3.4.1. INFOGUYS PBS

Location: San Tan Valley, AZ

Phone: (602)614-9494

3.4.2. Highway Technologies

Location: Loveland, CO

Phone: (970)667-3620

APPENDIX A: OVERALL CONTACT INFORMATION

ROMO:

Primary Contact:

John Hannon, Supervisory Management Specialist
(970)586-1365 or (970)481-0545 (cell), john_hannon@nps.gov

Secondary Contacts:

Chris Williamson, Deputy Fee Manager
(970)-586-1439, Chris_Williamson@nps.gov

Jim Hein, Lead Park Ranger - VTS
(970)-586-4838, James_Hein@nps.gov

INFOGUYS PBS:

Wendy Rose,
(602)614-9494, info@goinfoguys.com

Highway Technologies:

Shawn Severin, Branch Manager
(970)667-3620 or (970)227-8116 (cell), shawn.severin@hwy-tech.com

CDOT:

Bruce Coltharp, Intelligent Transportation Systems Planning Manager
(303)512-5807, Bruce.Coltharp@dot.state.co.us

Larry Haas, Region 4 Traffic Operations Engineer
(970)350-2143, larry.haas@dot.state.co.us

Central Federal Lands Highway:

Laurie Miskimins, Transportation Planner
(720)963-3455, Laurie.Miskimins@dot.gov

Stephanie Lind, Transportation Planner
(720)963-3555, Stephanie.Lind@dot.gov

Elijah Henley, Transportation Planning Team Lead
(720)963-3562, Elijah.Henley@dot.gov

Town of Estes Park:

Scott Zurn, Director of Public Works
(970)577-3582, szurn@estes.org

WTI:

Steve Albert, Director
(406)994-6126, SteveA@coe.montana.edu

Natalie Villwock-Witte, Research Engineer
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Zhirui Ye (Jared), Research Scientist
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TRIPTAC Technical Liaison:

Jaime Eidswick, Resource Manager
(774)571-3503, jaime.eidswick@coe.montana.edu

APPENDIX B: LOG FORMS

DMS Message Log

Date	Organization Changing Message	Location (Community, Pinyon Trl, or Lyons)	Time Message On (i.e. 10am)	Time Message Off (i.e. 10am)	Accessed Remotely (yes or no)	Message Number (if not pre-approved message, type out entire message)

HAR Message Log

Date	Location (i.e. Pinyon Trl or Lyons)	Time Message On (i.e. 10am)	Time Message Off (i.e. 10 am)	Accessed Remotely (yes or no)	Message Number (if not preapproved message, please type out entire message)

System Test Log

Date	Organization Testing Device	Location (i.e. Community, Pinyon Trl or Lyons)	Device (i.e. HAR or DMS)	Time of Test	Operation (i.e. working properly or needs fixing)	Need to Contact contractor? (i.e. yes/no answer)	When Device Fixed (i.e. date and time)	How Device Fixed

APPENDIX C: CANDIDATE LOCATION ANALYSIS

In addition to the locations identified in Section 2.4, other locations were identified as potential candidates. If necessary, these locations could be used as "back-ups." However, these locations were not chosen initially, because they were not considered optimal.

PINEWOOD SPRINGS

One of the only other locations between Lyons and Estes Park that had a flat topography was Pinewood Springs as shown in Figure 22.

