NEW APPLICATION

ORIGINAL

ADOT
Intermodal Transportation

Robert Samoi
Dallas Hammit, [illegible], State Engineer, Development

July 31, 2013

Arizona Corporation Commission
Office of Railroad Safety
Attn: Chris Watson
1200 W Washington Street
Phoenix, AZ 85007

Arizona Corporation Commission
DOCKETED
AUG - 5 2013
DOCKETED BY

RE: Application to upgrade existing railroad signals
Project: Dobson Road Signals
Federal Project # STP-MES-0(204)A
ADOT Tracs # 0000 MA MES SR232 01C
Dobson Crossing AAR/DOT # 741-649-G

RR-03639A-13-0268

Mr. Watson,

Please find enclosed the original and 13 copies of the application to allow UPRR to furnish and install two cantilevers and four gate and flasher units at the Dobson crossing. Also enclosed is a copy of the addendum and agreement between ADOT and the UPRR Railroad. Also included is sheet 5 of City of Mesa final plan set project CP0184 and pictures of both road approaches, and tracks-east for reference.

Feel free to contact me if you have any questions.

Sincerely,

Robert Travis, PE
Railroad Liaison
Arizona Department of Transportation
205 S. 17th Ave, Room 357 MD 618E
Phoenix, AZ 85007
Phone: 602-712-6193 rtravis@azdot.gov

RECEIVED
2013 AUG -5 P 2:28
AZ CORP COMMISSION
DOCKET CONTROL

Janice K. Brewer, Governor
John S. Halikowski, Director
Jennifer Toth, State Engineer
Robert Samour, Senior Deputy State Engineer, Operations
Dallas Hammit, Senior Deputy State Engineer, Development

July 31, 2013

Arizona Corporation Commission
Office of Railroad Safety
Attn: Chris Watson
1200 W Washington Street
Phoenix, AZ 85007

RE: Application to upgrade existing railroad signals
Project: Dobson Road Signals
Federal Project # STP-MES-0(204)A
ADOT Tracs # 0000 MA MES SR232 01C
Union Pacific Railroad Crossing AAR/DOT # 741-649-G

Mr. Watson,

This application is being submitted to allow the Union Pacific Railroad (UPRR) to install two cantilevers and four gate and flasher units to provide train warning to the traveling public. This work was identified thru the 2008 array and onsite diagnostic meetings.

1. **Project Location and Description**
   The project is located on Dobson Road between Broadway Road and Main Street in Mesa. Dobson Road is 7 lanes wide and is normally used for 2-way traffic, consisting of 3 northbound and 3 southbound lanes and a center median/turn lane.

   The project consists of installing two gate and flasher units on the outside edge of Dobson Road, two gate and flasher units within new raised medians along Dobson Road, one cantilever on the outside edge of the road for northbound traffic, one cantilever in the new raised median for southbound traffic, and additional concrete crossing panels on the outside edges of Dobson Road. The City of Mesa will also construct civil improvements including new raised medians, sidewalk adjustments, and road approach improvements to accommodate the railroad signal and surface improvements.

2. **Why the crossing is needed**
   Based on the 2008 crossing improvement array, this crossing was selected for upgrades to the signals by installing the cantilevers and gates.

3. **Construction Phasing**
   Once the utility, environmental, and right-of-way clearances are obtained, ADOT can apply for and receive FHWA construction authorization and authorize UPRR to order their signal materials and authorize the City of Mesa to construct their civil improvements. Once an Opinion and

Order is issued and the City of Mesa constructs the civil improvements on Dobson Road, UPRR will install the signal equipment within 12 to 15 months.

4. **Maintenance of the crossing**
   UPRR will be responsible for installing and maintaining the crossing surface and signal equipment. City of Mesa will be responsible for maintaining the road approaches outside of UPRR responsibility.

5. **Project Funding**
   100% of the funding will be provided thru the Federal Highway Administration thru their Section 130/highway-railroad crossing safety improvement program.

   Costs are as follows:

Preliminary and Construction Engineering		$15,000.00
UPRR Furnish and Install Flashers and Gates and Advanced Pre-emption		$477,640.00
UPRR Furnish and Install Concrete Crossing Panels		$112,250.00
City of Mesa Construction of Civil Improvements		$54,879.50
	Total Cost	$659,769.50

6. **Other information (based on typical Staff Data Requests):**

1. Provide Average Daily Traffic Counts for each of the locations.
   The Average Daily Traffic Counts for this crossing was 27,300 ADT in 2010 per the City of Mesa.

2. Please describe the current Level of Service (LOS) at each intersection.
   The City of Mesa does not currently have a Level of Service recorded for this area of Dobson Road at this time.

3. Provide any traffic studies done by the road authorities for each area.
   In May of 2010, the City of Mesa completed a traffic study of the railroad crossing at Dobson Road and other at-grade railroad crossings around the City. The traffic study provided data on the accident history for both car/train accidents and car/car accidents at the at-grade crossings throughout the City of Mesa.

   In the Fall of 2006, the City of Mesa began performing semi-annual travel time studies on arterial streets throughout Mesa. The studies are being done as part of a performance measure for Traffic Engineering. The travel time study for fall of 2006 and fall of 2009 are attached along with a crash study for this railroad crossing location that was conducted in 2009.

4. Provide the population of the City the crossing is located in.
   2009 census: 467,157 persons.

5. Provide what warning devices are currently installed at the crossing.
   Currently at this crossing there are flashing lights and gates on the outside edges of the roadway and flashing lights installed in raised medians for both traffic directions along Dobson Road.

6. Provide distances in miles to the next public crossing on either side of the proposed project location. Are any of these grade separations?
   Alma School Road (AAR/DOT 741 650 B) is at-grade and 1 mile east. Price Road (AAR/DOT 748 176 E) north bound only and (AAR/DOT 741 647 T) south bound only are both at-grade and are 1 mile to the west of the Dobson Road crossing.

7. How and why was grade separation not decided on at this time? Please provide any studies that were done to support these answers.
   Grade separation was not considered as part of this Section 130 safety upgrade due to the complexity of the crossing and cost to grade separate since it is within a major urban area.

8. If this crossing was grade separated, provide a cost estimate of the project.
   Estimate $30,000,000++ due to urbanized location.

9. Please describe what the surrounding areas are zoned for near this intersection. i.e. Are there going to be new housing developments, industrial parks etc.
   The properties to the northeast, southwest, and southeast of this crossing are zoned as Manufacturing/Industrial/Employment. The property to the northwest of the crossing is zoned commercial. There are no new developments in the area. The area to the southwest of the crossing is currently being developed as a new industrial park and is nearly complete.

10. Please supply the following: number of daily train movements through the crossing, speed of the trains, and the type of movements being made (i.e. thru freight or switching). Is this a passenger train route?
    Per the Federal Railroad Administration website this crossing has 11 thru freight train movements per day at speeds between 30 to 60 mph and contains no passenger traffic.

11. Please provide the names and locations of all schools (elementary, junior high and high school) within the area of the crossing.
    - Webster Elementary School – 202 N. Sycamore, Mesa (1/2 mile north of the crossing)
    - Roosevelt Elementary School – 828 South Valencia, Mesa (1 mile southwest of the crossing)

- Adams Elementary School – 738 South Longmore, Mesa (1 mile southeast of the crossing)

12. Please provide school bus route information concerning the crossing, including the number of times a day a school bus crosses this crossing.

    Per Mesa Unified District there are 46 bus crossings per day and per Tempe Union High School District there are 3 crossings per day for a total of 49 school bus crossings per day.

13. Please provide information about any hospitals in the area and whether the crossing is used extensively by emergency service vehicles.

    Banner Desert Hospital is located on Dobson Road approximately 1.5 miles south of this crossing. This crossing is used extensively by emergency vehicles.

14. Please provide total cost of the railroad improvements to each crossing.

    Cost described above.

15. Provide any information as to whether vehicles carrying hazardous materials utilize this crossing and the number of times a day they might cross it.

    The City of Mesa stated they do not have any information pertaining to the use of these crossings by vehicles carrying hazardous materials.

16. Please provide the posted vehicular speed limit for the roadway.

    Posted vehicle speed is 40 mph

17. Do any buses (other than school buses) utilize the crossing, and how many times a day do they cross the crossing. Bus traffic varies depending on sporting events.

    Dobson Route 96 and Route 45 (Broadway Rd) diverts north from Broadway Road onto Dobson Road, then east on 1st Avenue to serve the sycamore transit center.

    Route 96 utilizes the crossing 44 times in the northbound direction and 44 times in the southbound direction per day. Route 45 utilizes the crossing in the northbound direction 32 times a day and in the southbound direction 32 times a day. The transit buses utilize the crossing a total of 152 times a day according to Valley Metro.

18. Please indicate whether any spur lines have been removed within the last three years inside a 10 mile radius of any crossings covered in this application. Please include the reason for the removal, date of the removal and whether an at-grade crossing or crossings were removed in order to remove the spur line.

    None.

19. Please fill in the attached FHWA Grade Separation Guidelines Table, (from FHWA's 2007 revised second edition Railroad Highway Grade-Crossing Handbook, page 151) with a yes or no answer

as to weather each item applies. Also, please provide all information to support your answers of yes or no (i.e. vehicle delay numbers, any calculations that were performed to get the answers).

20. Based on the current single track configuration at the crossings specified by this application, please provide the current traffic blocking delay per train. Please indicate the time in which vehicular traffic is delayed (1) to allow the train to pass at a crossing and (2) due to trains stopped on the track for any purpose. The delay is measured from the point that the warning devices are activated at the crossing to the time after the train has cleared the crossing and the warning devices are reset.

    The City of Mesa stated that there are no significant train delays at the Dobson crossing.

Sincerely,

Robert Travis, PE
Railroad Liaison
Arizona Department of Transportation
205 S. 17th Ave, Room 357 MD 618E
Phoenix, AZ 85007
Phone: 602-712-6193 rtravis@azdot.gov

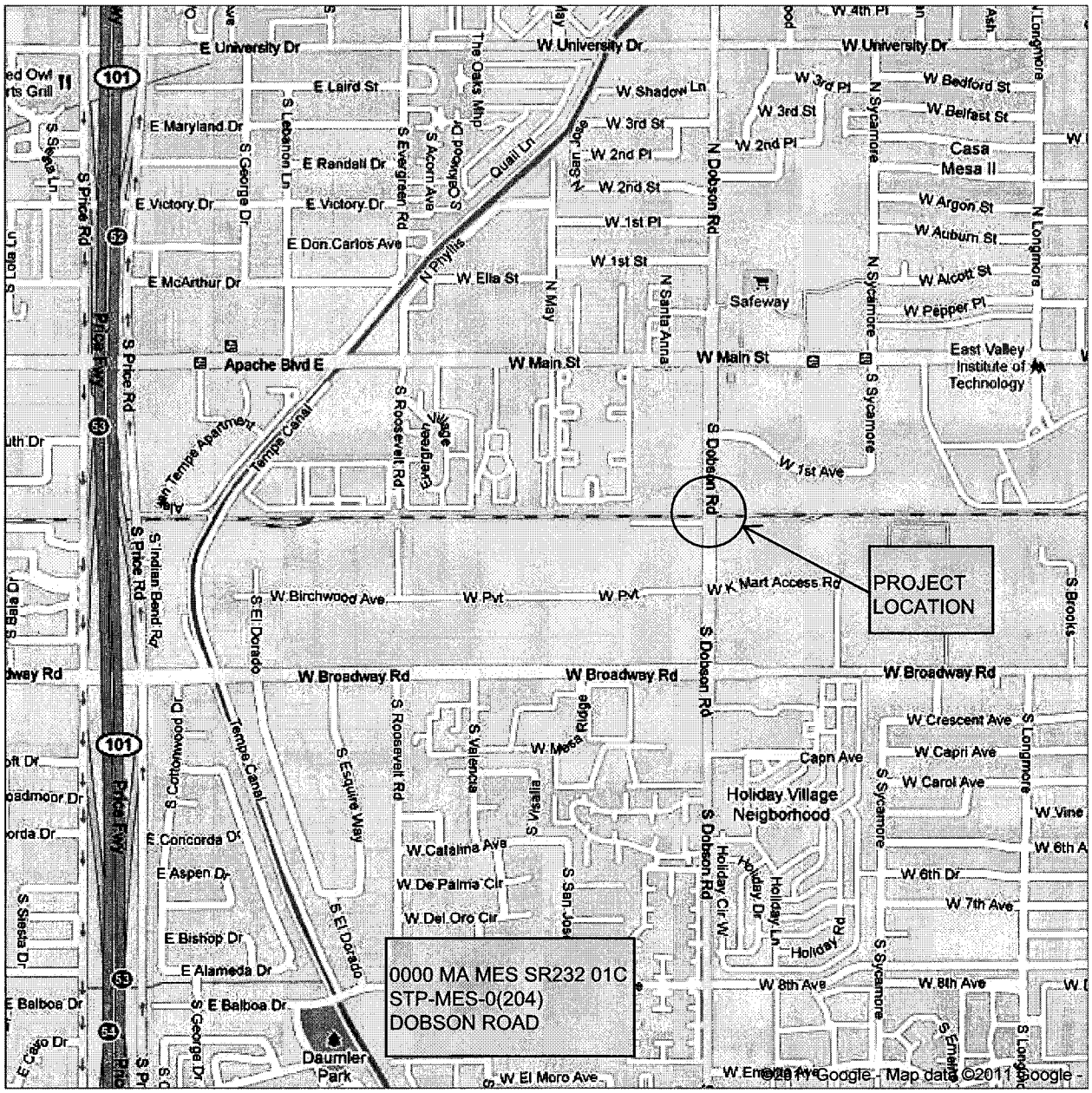
FHWA - GRADE SEPARATION GUIDELINES

Highway-rail grade crossings should be considered for grade separation or otherwise eliminated across the railroad **right of way whenever one or more of the following conditions exist:**

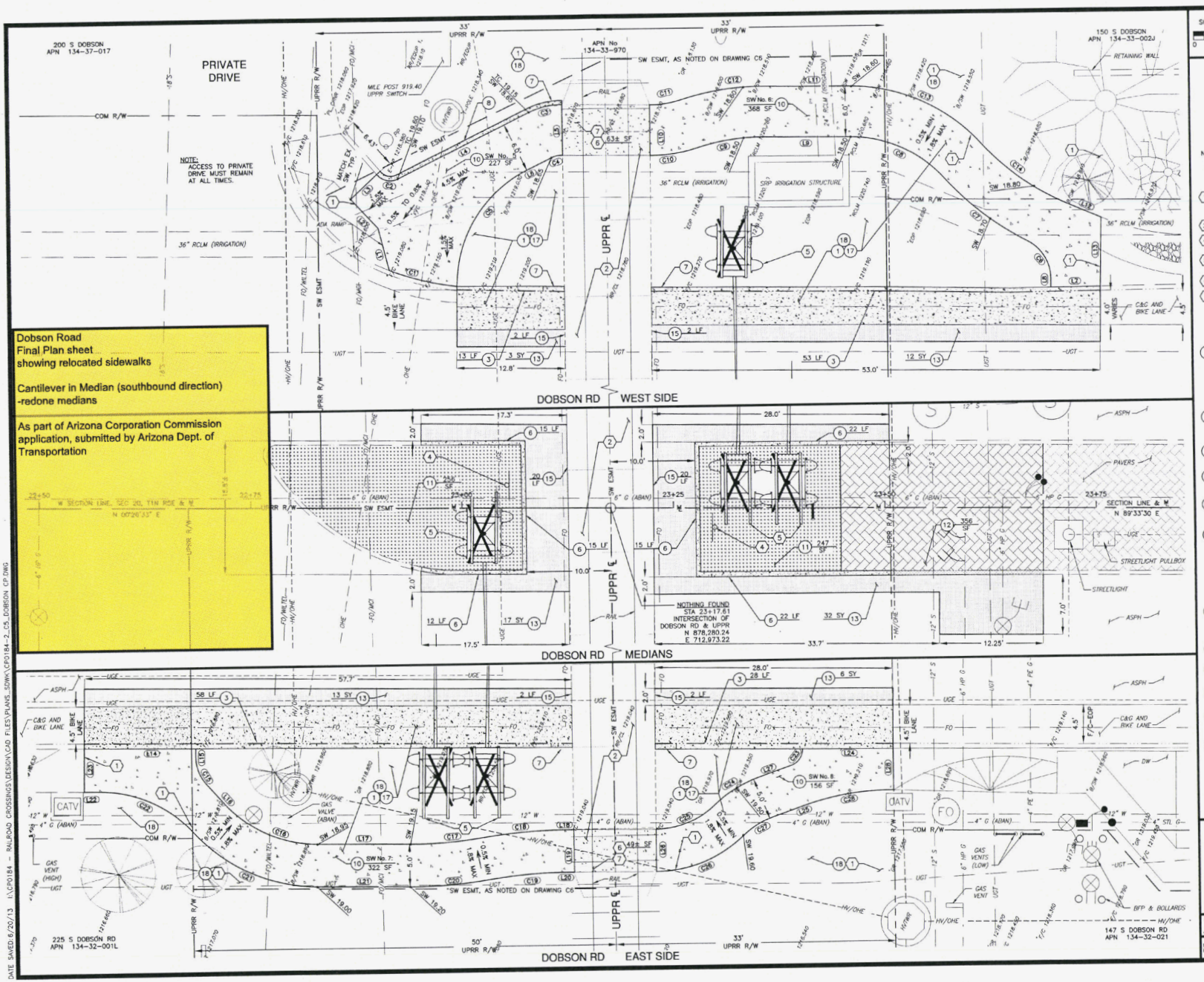
		Dobson Road			
The highway is a part of the designated Interstate Highway System	Crossing Currently meets the criteria	N			
	Crossing meets the criteria by 2030	N			
The highway is otherwise designed to have full controlled access	Crossing Currently meets the criteria	N			
	Crossing meets the criteria by 2030	N			
The posted highway speed equals or exceeds 70 mph	Crossing Currently meets the criteria	N			
	Crossing meets the criteria by 2030	N			
AADT exceeds 100,000 in urban areas or 50,000 in rural areas	Crossing Currently meets the criteria	N			
	Crossing meets the criteria by 2030	N			
Maximum authorized train speed exceeds 110 mph	Crossing Currently meets the criteria	N			
	Crossing meets the criteria by 2030	N			
An average of 150 or more trains per day or 300 million gross tons/year	Crossing Currently meets the criteria	N			
	Crossing meets the criteria by 2030	N			
Crossing exposure (trains/day x AADT) exceeds 1M in urban or 250k in rural; or passenger train crossing exposure exceeds 800k in urban or 200k in rural	Crossing Currently meets the criteria	N			
	Crossing meets the criteria by 2030	N			
Expected accident frequency for active devices with gates, as calculated by the US DOT Accident Prediction Formula including five-year accident history, exceeds 0.5	Crossing Currently meets the criteria	N			
	Crossing meets the criteria by 2030	N			
Vehicle delay exceeds 40 vehicle hours per day	Crossing Currently meets the criteria	N			
	Crossing meets the criteria by 2030	N			

Google maps

Get Google Maps on your phone
Text the word "GMAPS" to 466453



TRACS No. 0000 MA MES SR232 01C
Project No. STP-MES-0(204)A
Agreement No. 1532-91-SPTC
EXHIBIT "A"
Sheet 4 of 4



Dobson Road
Final Plan sheet
showing relocated sidewalks

Cantilever in Median (southbound direction)
-redone medians

As part of Arizona Corporation Commission application, submitted by Arizona Dept. of Transportation

SCALE: 1" = 5'
0 5 10
NORTH

BENCHMARK:
BRASS TAG ON TOP OF CURB, SOUTHEAST CORNER OF ALMA SCHOOL & BROADWAY ROADS
ELEV= 1225.13 (NAVD '88 DATUM)

CAUTION!
BEWARE OF LOCATIONS OF UNDERGROUND ELECTRICAL & GAS LINES (UGE & G) AND OVERHEAD ELECTRICAL LINES (OHE & HV/OHE)

UPPR COORDINATION NOTES

NOTE:
COORDINATE ALL PERTINENT RAILROAD (RR) SIGNAL, SEMAPHORE, RELATED COMMUNICATION & ELECTRICAL CABLING AND APPURTENANCES WITH UPPR PRIOR TO AND DURING DEMOLITION AND CONSTRUCTION OF ITEMS NOTED IN THESE PLANS.

(1)	EXTENTS OF COM REMOVAL AND PROPOSED CONSTRUCTION NOT SHOWN. REFER TO TEMPORARY CONSTRUCTION EASEMENT AS SHOWN ON DRAWING C6.	
(2)	RAIL & CROSSWALK MODIFICATION AREA BY UPPR.	
(4)	RAILROAD SIGNAGE RELOCATION TO BE COORDINATED BY UPPR	2 EA
(5)	CANTILEVER LIGHTS AND SIGNALS TO BE REPLACED PER PLANS BY UPPR.	6 EA
(6)	CROSSWALK AT TRACKS PER PLANS BY UPPR.	112 SF
(7)	COORDINATE FOR CLEARANCE & MATCH REQUIREMENTS PER PLANS BY UPPR.	

CONSTRUCTION NOTES

(1)	GRADE (ROUGH OR FINAL SUBGRADES) AS REQUIRED FOR DRAINAGE PER PRIOR CONDITIONS AND FOR FINISHED GRADES NOTED. COMPACT ALL TO 95% MINIMUM OF AASHTO T-99. FINISHED GRADE EQUALS TOP OF CONCRETE OR CURB, COMPACTED DECOMPOSED GRANITE, ABC OR SURFACE MATERIALS AFTER INSTALLATION. ANY EXPORT OR IMPORT SHALL BE AT NO ADDITIONAL COST TO THE CITY.	LUMP SUM
(3)	CONSTRUCT VERTICAL CURB & GUTTER PER MAG STD DTL 220-1, TYPE 'A', MODIFIED FOR 4.5-FOOT BICYCLE LANE PER DETAIL '1' ON DRAWING C2. MATCH EXISTING.	152 LF
(6)	CONSTRUCT VERTICAL CURB PER MAG STD DTL 222, TYPE 'A'.	101 LF
(7)	PROVIDE CURB TERMINATION PER MAG STD DTL 222. MODIFIED FOR CURB & GUTTER, WHERE APPLICABLE, PER DETAIL '3' ON DRAWING C2.	5 EA
(8)	CONSTRUCT VERTICAL CURB PER MAG STD DTL 222, TYPE 'B', MODIFIED TO 8" THICK RETAINING WALL PER DETAIL '4' ON DRAWING C2.	24 LF
(10)	CONSTRUCT SIDEWALK PER COM STD DTL M-43 AND DIMENSIONED PER LINE & CURVE TABLE, DRAWING C9. CROSS-SLOPES NOT TO EXCEED 1.8% MAXIMUM AND PATH SLOPES NOT TO EXCEED 4.8%. PROVIDE CLEARANCES FROM RAILROAD APPURTENANCES PER UPPR REQUIREMENTS. MATCH GRADES AT NEW RAILROAD CROSSWALK AND EXISTING SIDEWALKS. PROVIDE EXPANSION JOINTS PER SPECIFICATIONS. PATTERN, COLOR & TEXTURE TO MATCH CURRENT DESIGN FOR ADJOINING SIDEWALKS.	1,073 SF
(11)	CONSTRUCT CONCRETE IN MEDIAN WITH PATTERN, COLOR & TEXTURE TO MATCH EXISTING. FINISH WITH 0.5% MINIMUM & 1.8% MAXIMUM CROSS-SLOPES. PROVIDE EXPANSION JOINTS PER SPECIFICATIONS.	503 SF
(12)	FURNISH & INSTALL PAVERS IN MEDIAN WITH PATTERN, COLOR & TEXTURE TO MATCH EXISTING.	356 SF
(13)	FURNISH & INSTALL ASPHALT PAVEMENT PER COM STD DTL 19.04.1, TYPE 'A'.	83 SY
(15)	PROVIDE PAVEMENT THICKENED EDGE PER MAG STD DTL 201, TYPE 'A'.	48 LF
(17)	APPLY PRE-EMERGENT HERBICIDE BEFORE AND AFTER SURFACE TREATMENT PER MANUFACTURER'S RECOMMENDATIONS.	LUMP SUM
(18)	RESTORE AREAS TO PRIOR EXISTING SURFACE CONDITIONS, AS NECESSARY.	NPI