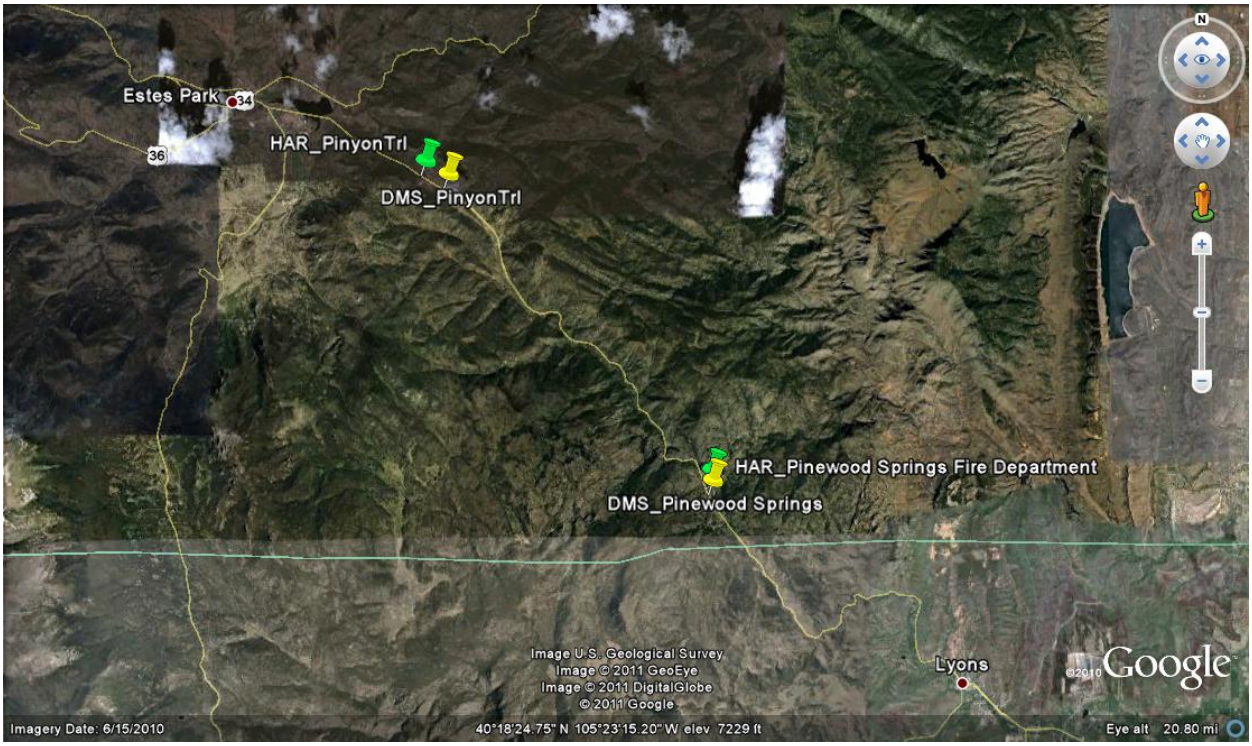

Figure 22: Alternative Option, Pinewood Springs (6)

Pinewood Springs could be considered an alternative to Location 2 described in Section 2.4. However, there are several reasons why this location is not desirable. First, the cell phone reception in the area is poor. It is desirable to provide the agency responsible for initiating messages on the DMS and HAR with remote access. However, to remotely access this equipment, cell phone reception is typically a necessary component. Therefore, the lack of cell phone reception in this area could possibly indicate that a remote connection is not feasible. Second, although there is room to place the DMS and HAR devices, visitors would have to quickly access the information from the HAR. As a driver leaves Pinewood Springs, they descend into an area that is surrounded by high, rocky hills, as shown in Figure 23. WTI had concerns that the hills would limit the distance over which the HAR could be transmitted.

Figure 23: Southbound on US 36, leaving Pinewood Springs

4TH STREET

The park-and-ride lot in Estes Park is designed with accesses from both 4th Street and Manford Avenue. The original proposed DMS location in Estes Park would have been just east of 4th Street, as shown in Figure 24. Figure 25 shows the topography along the side of the road at this location. Although not ideal, the topography could have provided a flat enough surface on which to position the DMS trailer.