CITY OF MESA
ENGINEERING DEPARTMENT

SIDEWALKS AT RAILROAD CROSSINGS ON DOBSON ROAD

DOBSON ROAD SIDEWALK CONSTRUCTION PLAN

DRAWING C5

DRAWN BY: E SORENSON
ENGINEER: L WEIR
APPROVED BY: R DRAPER

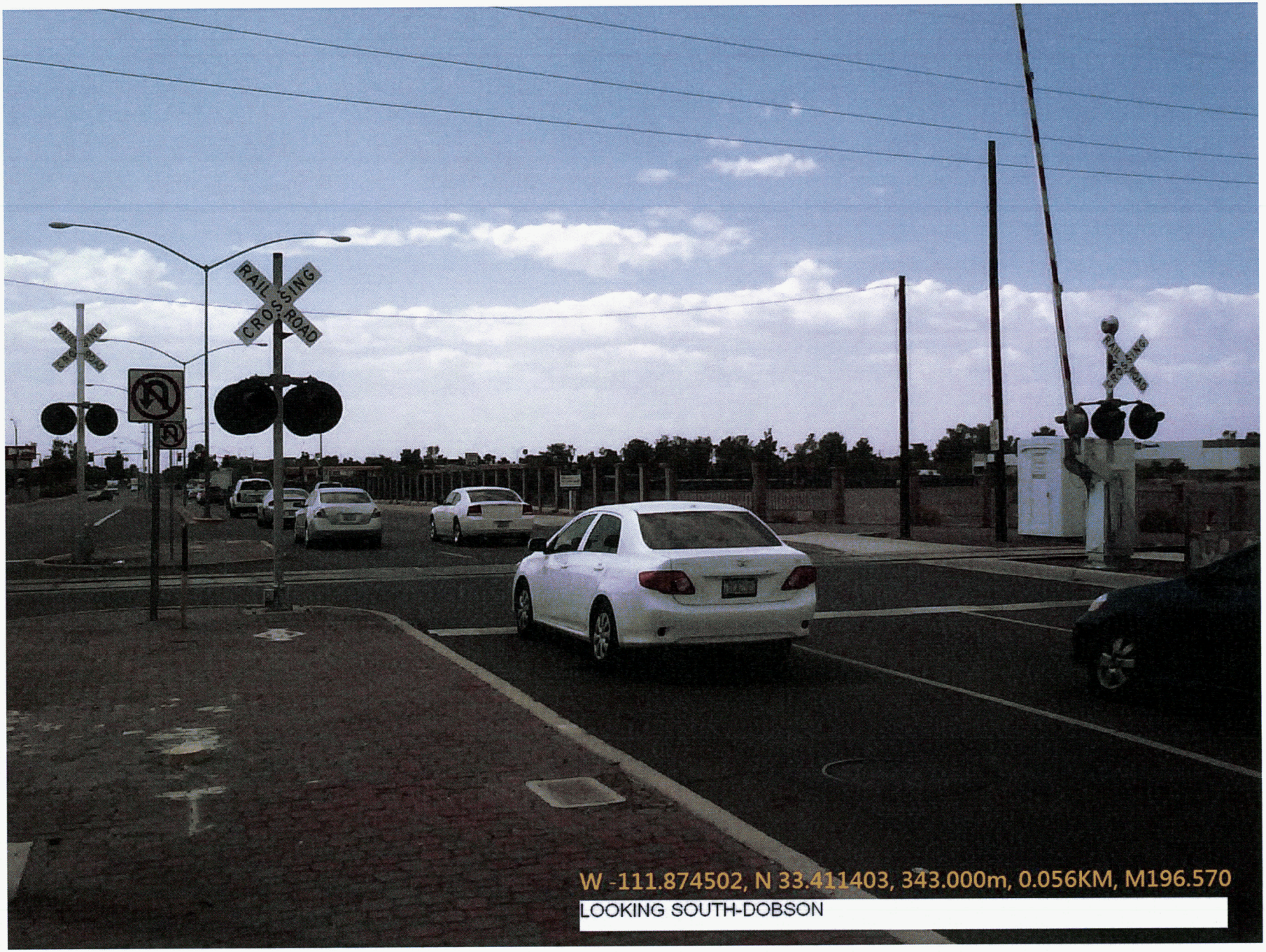
F165 AC 1675/10775062
PROJ. NO. CP0184

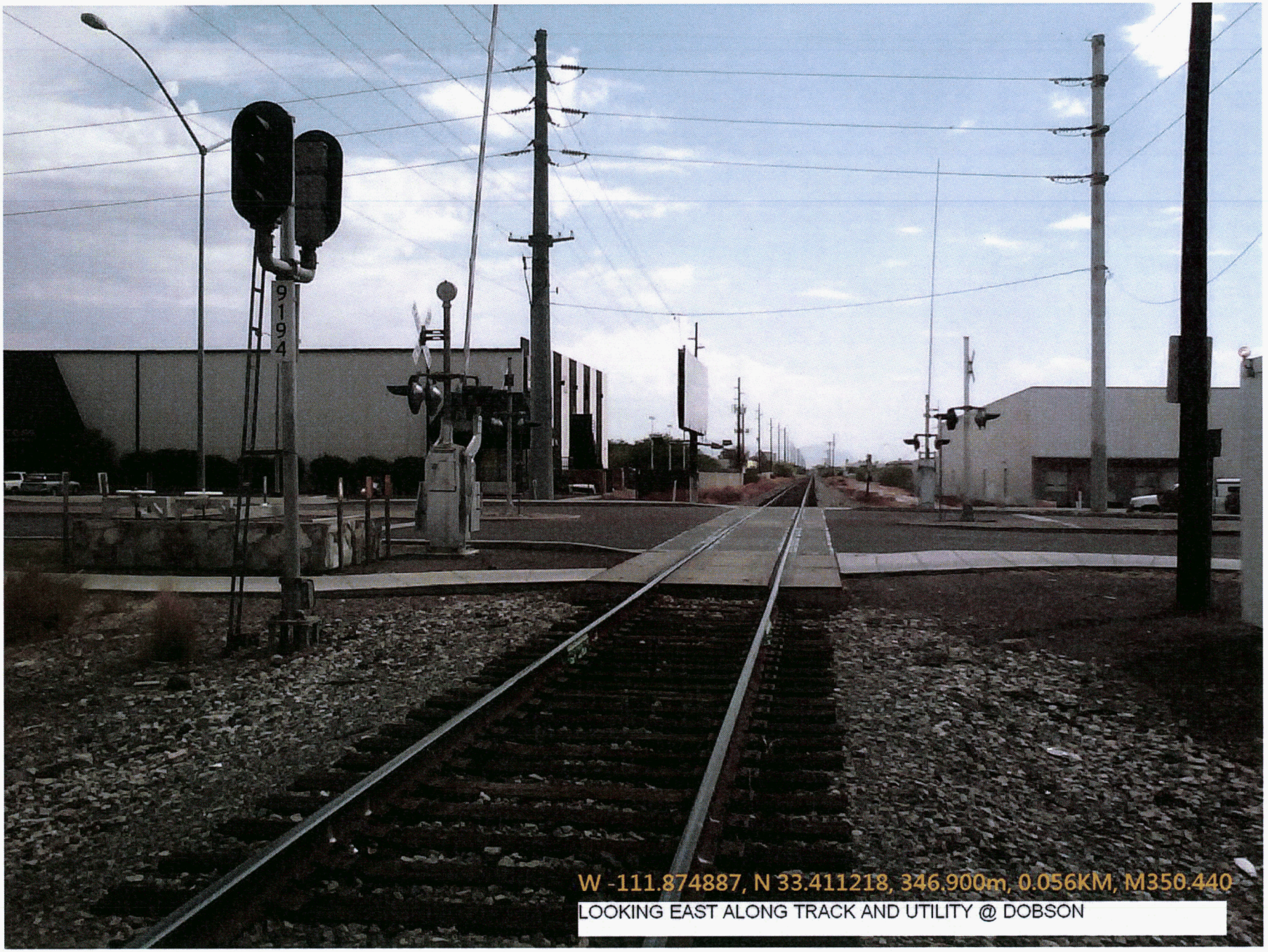
SHEET 5 OF 6

CATALOG NUMBER: A-149924

DATE SAVED: 6/20/13 I:\CP0184 - RAILROAD CROSSINGS\DESIGN\CAD FILES\PLANS_SDWK\CP0184-2_C5_DOBSON_CP.DWG


RAILROAD CROSSING
W -111.874395, N 33.410878, 339.000m, 0.241KM, M99.640
LOOKING NORTH-DOBSON


RAIL
CROSSING
ROAD
W -111.874502, N 33.411403, 343.000m, 0.056KM, M196.570
LOOKING SOUTH-DOBSON



W -111.874887, N 33.411218, 346.900m, 0.056KM, M350.440

LOOKING EAST ALONG TRACK AND UTILITY @ DOBSON

Janice K. Brewer, Governor
John S. Halikowski, Director
Jennifer Toth, State Engineer
Robert Samour, Senior Deputy State Engineer, Operations
Dallas Hammit, Senior Deputy State Engineer, Development

RAILROAD CROSSING PROJECT

TRACS No.: 0000 MA MES SR232 01C
Project No.: STP-MES-0(204)T
Location: Dobson Road
AAR/DOT No.: 741-649-G
RR M.P.: 919.40 Phoenix Subdivision
ADOT Accounting No: R1532JA13

RAILROAD AGREEMENT
For
FEDERAL AID
Railroad Crossing Projects

THE UNION PACIFIC RAILROAD COMPANY
Agreement No. 1532-91-SPTC
RAIL/HIGHWAY SAFETY PROGRAM

EXHIBIT A
Agreement 1532-91-SPTC
TRACS No. 0000 MA MES SR232 01C
PROJECT STP-MES-0(204)T
ADOT Accounting Number R1532HA11

SUMMARY OF ESTIMATE

		Total
Preliminary Engineering:		$8,000.00
Construction:		
Signals		
Construction Engineering		$31,431.00
Labor		$216,345.00
Materials		$229,864.00
	Signal Subtotal	$477,640.00
Crossing Surface		
Labor		$43,019.00
Materials		$69,231.00
	Crossing Surface Subtotal	$112,250.00
Contingency		$35,110.00
		*$633,000.00

* Railroad will invoice ADOT for 100% of total work. Railroad will separate Preliminary Engineering costs from Construction costs. Costs include installation of signals and providing power to the site.

DATE: 2013-01-25

ESTIMATE OF MATERIAL AND FORCE ACCOUNT WORK
BY THE
UNION PACIFIC RAILROAD

THIS ESTIMATE GOOD FOR 6 MONTHS EXPIRATION DATE IS :2013-07-26

DESCRIPTION OF WORK:
INSTALL AUTOMATIC FLASHING LIGHT CROSSING CANTILEVERS AND SIGNALS
WITH GATES AT MESA, AZ DOBSON ROAD M.P.919.40
ON THE PHOENIX SUBDIVISION - DOTH741649G
WORK TO BE PERFORMED BY RAILROAD WITH EXPENSE AS BELOW:
SIGNAL-FEDERAL/STATE - 100%
ESTIMATED USING FEDERAL ADDITIVES - 109.54%

FID: 71379 AWO: 06628 MP,SUBDIV: 919.40, PHOENIX
SERVICE UNIT: 16 CITY: NORMAL JCT STATE: AZ

DESCRIPTION	QTY	UNIT	LABOR	MATERIAL	RECOLL	UPRR	TOTAL
ENGINEERING WORK							
ENGINEERING			10218		10218		10218
LABOR ADDITIVE 109.54%			16392		16392		16392
SIG-HWY XNG			4821		4821		4821
TOTAL ENGINEERING			31431		31431		31431
SIGNAL WORK							
BILL PREP			900		900		900
CANTILEVERS				23085	23085		23085
CONTRACT				9775	9775		9775
LABOR ADDITIVE 109.54%			113097		113097		113097
MATL STORE EXPENSE				7	7		7
METER SERVICE				15000	15000		15000
PERSONAL EXPENSES				51000	51000		51000
ROCK/GRAVEL/FILL				800	800		800
SALES TAX				3910	3910		3910
SIGNAL			102348	97754	200102		200102
TRANSP/IB/OB/RCLW CONTR				14977	14977		14977
WET CONTROL				11475	11475		11475
1-970HS COOP.7A399F				580	580		580
2-84 OHM RELAYS TAB 912				1500	1500		1500
ENVIRONMENTAL - PERMITS				1	1		1
TOTAL SIGNAL			216345	229864	446209		446209
LABOR/MATERIAL EXPENSE			247776	229864			
RECOLLECTIBLE/UPRR EXPENSE					477640	0	
ESTIMATED PROJECT COST							477640

THE ABOVE FIGURES ARE ESTIMATES ONLY AND SUBJECT TO FLUCTUATION. IN THE EVENT OF AN INCREASE OR DECREASE IN THE COST OR QUANTITY OF MATERIAL OR LABOR REQUIRED, UPRR WILL BILL FOR ACTUAL CONSTRUCTION COSTS AT THE CURRENT EFFECTIVE RATE.

TRACS No. 0000 MA MES SR232 01C
Project No. STP-MES-0(204)A
Agreement No. 1532-91-SPTC
EXHIBIT "A"
Sheet 2 of 6

AREMA UNIT STATEMENT OF RAILROAD HIGHWAY GRADE CROSSING SIGNALS
ESTIMATED MAINTENANCE COSTS

BUILDING AMERICA®

FOR **PID #71379**

BY THE **UNION PACIFIC RAILROAD**

STREET	DOBSON RD.
TOWN	MESA, AZ.
MILEPOST	919.4
SUBDIVISION	PHOENIX
AAR/DOT NO.	741649G
WORK ORDER#	6628

DESCRIPTION	UNIT VALUE	QUANTITY	UNITS
NON-CODED TRK. CIRCUIT, (Standalone AFTAC or Ring 10)	2	0	0
SUPERIMPOSED CIRCUIT(AFTAC) / DETECTION LOOP	2	0	0
HIGHWAY GRADE CROSSING SIGNAL (ONE PAIR OF FLASHING LIGHTS)	2	6	12
ADDITIONAL PAIR OF LIGHTS	1	4	4
GATE MECHANISM, AUTOMATIC WITH ARM UP TO 26 FT	8	4	32
GATE MECHANISM, AUTOMATIC WITH ARM OVER 26 FT	10	0	0
GCP/HXP (Constant warning device, per track circuit)	15	2	30
EXIT GATE MANAGEMENT SYSTEM RACK*	10	0	0
MOVEMENT DETECTOR (PMD)	6	0	0
MOVEMENT DETECTOR (STANDBY UNIT)	3	0	0
RADIO DATA LINK, PER UNIT	1	0	0
PREEMPTION CIRCUIT	2	0	0
DATA RECORDER	1	0	0
REMOTE MONITORING DEVICE*	2	1	2
BONDED RAIL JOINTS (per mile, each rail, single bonded)	1	0	0
BATTERY AND CHARGER (per set)	1	2	2

TOTAL UNIT COUNT 82

PAVEMENT RESTORATION COSTS (Actual)

Annual Maintenance Cost at $170/Unit **$13,940**

*UP supplied Unit Value

January 25, 2013

TRACS No. 0000 MA MES SR232 01C
Project No. STP-MES-0(204)A
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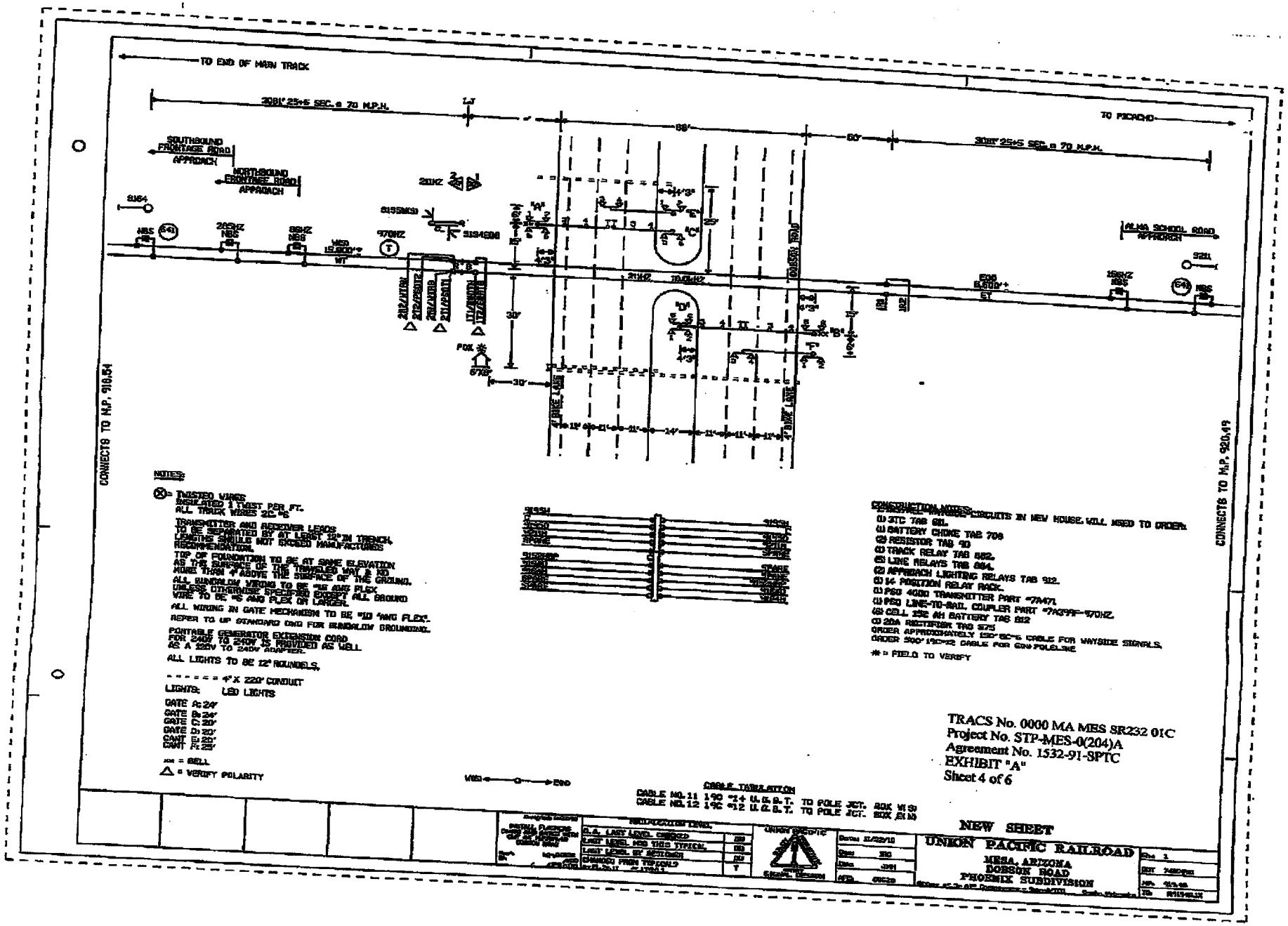
EXHIBIT "A"
Sheet 3 of 6


TO END OF MAIN TRACK
2081' 25#S SEC. @ 70 M.P.H.
TO PICACHO
SOUTHBOUND FRONTAGE ROAD APPROACH
NORTHBOUND FRONTAGE ROAD APPROACH
ALMA SCHOOL ROAD APPROACH
CONNECTS TO M.P. 910.54
CONNECTS TO M.P. 920.49
EAST BOUND
WEST BOUND
NOTES:
TWISTED WIRES INSULATED 1 TWIST PER FT. ALL TRACK WIRES 2C #6
TRANSMITTER AND RECEIVER LEADS TO BE SEPARATED BY AT LEAST 12" IN TRENCH. LOADING SHALL NOT EXCEED MANUFACTURES RECOMMENDATION.
TOP OF FOUNDATION TO BE AT SAME ELEVATION AS THE SURFACE OF THE TRAVELED WAY & NO MORE THAN 4" ABOVE THE SURFACE OF THE GROUND.
ALL BUNGALOW WIRING TO BE #10 AWG FLEX UNLESS OTHERWISE SPECIFIED EXCEPT ALL GROUND WIRE TO BE #6 AWG FLEX OR LARGER.
ALL WIRING IN GATE MECHANISM TO BE #10 AWG FLEX.
REFER TO UP STANDARD DWG FOR BUNGALOW GROUNDING.
PORTABLE GENERATOR EXTENSION CORD FOR 240V TO 240V IS PROVIDED AS WELL AS A 120V TO 240V ADAPTER.
ALL LIGHTS TO BE 12" ROUNDELS.
= 4" X 220' CONDUIT
LIGHTS: LED LIGHTS
GATE A: 24'
GATE B: 24'
GATE C: 20'
GATE D: 20'
CANT #1: 20'
CANT #2: 20'
xx = BELL
△ = VERIFY POLARITY
CONSTRUCTION NOTES:
(1) 3TC TAB 681.
(4) BATTERY CHOKE TAB 708
(2) RESISTOR TAB 90
(6) TRACK RELAY TAB 682.
(6) LINE RELAYS TAB 684.
(2) APPROACH LIGHTING RELAYS TAB 912.
(1) 14 POSITION RELAY RACK.
(1) PSO 4000 TRANSMITTER PART #7A47L
(1) PSO LINE-TO-RAIL COUPLER PART #7A39F-970HZ.
(4) CELL 12E AH BATTERY TAB 812
(1) 20A RECTIFIER TAB 875
ORDER APPROXIMATELY 150'-6C#6 CABLE FOR WAYSIDE SIGNALS.
ORDER 500' 19C#12 CABLE FOR GRADE CROSSING
* = FIELD TO VERIFY
CABLE TABULATION
CABLE NO.11 19C #14 U.G.S.T. TO POLE JCT. BOX W 39
CABLE NO.12 19C #12 U.G.S.T. TO POLE JCT. BOX W 39
TRACS No. 0000 MA MES SR232 01C
Project No. STP-MES-0(204)A
Agreement No. 1532-91-SPTC
EXHIBIT "A"
Sheet 4 of 6
NEW SHEET
UNION PACIFIC RAILROAD
MESA, ARIZONA
DOBSON ROAD
PHOENIX SUBDIVISION

DATE: 2013-01-24

ESTIMATE OF MATERIAL AND FORCE ACCOUNT WORK
BY THE
UNION PACIFIC RAILROAD

THIS ESTIMATE GOOD FOR 6 MONTHS EXPIRATION DATE IS :2013-07-25

DESCRIPTION OF WORK:
2013 RECOLLECTABLE ROAD CROSSING SURFACE PROJECT
PHOENIX SUB M.P. 919.45
DOBSON ROAD / MESA AZ. / DOT# 741649G
INSTALL 112 TF OF CONCRETE CROSSING SURFACE WITH RAIL, TIES AND OTM
UNLOAD BALLAST AND SURFACE TRACK

PID: 78276 AWO: 14707 MP,SUBDIV: 919.45, PHOENIX
SERVICE UNIT: 16 CITY: NORMAL JCT STATE: AZ

DESCRIPTION	QTY	UNIT	LABOR	MATERIAL	RECOLL	UPRR	TOTAL
ENGINEERING WORK							
ENGINEERING			1500		1500		1500
LABOR ADDITIVE 144%			2160		2160		2160
TOTAL ENGINEERING			3660		3660		3660
SIGNAL WORK							
SIGNAL			228	3	231		231
TOTAL SIGNAL			228	3	231		231
TRACK & SURFACE WORK							
BALAST	2.00	CL	1445	1651	3096		3096
ENVIRONMENTAL - PERMITS				10	10		10
EQUIPMENT RENTAL W/OPER				10000	10000		10000
LABOR ADDITIVE 144%			18956		18956		18956
MATL STORE EXPENSE				271	271		271
OTM			2060	5601	7661		7661
RAIL	240.00	LF	832	6084	6916		6916
RDXING	112.00	TF	3685	17656	21341		21341
SALES TAX				1670	1670		1670
SAW CUT STREET APPROACH				500	500		500
SWTIE		EA	1196		1196		1196
TRAFFIC CONTROL				15000	15000		15000
TRK-SURF,LIN			2795		2795		2795
WELD			2935	631	3566		3566
XTIE	104.00	EA	5227	10154	15381		15381
TOTAL TRACK & SURFACE			39131	69228	108359		108359
LABOR/MATERIAL EXPENSE			43019	69231			
RECOLLECTIBLE/UPRR EXPENSE					112250	0	
ESTIMATED PROJECT COST							112250
EXISTING REUSEABLE MATERIAL CREDIT					0		
SALVAGE NONUSEABLE MATERIAL CREDIT					0		
RECOLLECTIBLE LESS CREDITS							

THE ABOVE FIGURES ARE ESTIMATES ONLY AND SUBJECT TO FLUCTUATION. IN THE EVENT OF AN INCREASE OR DECREASE IN THE COST OR QUANTITY OF MATERIAL OR LABOR REQUIRED, UPRR WILL BILL FOR ACTUAL CONSTRUCTION COSTS AT THE CURRENT EFFECTIVE RATE.

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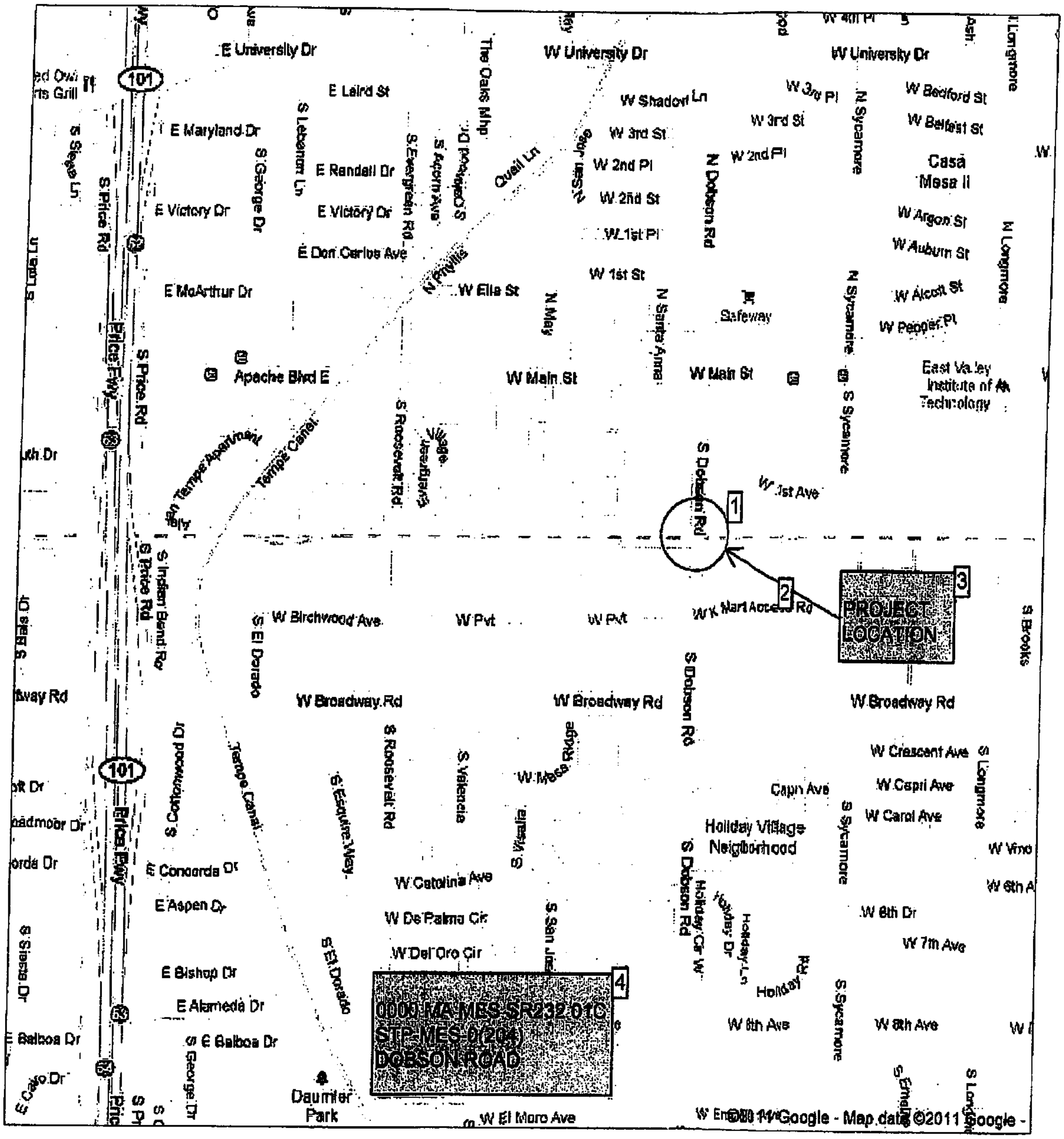

TRACS No. 0000 MA MES SR232 01C
Project No. STP-MES-0(204)A
Agreement No. 1532-91-SPTC
EXHIBIT "A"
Sheet 6 of 6

STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION

Agreement No. 1532-91-SPTC Agreement Addendum No. 1

Company's Name: The Union Pacific Railroad Company
Address: 101 S. Watson Road, Arlington, TX 76010

The purpose of this addendum is to modify the Company name as stated herein:

WHEREAS: **Agreement No. 1532-91-SPTC terms the "RAILROAD" as SOUTHERN PACIFIC TRANSPORTATION COMPANY.**

WHEREAS: **Agreement No. 1532-91-SPTC is revised to term the "RAILROAD" as the UNION PACIFIC RAILROAD COMPANY.**

THEREFORE: **The parties hereto agree that Agreement No. 1532-91-SPTC is hereby amended as shown herein. All other provisions of Agreement No. 1532-91-SPTC shall remain unabrogated.**

IN WITNESS WHEREOF, the parties hereto have executed this Agreement.