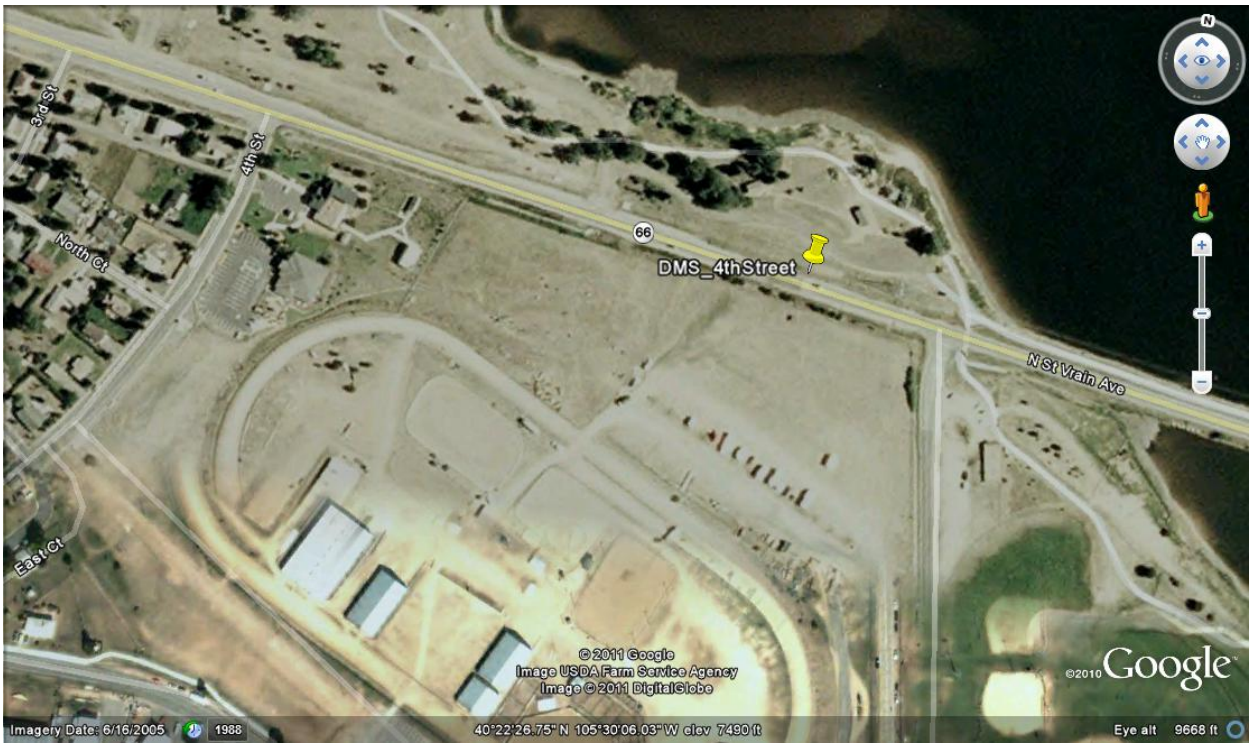

Figure 24: Estes Park, Park and Ride Access Via 4th Street (6)

Figure 25: Proposed 4th Street DMS Location Topography

However, Scott Zurn of Estes Park indicated that public input had resulted in a request by local residents to route users from US 36 onto Community Drive, where they would turn right onto Manford Avenue followed by a right into the park-and-ride lot. Therefore, the new proposed DMS location, as identified in Section 2.4 is prior to Community Drive.

LYONS, HAR ALTERNATIVE

The proposed HAR location, in tandem with the DMS to the east and south of the SR 66/US 36 intersection, is within the Longmont Water Treatment Plant. However, an additional location was identified along the eastbound right turn lane at the SR 66/US 36 intersection, as shown in Figure 26.

Figure 26: Secondary HAR Location in Lyons (6)

This location was not recommended for several reasons. First, less protection is offered at this location when compared with the proposed location within the gates of the Longmont Water Treatment Plan. Second, there are power lines behind the line of trees which run approximately parallel to the eastbound right turn lane. Power lines can interrupt a HAR transmission.

WEST END OF LYONS, DMS/HAR

The current proposed DMS/HAR implementation utilizes two DMS devices in tandem with one HAR in Lyons. An alternative was identified at the west end of Lyons where the US 36 and CR 66 traffic would have merged. Unfortunately, there was not sufficient unobstructed space to implement a DMS with a corresponding HAR. The location that was considered, as shown in Figure 27, would have allowed for the installation of a DMS. However, the corresponding HAR message would not have traveled far because of the rock wall (Figure 28) immediately after the location where the HAR would have been installed.

Figure 27: DMS Location, West End of Lyons (6)

Figure 28: Rock Wall Leaving Lyons

APPENDIX D: GUIDELINES ON PLACEMENT

D.1 Guidelines on Placement

This section describes guidelines for the placement of DMS, HAR, and HAR static signs, respectively.

D.1.1. DMS

Placement of DMS should follow general regulations to guarantee optimal viewing of the sign to motorists, including sight distance, horizontal and vertical alignment, delineation and positive protection, and physical security.