ARIZONA DEPARTMENT OF TRANSPORTATION

By _____
~~WILLIAM R. ERTSCOE~~, P.E.
J. Patrick Hackett
Utility & Railroad Engineering Section

Date 2-18-99

UNION PACIFIC RAILROAD COMPANY

By _____
CHIEF ENGINEER

Date _____

Approved as to Form
General Attorney

A. G. CONTRACT NO. KR95-1689-TF

ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
UTILITY AND RAILROAD ENGINEERING SECTION

MASTER
RAILROAD AGREEMENT
For
FEDERAL AID
Railroad Crossing Projects

SOUTHERN PACIFIC TRANSPORTATION COMPANY
Agreement No. 1532-91-SPTC
RAIL/HIGHWAY SAFETY PROGRAM

THIS AGREEMENT by and between SOUTHERN PACIFIC TRANSPORTATION COMPANY, a Delaware corporation, herein termed "RAILROAD," and STATE OF ARIZONA, DEPARTMENT OF TRANSPORTATION, HIGHWAYS DIVISION, herein termed "STATE".

WITNESSETH:

The parties hereto desire to set forth by this instrument their understanding and agreements with respect to the installation, at various times, of railroad warning devices and/or surface crossing materials with track rehabilitation, if required, throughout the State of Arizona, where a roadway crosses the property and tracks of RAILROAD.

AGREEMENT:

NOW THEREFORE, it is mutually agreed as follows:

1. The work to be performed by RAILROAD under this agreement is hereinafter referred to as "PROJECT".

2. RAILROAD agrees to furnish all labor, materials, tools, and equipment necessary to install such warning devises including necessary actuating and operating circuits and adequate instrument housing and/or roadway crossing materials with track rehabilitation, if required, upon its property at certain designated grade crossings.

Said installation shall comply with the latest standards prescribed by the Association of American Railroads and the Manual On Uniform Traffic Control Devices, Part VIII.

3. RAILROAD will prepare both a cost estimate, marked Exhibit "A" and a location plan marked, Exhibit "B", showing the general details of each PROJECT and send them to STATE for acceptance.

4. It is agreed that the work to be performed by RAILROAD is a part of a Federal-Aid project. Pursuant to the provisions of Federal-Aid Policy Guide Subchapter G, Part 646 Subpart B, there is no ascertainable net benefit to RAILROAD, and STATE agrees to reimburse RAILROAD for one hundred percent (100%) of the cost and expense incurred by RAILROAD in furnishing of materials and performing the work as described in the Cost Estimate, marked EXHIBIT "A", attached to and made a part hereof.

5. It is understood and agreed that the STATE is acting solely as an agent for the project sponsor in securing and administering Federal funds and STATE assumes no other liability hereunder for the project sponsor.

6. Prior to commencing construction of each PROJECT, Railroad agrees to notify STATE, in writing, of the actual construction start date. Upon completion of each PROJECT, RAILROAD agrees to notify STATE, in writing, of the actual completion date. The construction start date shall not be prior to receiving a notice to proceed from STATE. Construction progress payments shall not be made without the actual construction start date. Final payment shall not be made without the actual construction completion date.

7. The work for each PROJECT shall be performed by RAILROAD forces on an actual cost basis, and as supported by the analysis of estimated costs set forth in Exhibit "A". The actual cost shall be payable in payments as follows:

a. RAILROAD will order the materials for each PROJECT, and may invoice the STATE upon receipt, for materials and related costs, as set forth in Exhibit "A".

b. RAILROAD may submit monthly invoices for work performed and materials installed unless invoiced under subparagraph a.

c. Minimum payment, except for final invoice, is $5,000.

d. Upon completion of all work under each PROJECT, RAILROAD shall arrange for a joint close-out inspection of the completed PROJECT. Upon determination by STATE that the work has been completed in accordance

with Exhibits "A" and "B", RAILROAD will submit final and complete invoice to the STATE. STATE agrees to pay RAILROAD the difference between the final invoice and any previous payments for PROJECT. Any amount with which STATE disagrees shall be paid under protest, subject to resolution.

e. All invoices will be paid by STATE within sixty (60) days of receipt.

All expenses incurred by RAILROAD for work which STATE is obligated to reimburse RAILROAD hereunder, including all work incidental to such work but not specifically mentioned herein, shall be subject to the provisions of the Federal-Aid Policy Guide Subchapter B Part 140 Subpart I.

8. Pursuant to A.R.S. Sections 35-214, 35-215 and 41-1279.04, the books of RAILROAD shall be open for inspection and audit by authorized representatives of STATE and the Federal Government for a period of not less than five (5) years from the date final payment has been received by RAILROAD. State agrees to pay RAILROAD any sums found to be owing as a result of an audit within sixty (60) days of receipt of the audit by the Utility and Railroad Engineering Section of STATE. RAILROAD agrees to reimburse STATE, within sixty (60) days of notification for any amount STATE disallows as a result of its audit. Any audit exceptions with which RAILROAD disagrees shall be paid to STATE under protest subject to resolution.

9. All invoices shall contain STATE's project number and agreement number. The invoice shall be sent to:

ARIZONA DEPARTMENT OF TRANSPORTATION
Utility and Railroad Engineering Section
205 South 17th Ave. Mail Drop 618E
Phoenix, Arizona 85007-3212

10. Once installation of railroad warning devices and/or roadway crossing material has been completed, RAILROAD shall maintain, in kind, the railroad warning devices and the crossing material two feet outside of each rail as long as they remain in place. However, RAILROAD shall be entitled to receive any contribution toward the cost of such maintenance as may be now or hereafter made available by means of any law, ordinance, regulation, order, grant or by other means or sources.

11. Claims and disputes between STATE and RAILROAD involving sums less than $100,000 and arising out of the terms of this Agreement relating to work performed, invoicing and similar matters, shall be subject to arbitration, at the request of either party, in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association then obtaining; provided, however, that claims or disputes arising out of personal injury, death, property damage, or environmental incidents shall not be subject to arbitration without the concurrence of both parties, except to the extent otherwise required by the rules of Arizona courts.

12. In compliance with the regulations of the United States Department of Transportation, RAILROAD hereby agrees to comply fully with all of the provisions of Appendix "A", attached hereto and by this reference made a part of this Agreement; provided, however, that Appendix "A" shall be applicable only in those cases where RAILROAD does not perform the work contemplated in this Agreement with its own forces.

13. This Agreement is subject to the budgetary limitations set forth in Arizona Revised Statutes Subsection 28-1823 through 28-1826 inclusive and is further subject to the provisions of Chapter 1 of Title 35, Arizona Revised Statutes.

14. STATE and RAILROAD each agrees to be liable to the other party for its own acts of negligence and the negligence of its own employees.

15. This Agreement shall inure to the benefit of and be binding upon the successors and assigns of RAILROAD and the assigns of STATE.

16. RAILROAD is required to comply with Executive Order 75-5, "Non-Discrimination in Employment by Government Contractors and Subcontractors," which is hereby included in its entirety by reference and considered a part of this Agreement.

17. Pursuant to A.R.S. Subsection 38-511, STATE may cancel this Agreement, without penalty or further obligation, if any person significantly involved in initiating, negotiating, securing, drafting or creating the Agreement on behalf of STATE or any of its departments or agencies is, at any time while this Agreement or any extension of it is in effect, an employee of any other party to this Agreement with respect to the subject matter of this Agreement.

IN WITNESS WHEREOF, the parties have executed this Agreement as of the day and year signed by both parties.

SOUTHERN PACIFIC TRANSPORTATION COMPANY	ARIZONA DEPART. OF TRANSPORTATION HIGHWAY DIVISION
By Jane L Mather	By William R Briscoe
Its MANAGER-CONTRACTS	Manager of Utility & Railroad Engineering Section
Date October 2, 1995	Date 10-17-95

Approved as to Form
ATTORNEY 10/2/95

STATE OF COLORADO)
) ss.
COUNTY of DENVER)

The foregoing instrument was acknowledged before me this 2nd day of October, 1995, by Ms. J. L. Mather, the MANAGER-CONTRACTS of SOUTHERN PACIFIC TRANSPORTATION COMPANY, a Delaware corporation, on behalf of the corporation.

My Commission Expires:
2-11-97

NOTARY PUBLIC ALISON DILGES STATE OF COLORADO

Notary Public Alison Dilges

My Commission Expires 2-11-97

STATE OF ARIZONA)
)ss.
COUNTY of MARICOPA)

The foregoing instrument was acknowledged before me this 17 day of October, 1995 by William R. Briscoe, the Manager of Utility and Railroad Engineering Section of the Arizona Department of Transportation, on behalf of the STATE.

My Commission Expires:

Commission Expires March 30, 1998

Notary Public

APPENDIX A
(Revised)

II EQUAL OPPORTUNITY

1. Selection of Labor:
During the performance of this contract, the contractor shall not discriminate against labor from any other State, possession or territory of the United States.

2. Employment Practices:
During the performance of this contract, the contractor agrees as follows:

a. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoffs or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the State highway department setting forth the provisions of this nondiscrimination clause.

b. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

c. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided by the State highway department advising the said labor union or workers' representative of the contractors commitments under this section II-2 and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

d. The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations (41 CFR, Part 60) and relevant orders of the Secretary of Labor.

e. The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records and accounts by the Federal Highway Administration and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations and orders.

f. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations or orders, this contract may be canceled, terminated or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or Federally-assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation or order of the Secretary of Labor, or as otherwise provided by law.

g. The contractor will include the provisions of this Section II-2 in every subcontract or purchase order unless exempted by rules, regulations or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the State highway department or the Federal Highway Administration may direct as a means of enforcing such provisions including sanctions for noncompliance: Provided, however, that in the event a contractor becomes involved in, or is threatened with litigation with a subcontractor or vendor as a result of such direction by the Federal Highway Administration, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

3. Selection of Subcontractors, Procurement of Materials, and Leasing of Equipment:

During the performance of this contract, the contractor, for itself, its assignees and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

a. Compliance With Regulations: The contractor shall comply with the Regulations relative to nondiscrimination in federally-assisted programs of the Department of Transportation, Title 49, Code of Federal Regulations, Part 21, as they may be amended from time to time, (hereinafter referred to as the Regulations), which are herein incorporated by reference and made a part of this contract.

b. Nondiscrimination: The contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor shall not participate either directly or indirectly in the discrimination prohibited by section 21.5 of the Regulations, including employment practices when the contract covers a program set forth in Appendix B of the Regulations.

c. Solicitations for Subcontracts, Including Procurements of Materials and Equipment: In all solicitations either by competitive bidding or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the contractor of the contractor's obligations under this contract and the Regulations relative to nondiscrimination on the grounds of race, color, or national origin.

d. Information and Reports: The contractor shall provide all information and reports required by the Regulations, or directives issued pursuant thereto, and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the State highway department or the Federal Highway Administration to be pertinent to ascertain compliance with such Regulations or directives. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish this information the contractor shall so certify to the State highway department, or the Federal Highway Administration as appropriate, and shall set forth what efforts it has made to obtain the information.

e. Sanctions for Noncompliance: In the event of the contractor's noncompliance with the nondiscrimination provisions of this contract, the State highway department shall impose such contract sanctions as it or the Federal Highway Administration may determine to be appropriate, including, but not limited to:

(1) withholding of payments to the contractor under the contract until the contractor complies, and/or

(2) cancellation, termination or suspension of the contract, in whole or in part.

f. Incorporation of Provisions: The contractor shall include the provision of this paragraph 3 in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Regulations, or directives issued pursuant thereto. The contractor shall take such action with respect to any subcontractor or procurement as the State highway department or the Federal Highway Administration may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, however, that, in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the contractor may request the State highway department to enter into such litigation to protect the interests of the State, and, in addition, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

City of Mesa
Semi-Annual Travel Time Study
Fall 2006

Alma School Road
Brown Road
Dobson Road
Greenfield Road
McKellips Road
University Drive

CITY OF
MESA
Great People, Quality Service!

CITY OF MESA
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CITY OF MESA
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1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

The City of Mesa has started a program to measure how well the services it provides are serving its citizens through a group of performance measures. One of the performance measurements given to Responsibility Center 364 (RC 364), or Traffic Engineering, is to monitor travel times. The specific goal is to:

- keep the rate of travel time increases below the growth rate of traffic volumes. This measure is to be applied on a corridor by corridor basis, and applied to each direction during each of the three study times (AM peak, Mid Day, and PM peak).

This goal can be achieved by increasing the capacity of the roadways in Mesa through constructing new roadways, widening existing roadways, and by making adjustments to traffic signal timing in response to evolving traffic patterns and volumes.

In addition to the freeway construction projects currently happening in Mesa, the City of Mesa has a number of arterial roadway widening projects in the planning stages that are part of the Regional Transportation Plan (RTP). The City is also investing in Intelligent Transportation Systems (ITS), which will enable the City to be more responsive to changes in traffic patterns or volumes by adjusting the timing of the traffic signals.

Traffic Engineering Staff will be performing semi-annual travel time studies, which will allow Staff to:

- compare current traffic conditions to those of the past,
- identify congested areas, and make adjustments to traffic signal timings as necessary, and
- identify congested areas, which will provide decision makers with information that can be used to decide where to spend money intended for roadway improvements.

Twenty major arterial streets were identified to be included in the traffic time studies. Two of these arterials, University Drive and Greenfield Road, will be studied every fall and used as control corridors. The other 18 arterials will be studied once every three years. The studies will be conducted twice per year, once in the spring, and once in the fall.

The City of Mesa has conducted travel time studies twice in the past. The first study was in 1985, and the second in 2000. The first round of the new travel time studies (studies done from fall of 2006 through spring of 2009) will be compared with results from the 2000 study (if the specific arterial was studied in 2000). However, the most accurate comparisons likely won't be achieved until the second round of travel time studies, as methodologies will now be consistent, the study schedule will be consistent, and the corridor begin/end points will be consistent.

In addition to travel time, this report will also present travel speeds through a number of figures, graphs, and tables.

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1.2 PRINCIPAL FINDINGS

The primary purpose of this study is to compare the current performance of Mesa's roadway network to the performance recorded in 2000. However, the new study is being conducted with future studies in mind, and as a result, some characteristics between this study and the 2000 study differ, such as test car technique, corridors studied, and corridor begin/end points.

In this study, three east/west arterial streets and three north/south arterial streets were studied. They were Brown Road, McKellips Road, Dobson Road, Alma School Road, and the two control corridors, which will be studied every fall, Greenfield Road and University Drive. These arterials are illustrated in **Figure 1**.

The arterials were studied during three time periods:

- AM Peak (6:30am to 8:30am)
- Mid Day (11:30am to 1:30pm)
- PM Peak (3:30pm to 5:30pm)

The mid day study period for this study did not match the mid day study period for the 2000 study. The 2000 study considered mid day to be either the AM off peak (9am to 11am) or the PM off peak (1pm to 3pm). The reason for the change is because the noon hour has the potential to have increased traffic volumes, especially in areas with restaurants. So there is no direct comparison between this mid day study, and the mid day study done in 2000.

In some cases, the arterials that were studied in 2000 had different start/end points than this study. In this study, every effort was made to include the eastern and western (or northern and southern) most signals on the arterial streets, whereas the 2000 study went no further east than Power Road. So in order for a direct comparison to be made, some segments in the current study were recorded, but not used for the comparison.

Table 1, below, is a summary of the improvement (or degradation) in average travel speeds for arterials in the peak direction during the peak hours from 2000 to 2006, and compares it with the increase (or decrease) in traffic volumes from 2000 to 2006. It is important to note that while the performance measure uses travel times, technical and non-technical audiences alike can easily read travel speeds. In other words, **Table 1**, gives a good snapshot comparison from the 2000 study to this study, but the actual performance measures are presented in **Table 9**, found on page 14 in the body of the report.

Figure 1
Recommended Future Travel Time Study Schedule

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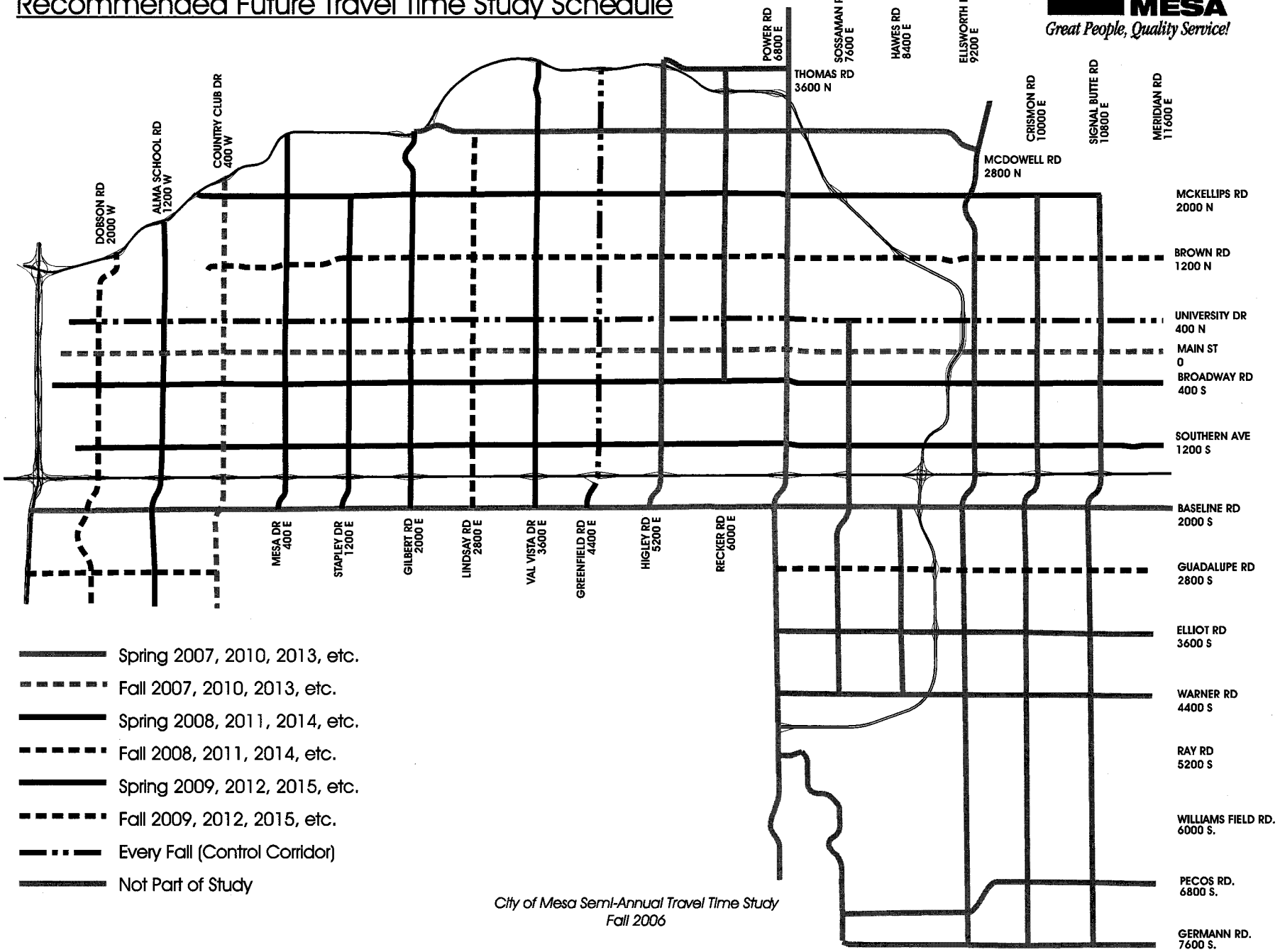

City of Mesa Semi-Annual Travel Time Study
Fall 2006

Table 1 - Average Travel Speed vs. Average Traffic Volumes, from 2000 to 2006*

Time Period	Direction of Travel	Average Travel Speed (mph)**			Average Traffic Volume (daily)***		
		2000	2006	Increase (Decrease)	2000	2006	Increase (Decrease)
AM Peak	Westbound	30.0	35.5	18.4%	27,576	23,826	-13.6%
	Southbound	31.7	34.8	9.7%	33,710	33,102	-1.8%
PM Peak	Eastbound	28.5	31.0	8.6%	27,576	23,826	-13.6%
	Northbound	31.9	31.2	-2.4%	33,710	33,102	-1.8%

*For eastbound and westbound corridors, results for McKellips Road, Brown Road and University Drive were compared to the 2000 study. For northbound and southbound, results of Alma School Road and Dobson Road were compared to the 2000 study (Greenfield not studied in 2000).
**Weighted average by traffic volume, and length of corridor.
***Bidirectional, Weighted average by length of corridor.

The westbound and eastbound directions of travel during the peak hours have seen an improvement in average travel speeds since 2000, and the traffic volumes along these same corridors have dropped. This is likely due to the number of freeway improvements that have been made in Mesa, meaning traffic that previously used the arterial street network, is now using the freeways. As the freeways become more congested, the volumes on the arterial streets will likely begin to grow again.

There has not been as much change on the north/south arterials. Average travel speeds have decreased slightly, and traffic volumes are down slightly.

Once the first three-year cycle of travel time studies has been completed, better comparisons can be made as travel study techniques, study corridors, and corridor lengths will be performed on a consistent basis.

1.3 RECOMMENDATIONS FOR FUTURE STUDIES

The data collected for this study took 200 individual runs and three weeks to complete. Significant staff time was invested in both data collection and analysis and would be difficult to repeat every six months. As a result, it is recommended to scale future studies back to four arterials at a time from six. The proposed schedule is shown in **Table 2** and illustrated in **Figure 1**. This schedule allows all arterials to be studied every three years, and the control corridors of University Drive and Greenfield Road to be studied every year.

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Table 2 - Proposed Future Travel Time Schedule

Year	Season	East – West Arterials	North – South Arterials
2007, 2010, 2013, etc.	Spring	• McDowell Road • Baseline Road	• Higley Road • Power Road
	Fall	• University Drive • Main Street	• Greenfield Road • Country Club Drive
2008, 2011, 2014, etc.	Spring	• Broadway Road • Southern Avenue	• Mesa Drive • Gilbert Road
	Fall	• University Drive • Guadalupe Road	• Greenfield Road • Lindsay Road
2009, 2012, 2015, etc.	Spring	• McKellips	• Stapley Drive • Val Vista Drive • Alma School Road
	Fall	• University Drive • Brown Road	• Greenfield Road • Dobson Road

Once the travel time data collection was complete and the data downloaded and analyzed, it was discovered that there was variation in where staff was recording the locations of the nodes (traffic signals). The locations of the traffic signals define the sections used for analysis, so accurately locating these points is very important. For the follow up sessions, Staff was instructed to only record the begin point of the arterial, and the end point. The locations of the nodes were manually entered into PC Travel traffic analysis software based on distances obtained from the City's land database. The results showed great improvement in consistency, and it is recommended that this become standard practice.

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2.0 STUDY METHODOLOGY

2.1 STUDY SCHEDULE

Most of the major arterial streets in Mesa will be studied as part of the travel time study program. Some arterials in the eastern and southeastern parts of Mesa are not entirely within Mesa's jurisdiction (i.e. still controlled by Maricopa County), or have not yet been improved to the point where conducting travel time studies on them makes sense. However, at some point in the future, additional corridors may be added to the travel time study program.

The arterials that will be studied are listed in **Table 3,** and will be included in the initial travel time study program.