D.1.1.1. Sight Distance

The signs should be visible from ½ mile under ideal day and night conditions. Each sign message should be legible from all lanes at the specified distance and in accordance with the current revision of Part 6 of the Manual on Uniform Traffic Control Devices (MUTCD) (13). In the field, the portable DMS should be sited and aligned to optimize visibility.

Chapter 6F of the 2009 MUTCD specifies standards and guidance on the placement and use of Portable DMS, which are described as follows.

Standards:

- Portable DMS shall automatically adjust their brightness under varying light conditions to maintain legibility
- The control system shall include a display screen upon which messages can be reviewed before being displayed on the message sign. The control system shall be capable of maintaining memory when power is unavailable
- Portable DMS shall be equipped with a power source and a battery back-up to provide continuous operation when failure of the primary power source occurs
- When a portable DMS is mounted on a trailer, a large truck, or a service patrol truck, the bottom of the message sign panel shall be a minimum of 7 ft above the roadway in urban areas and 5 ft above the roadway in rural areas when it is in the operating mode
- Techniques of message display such as animation, rapid flashing, dissolving, exploding, scrolling, travelling horizontally or vertically across the face of the sign or other dynamic elements shall not be used

Guidance:

- For a trailer or large truck mounted sign, the letter height should be a minimum of 18 in. For DMS mounted on service patrol trucks or other incident response vehicles, the letter height should be a minimum of 10 in
- Retroreflective material, also known as conspicuity material, should be affixed in a continuous line on the face of the portable DMS trailer to permanently delineate the devices to oncoming traffic

- Portable DMS should be placed off the shoulder of the roadway and behind a traffic barrier when possible. If a traffic barrier is not available, the DMS should be placed off the shoulder outside of the clear zone. If the DMS is placed on the shoulder or within the clear zone, it should be delineated with temporary traffic control devices
- Portable message signs should be utilized to supplement and not replace conventional signs and pavement markings.
- When messages are divided into two phases, each phase should be displayed for a minimum of 2 seconds, and the combined display time for each phase should be less than 8 seconds.
- Messages should be brief with a maximum of three thoughts, each on its own line
- Additional portable DMS should be utilized if more than two phases are needed to convey a message.

Support:

- Per Table 2A-5 of the MUTCD, for changeable message signs used for temporary traffic control, the legend may be yellow or orange with a black background.

D.1.1.2. Horizontal and Vertical Alignment

DMS should not be placed in sags or just beyond crests of roadways. DMS should be level and angled approximately three degrees away from perpendicular to the roadway to minimize glare. DMS, if facing either east or west, should be checked at sunrise and sunset to ensure that their reflection of the sun does not blind motorists.

D.1.1.3. Delineation and Positive Protection

Two DMS will be provided by CDOT. CDOT requires that the DMS are protected by a concrete barrier.

The remaining two DMS will be rented from a vendor. The contracted DMS, where possible, should be placed behind existing rigid or semi-rigid protection (barrier or guardrail). This will help to avoid potential injury to errant motorists, while simultaneously aiding in the protection of this valuable equipment. When DMS systems are required for long terms in locations where no protection exists, a temporary guardrail or barrier should be considered. Where positive protection is not feasible DMS should be delineated with drums. If a DMS is placed on a 10 ft shoulder, a shoulder closure should be installed. If a DMS is placed adjacent to a 4 ft shoulder, it should be delineated with a minimum of three drums. If possible, DMS should not be placed closer than 6 ft or farther than 20 ft from the edge of the roadway. A sign placed closer than 6 ft from the edge of the roadway becomes an obstruction that causes a reduction in traffic flow. A sign placed farther than 20 ft from the edge of the roadway becomes unreadable for many motorists.

D.1.1.4. Physical Security

When the DMS controller door is open, the operator should stand in front to block the box so that passing motorists cannot see the internal components of the compartment. Blocking this

door may decrease glare on the screen. When checking the message on the sign face, the operator should close the door to ensure passing motorists are not aware of cabinet's contents.

The DMS system's keyboard box should be secured with a sturdy lock. The operator should check all locks and never leave any door open even for a moment. The operator should also chain and lock the trailer to a fixed object if possible. If the DMS is to be left in one place for a long period of time, then its trailer wheels should be removed.