Table 3 - Arterial Streets Included in Travel Time Study Program

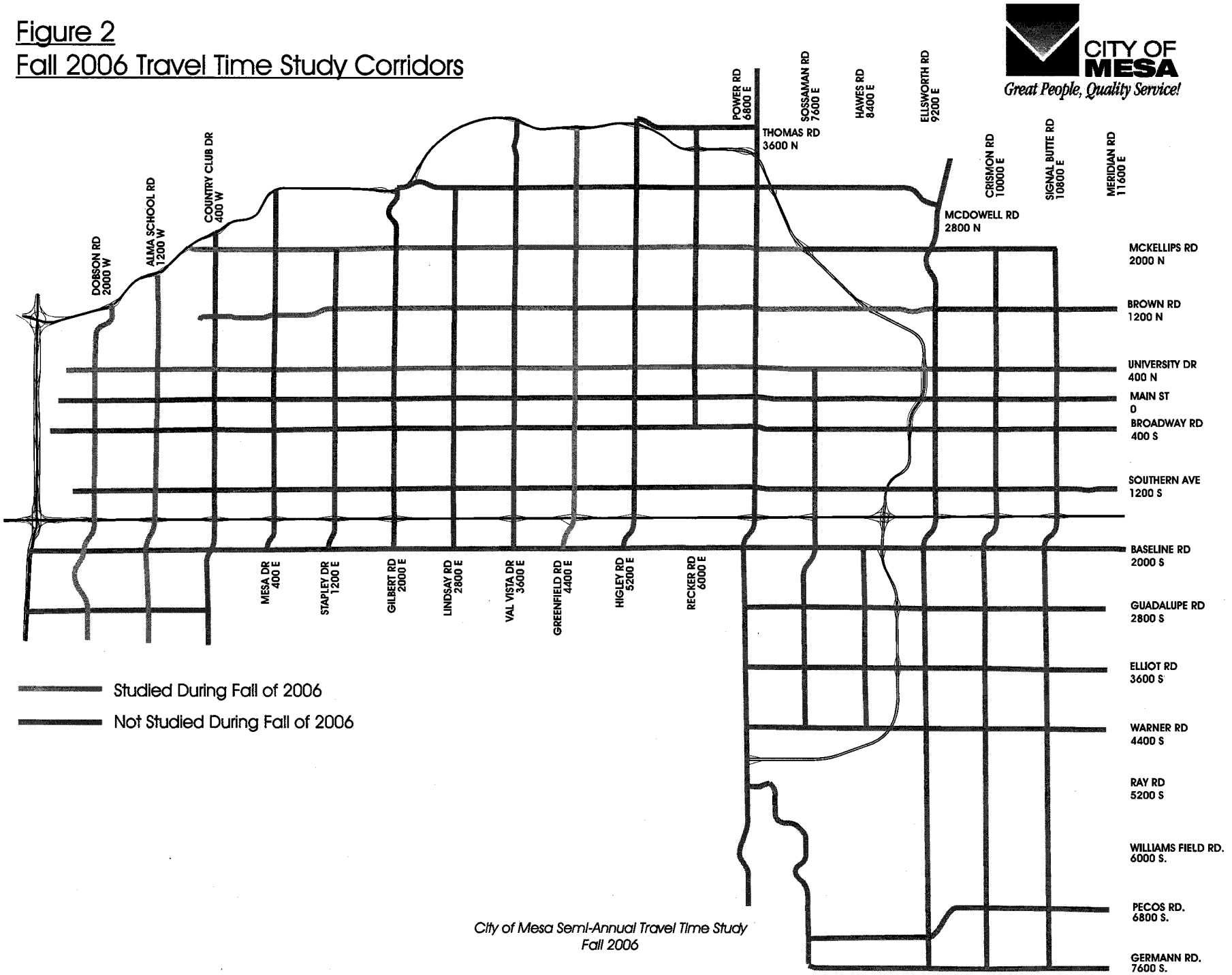
East – West Arterials	North – South Arterials
• McDowell Road	• Dobson Road
• McKellips Road	• Alma School Road
• Brown Road	• Country Club Drive
• University Drive	• Mesa Drive
• Main Street	• Stapley Drive
• Broadway Road	• Gilbert Road
• Southern Avenue	• Lindsay Road
• Baseline Road	• Val Vista Drive
• Guadalupe Road	• Greenfield Road
	• Higley Road
	• Power Road

Travel time studies will be done twice per year, in the Spring and again in the Fall. Because of the amount of time required to study each corridor, and the limited amount of manpower and data collection equipment available, it was initially decided to limit the number of arterials studied during each session to six, and attempt to have the remaining arterials studied over the next three years, thereby creating a rotation where the performance of an arterial can be measured every three years.

In addition, it was decided that two "control" arterials should be created. The control arterials will be studied once per year, and will allow the City to record any year over year changes that may occur. University Drive and Greenfield Road were chosen because of their central locations.

In identifying what order to schedule the arterial streets, the ITS/Traffic Signal Systems group preferred that corridors in which they have communications be studied first, so that the study reflects the benefits of coordination. The arterial streets studied during the fall of 2006 are shown in **Table 4**, and illustrated in **Figure 2**.

Figure 2
Fall 2006 Travel Time Study Corridors



City of Mesa Semi-Annual Travel Time Study
Fall 2006

Table 4 - Fall 2006 Study Arterials

East – West Arterials	North – South Arterials
• McKellips Road	• Dobson Road
• Brown Road	• Alma School Road
• University Drive (Control)	• Greenfield Road (Control)

The studies were done during the first two weeks of October. This time frame was chosen because it represents "average" traffic conditions for Mesa. Traffic volumes drop during the summer, and rise during the winter season with the influx of winter visitors. Likewise, the spring travel time study will be performed during the first week of April, which also represents average traffic conditions in Mesa because the winter visitors will be leaving, and spring training will be finished.

Studies were performed during three time periods as shown in **Table 5**. Mid day travel time runs were performed over the lunch hour, to capture lunchtime traffic.

Table 5 - Travel Time Study Times

Time Period	Hours
AM Peak	6:30 AM – 8:30 AM
Mid Day	11:30 AM – 1:30 PM
PM Peak	3:30 PM – 5:30 PM

Initially, each of the six arterials were scheduled for four runs in each direction, for each of the three periods per day. It was assumed that during each period, two runs in each direction could be completed.

The initial travel time schedule is contained within the **appendix**.

After the initial schedule was completed, a statistical analysis was performed for each time period and direction on each corridor to determine whether or not the results of the study were statistically valid. The methodology of the analysis will be discussed in more detail in Section 3. The analysis indicated that on some arterials, more than four runs per direction per period were necessary in order to have statistically valid data. These additional runs took almost an entire extra week to complete. The follow up schedule is also contained in the **appendix**.

By the time enough data was collected to be statistically valid, 200 individual travel time runs were done, taking three weeks to complete. This is a substantial effort in terms of manpower. Because of the amount of manpower needed to collect this much data, it is recommended to scale future studies back to four arterials at a time from six. The proposed schedule is shown in **Table 2** and illustrated in **Figure 1** (both previously presented). This schedule still allows the arterials listed in **Table 2** to be completed in three years, and the control corridors of University Drive and Greenfield Road to be studied every year.

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2.2 DATA COLLECTION TECHNIQUES

Data was collected using Jamar TDC-12 hand held electronic data collection boards. These boards interface with in-vehicle distance measurement devices to collect speed data, and records it in reference to the distance traveled along a corridor. In vehicle measurement devices that are compatible with the TDC-12's were installed in two vehicles: Unit 791, a Ford F-150 truck, and Unit 781, a Ford Contour sedan.

Prior to the first travel time runs, Staff was given a tutorial on how to operate the Jamar units, and perform the travel time studies. Staff was given a unique site code for each individual travel time study. An explanation of the site code is contained in the **appendix**. A step by step procedure sheet that was given to staff is also contained in the **appendix**.

Once in the vehicle, and positioned at the start of the corridor with the site code properly entered into the Jamar units, Staff was instructed to begin the study at a specified location, then to record each traffic signal (also referred to as a "node") that they passed by using the hand held button on the Jamar units, and finally instructed on the specific end location. After the study is complete, the data was downloaded and analyzed using PC-Travel traffic analysis software. The recording of each traffic signal allows PC-Travel to calculate such statistics as average speed, travel time, and number of stops between nodes (traffic signals).

Staff was instructed to use the Average Speed Method for collecting data. This method requires the drivers to travel at a speed that they judge to be representative of all traffic at the time. This method was chosen over the Floating Car Technique, which requires drivers to pass the same number of vehicles that they are passed by. This technique can encourage erratic driving.

Once the initial travel time schedule was complete, and the data downloaded and analyzed, it was discovered that there was some variation in where staff was recording the location of the nodes. For the follow up session, Staff was instructed to only record the begin point of the corridor, and the end point. The locations of the nodes were manually entered into PC Travel based on distances obtained from the City's land database. The results showed great improvement in consistency, and it is recommended that this become standard practice.

As mentioned in the previous section, once the initial round of travel time runs were complete, the runs were all analyzed to determine whether or not they are statistically valid. The risk of having a small number of runs is that there can be too much variation in the travel times for the data to be reliable. The City desires that the maximum variation in average travel speed be 3 mph, 95 percent of the time.

The error of each group of travel time runs was determined using the following formula obtained from the Institute of Transportation Engineer's *Traffic Engineering Fundamentals (Jan 2001)*:

$$\in = t_{\alpha} * \frac{s}{\sqrt{n}}$$

where: $\in$ = error of the mean at the selected confidence level (maximum 3mph at 95% confidence level)

s = standard deviation of the sample

t_α = (1 - α)th percentile of the t distribution with (n - 1) degrees of freedom

α = (1 – selected confidence level, .95 in this case)

n = sample size

After the initial set of travel time runs, it was determined that on some arterials, the error was greater than 3 mph, and therefore, additional travel time runs were needed. The final number of runs completed in each direction for the study to be statistically valid is listed below, in **Table 6**. Calculations are contained in the **appendix**.

Table 6 - Final Number of Runs Completed in Each Direction for Statistically Valid Study (Maximum Error of 3mph, 95% of the time)

Arterial	AM Peak (6:30-8:30AM)	Mid Day (11:30-1:30PM)	PM Peak (3:30-5:30PM)
Alma School Road	7	8	5
Brown Road	4	4	6
Dobson Road	8	8	7
Greenfield Road	6	4	6
McKellips Road	7	6	4
University Drive	4	4	2

2.3 ANALYSIS TECHNIQUES

2.3.1 Information Obtained from PC Travel

PC Travel provides information and data on the traffic studies in the form of tables and graphs. The information available in tabular form includes travel time, number of stops, average speed, total delay, time spent in pre-defined speed ranges, as well as information on amount of fuel used, and emissions. For the purposes of this study, the only information deemed useful is travel time, number of stops, and average speed.

Graphical information available includes speed–distance plots, and time–space plots. For the purposes of this study, the speed-distance plots were used.

Tables from PC Travel, as well as speed distance plots are included in the **appendix**.

2.3.2 Comparison to Past Studies

The tabular reports exported from PC Travel were modified so that the information contained in the reports could be easily compared with results from past studies. The specific comparison being focused on is travel time.

Because some of the arterials studied in 2000 had different begin and end points than this study, travel times for this study were summarized to match the beginning and end points from

the 2000 study. With the travel times from 2000 and 2006 side by side, an annual rate of increase (or decrease) could be calculated. Results of this effort are shown in the tables placed in the **appendix**.

2.3.3 Average Daily Traffic Volume Comparison

The intent of this study is to compare the annual rate of increase (or decrease) of travel time, with the annual rate of increase (or decrease) of traffic volumes. Volumes from Mesa's traffic count program were used for this comparison.

The City of Mesa has historically counted half the city one year, and the other half the next year. So for any given year, the most recent volumes may be from the previous year. In other words, for the 2000 study, some volumes may be from 1999, and for this study, some volumes may be from 2005. In either case, the rates of growth of these volumes were compared to travel time growth rates.

Traffic volumes along any given arterial vary by section. The City of Mesa generally collects one set of traffic volumes per one-mile section of arterial. In order to compare the travel time growth of an entire arterial to the traffic volume along an arterial, one number representing all the traffic volumes along an arterial must be obtained. To determine this number, a weighted average traffic volume was calculated. This number was obtained by multiplying the length of the section by the traffic volume, and then dividing by the entire arterial length. These calculations are contained in the **appendix**.

Once the average volume for an arterial was determined for both the 2000 study and this study, a rate of increase (or decrease) could be calculated.

2.3.4 Average Travel Speeds

The intent of this study is to compare rates of travel time growth against rates of traffic volume growth along individual arterials. For each arterial studied, there are two travel directions, and each arterial is studied during three periods of the day. In other words, for each arterial studied, there will be six comparisons made. All tolled, there will be 24 comparisons made when four arterials are studied, and 36 comparisons made when six arterials are studied.

Because 36 separate comparisons is a large number of comparisons to be made, a more general performance measure that can be easily understood will also be presented. Travel speeds can be more easily understood at a glance (i.e. averaging 36 mph on an arterial means more to the average reader than taking 318 seconds to traverse the corridor). The more general performance measure will include only the peak directions of travel, during the peak time periods (i.e. westbound during the AM peak, or eastbound during the PM peak).

Along One Arterial

PC Travel provides average travel speed data along an entire corridor, and for the sections between nodes (traffic signals). The standard roadway section in Mesa is generally referred to between major cross streets (generally one mile segments). So sometimes, it is necessary to combine several short sections of data collected to form one-mile segments.

Along Multiple Arterials

In order to provide this statistic, speeds from multiple arterials must be combined to provide an overall average travel speed. To calculate this statistic, the average travel speed for each arterial is weighted according to the length of the arterial, and the average traffic volume along that arterial.

2.4 CURRENT CONSTRUCTION PROJECTS THAT MAY IMPACT RESULTS

Current construction projects that likely had an impact on travel speeds are listed in **Table 7**, below. The effects of these projects should be considered when future travel time studies are compared with this study.