D.1.2. HAR

The quality of a selected site determines the level of effectiveness of a HAR system. When selecting a site, staff should review factors affecting quality, such as clear frequency, terrain, clear area around antenna, and coordination with DMS to identify the optimum HAR location. The use of HAR requires a license certified by the Federal Communications Commission (FCC).

D.1.2.1. FCC License

Under Title 47, Section 90.242 of FCC's rules and regulations (14), a license is required before the operation of Travelers' Information Stations (*Travelers' Information Stations (TIS)* is the FCC term for HAR). TIS operate in the AM Broadcast Band (530kHz-170kHz) and are limited to a 10 watt transmitter output power; the antenna shall not exceed 15 meters (49.2 feet). TIS shall not transmit commercial information. The maximum height of antenna is important for those planning roof-mounted systems. This requirement usually limits mounting to buildings no more than two stories tall.

Two types of operations licenses can be issued by FCC: fixed operation for a specific location and mobile operation for a region. Application for a TIS license must be made on FCC Form 601 (formerly Form 574). In addition, licensees are required to submit maps showing the proposed station's 2mV/m contours and to identify adjacent commercial stations within the region.

D.1.2.2. Clear Frequency

The following actions can be taken to search for clear frequencies. When driving through the area and tuning to the desired frequency on a good digital radio, ensure the frequency is quiet without regular splashes from adjacent frequencies. If regular beats of static or noise are heard, tune to the adjacent frequencies to see if strong signals exist. For 530 kHz band, monitor 540 kHz, 550 kHz, etc. For 1610 kHz and other frequencies in the 1610-1700 kHz band, listen to the two adjacent frequencies on either side of your frequency for strong signals (15).

D.1.2.3. Terrain

Terrains should be carefully reviewed prior to site selection. At an optimal location, a circle of 2.5-3 mile radius from the antenna site will cover the primary areas where listening is desired. Check 2.5-3 mile radius from antenna site for high terrain features such as large numbers of tall buildings, or extremely tall, dense foliage. These factors will reduce transmission range. The area around the transmitter should be checked for rocks, sand, and tree roots, which are not good conduits and might affect the performance of the system (15).

D.1.2.4. Clear Area around Antenna

For optimum transmission, there should be plenty of clear area around the antenna (15).

- Objects within 50 feet of antenna: These objects should be no higher than the antenna's base. This height is typically 17 feet for pole-mounted antennas and 4 feet from the roof surface for roof-mounted antennas.
- Objects between 50 and 100 feet of antenna: These objects should be no higher than the antenna's tip. This height limit is typically 32 feet for pole-mounted antennas or 19 feet from the roof surface for roof-mounted antennas. These objects include trees, buildings, walls, towers, other antennas, etc. The 530 kHz frequency is especially sensitive to this, and the distances of 50 and 50-100 feet specified above should be doubled under this scenario to preserve optimum transmission.

The following sites should be avoided when selecting a site for HAR antenna:

- Directly beneath high-tension power lines
- Next to existing radio towers or water tower supports
- In close horizontal proximity to large structures such as water towers, stadiums or buildings
- In locations overshadowed or crowded by terrain features of foliage

D.1.2.5. Coordination with DMS

When possible, HAR should be coordinated with an existing or planned DMS. This type of coordination will allow DMS messages to advise the motorists to tune to HAR for more detailed information (15).

D.1.2.6. Message Development

The following general guidelines should be considered for the development of HAR messages (11, 13):

- Be concise: HAR should contain the minimum number of words needed to convey the situation. Use phrases and short sentences. The motorist should be able to hear the entire message twice while within the effective transmission range.
- Follow a standard format:
    - An introductory statement (agency name, location of HAR, date and time)
    - An attention statement (to address a certain group of motorists or destination)
    - A problem statement
    - A location statement
    - An effect statement (lane closure, delay, etc.)
    - An action statement
- Follow FCC requirements (non-commercial, etc.)

- Use clear and accurate messages without inappropriate background noises

D.1.2.7. Security

The HAR system may be activated and deactivated locally, via a dial-up system, cellular phone/touch tone phone, or even satellite from a remote location. Thus, the system should be protected by a security code.

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