Table 7 - Current Construction Projects Along Study Corridors

Arterial	Project
McKellips Road	• Closed at CAP Canal (east of Power Road) for Loop 202 Construction.
Brown Road	• Traffic volumes east of Power Road increased due to McKellips Road closure.
Greenfield Road	• US 60 Interchange Construction
University Drive	• May have increased traffic volumes near western edge of Mesa due to light rail construction on Main Street • Loop 202 Construction (roadway detour in place for interchange construction)

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3.0 ANALYSIS

3.1 COMPARISON AGAINST PAST STUDIES

A consultant was hired to do the last travel time study, which was performed in 2000. Data was collected on the arterials listed in **Table 8**. Data was collected on these streets from February through April 2000.

Table 8 - Arterial Streets Included in 2000 Travel Time Study

East – West Arterials	North – South Arterials
• McKellips Road	• Dobson Road
• Brown Road	• Alma School Road
• University Drive	• Country Club Drive
• Main Street	• Mesa Drive
• Broadway Road	• Stapley Drive
• Southern Avenue	• Gilbert Road
• Baseline Road	• Val Vista Drive
• Guadalupe Road	• Higley Road
	• Power Road

The north/south arterial streets were studied from the southern city limits to the northern city limits, the same as the current study. The east/west arterial streets were studied from the west city limits, to Power Road. In the current study, the east limits were Ellsworth Road, except on McKellips Road, which was closed at the CAP canal due to freeway construction.

Table 9 presents performance measure for which this study was conducted: the growth of travel times versus the growth in traffic volumes from 2000 to 2006. The corridor limits for the current study were adjusted to be the same as the corridor limits for the study in 2000.

Table 9 - Growth of Travel Times vs. Growth of Traffic Volumes for Study Corridors

Street	AM Peak			PM Peak		
	Annual Growth (Decline) in Travel Time (%)	Annual Growth (Decline) in Traffic Volumes (%)	Is Travel Time Growth Greater Than Traffic Volume Growth?	Annual Growth (Decline) in Travel Time (%)	Annual Growth (Decline) in Traffic Volumes (%)	Is Travel Time Growth Greater Than Traffic Volume Growth?
Alma School EB	0.50%	0.01%	Yes	-0.30%	0.01%	No
Alma School WB	-0.84%	0.01%	No	-3.09%	0.01%	No
Brown EB	0.85%	-0.79%	Yes	-2.77%	-0.79%	No
Brown WB	-2.83%	-0.79%	No	0.81%	-0.79%	Yes
Dobson NB	1.12%	-0.84%	Yes	1.04%	-0.84%	Yes
Dobson SB	2.20%	-0.84%	Yes	0.50%	-0.84%	Yes
Greenfield NB	Not Studied in 2000 – No Direct Comparison Possible					
Greenfield SB						
McKellips EB	1.36%	-5.34%	Yes	-0.35%	-5.34%	Yes
McKellips WB	-2.56%	-5.34%	Yes	-1.30%	-5.34%	Yes
University EB	0.09%	-0.94%	Yes	-1.05%	-0.94%	No
University WB	-2.84%	-0.94%	No	0.16%	-0.94%	Yes

In total, 20 comparisons were made. Of the 20 comparisons, there were 13 instances where growth in travel times were greater than growth in traffic volumes, and 7 instances where travel time growth was smaller than the growth in traffic volumes.

It is worth noting that of the 20 comparisons made, there were 10 instances that saw travel times decrease (meaning, it took less time to drive the length of the corridor). In some cases, traffic volumes decreased as well.

3.2 IDENTIFICATION OF CONGESTED AREAS

The average travel speeds were summarized, and are displayed graphically in **Figure 3, Figure 4**, and **Figure 5**. The speeds were divided into six ranges, and each range was given a color code. Any segment that showed an average speed of greater than 40 mph was considered good, and is indicated by a green line. Anything below 20 mph is considered poor, and is indicted by red. Speeds in between are divided into 5 mph increments, and are indicated by lines going from shades of green to red.

Generally speaking, the slowest moving traffic during the AM peak is on the north/south arterials in the vicinity of the US 60, on westbound University from Stapley Drive to Dobson Road, and on westbound McKellips Road from Gilbert to Stapley.

The slowest moving traffic during the mid day peak is on the north/south arterials in the vicinity of US 60, on Greenfield Road in the vicinity of Main Street, and on University Drive between Dobson Road and Stapley Drive.

The slowest moving traffic during the PM peak is on the north/south arterials in the vicinity of US 60, and eastbound University from the west city limits to Greenfield Road.

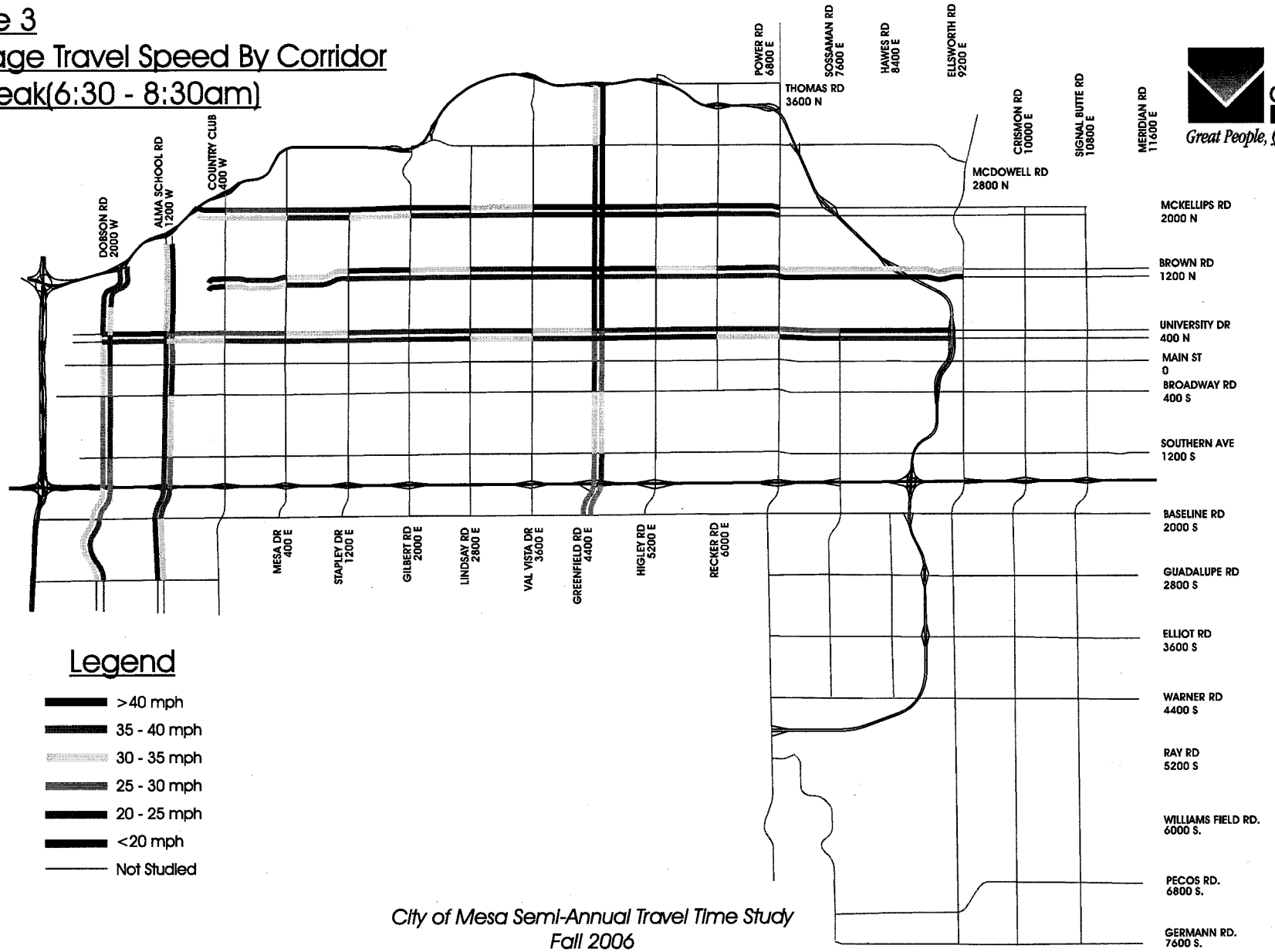
3.3 Effects Of Future Capital Improvement Projects

The City of Mesa has a number of capital improvement projects scheduled to be constructed in Phase I of the RTP. The projects include:

- Corridor widening of Broadway Road from Dobson Road to Stapley Drive,
- Intersection widening at Gilbert Road and University Drive,
- Intersection widening at McKellips Road and Lindsay Road, Val Vista Drive, Greenfield Road, and Higley Road,
- Intersection widening at Southern Avenue and Country Club Drive, Mesa Drive, and Stapley Drive
- Intersection Widening at Dobson Road and Guadalupe Road,
- Corridor widening on Mesa Drive from US 60 to Southern Avenue
- Corridor widening on Greenfield Road from Baseline Road to University Drive,
- Intersection widening at Broadway Road and Mesa Drive, and
- Intersection widening at Country Club Drive and University Drive.

Many of the arterials included in this study are planned to have major capacity improvements within the next five years. This will likely improve travel times on these corridors. It may also attract traffic from other congested corridors, improving the travel times on these corridors as well.

Figure 3
Average Travel Speed By Corridor
AM Peak(6:30 - 8:30am)



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Legend

- >40 mph
- 35 - 40 mph
- 30 - 35 mph
- 25 - 30 mph
- 20 - 25 mph
- <20 mph
- Not Studied

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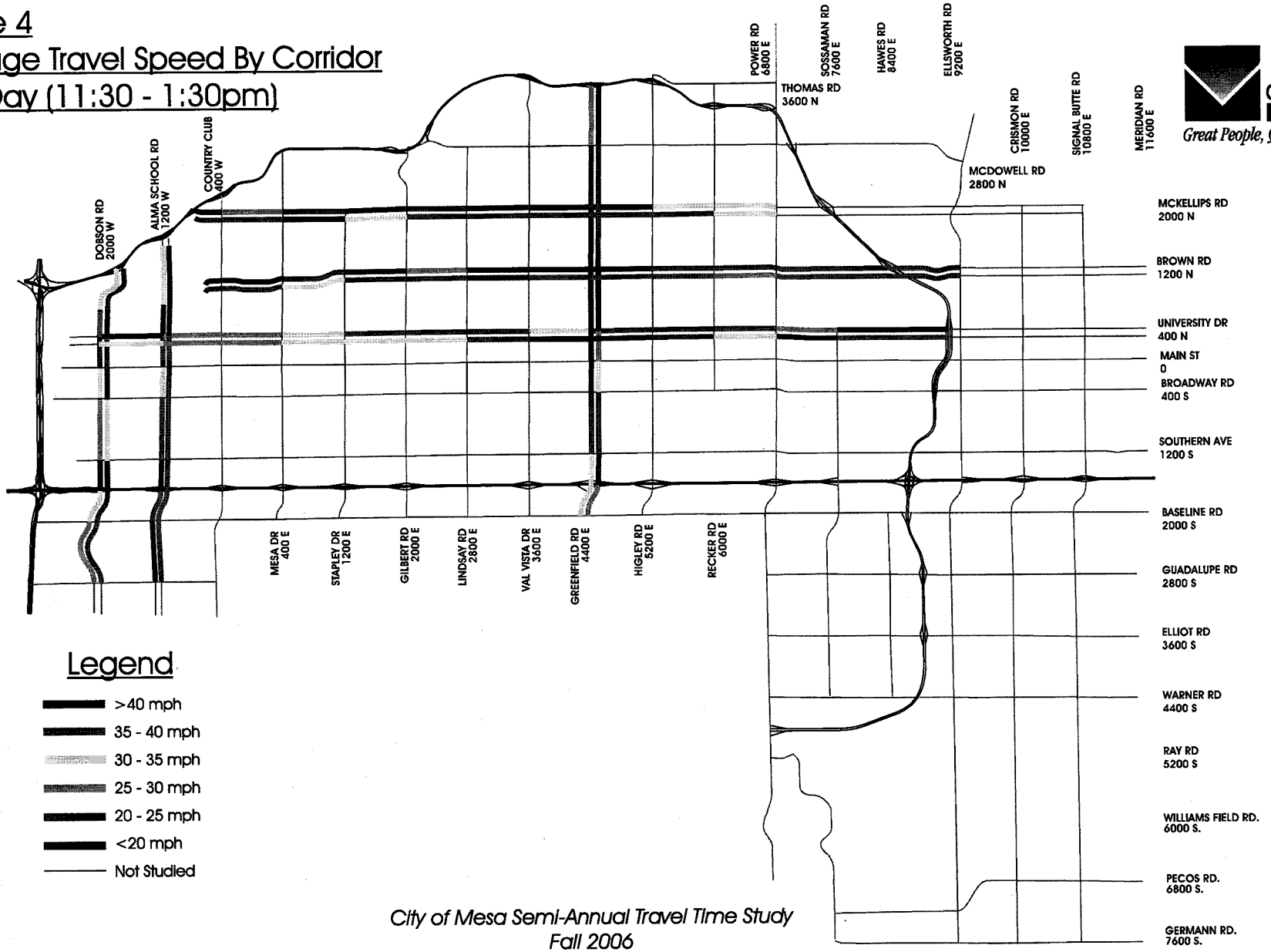
Fall 2006

Figure 4
Average Travel Speed By Corridor
Mid Day (11:30 - 1:30pm)



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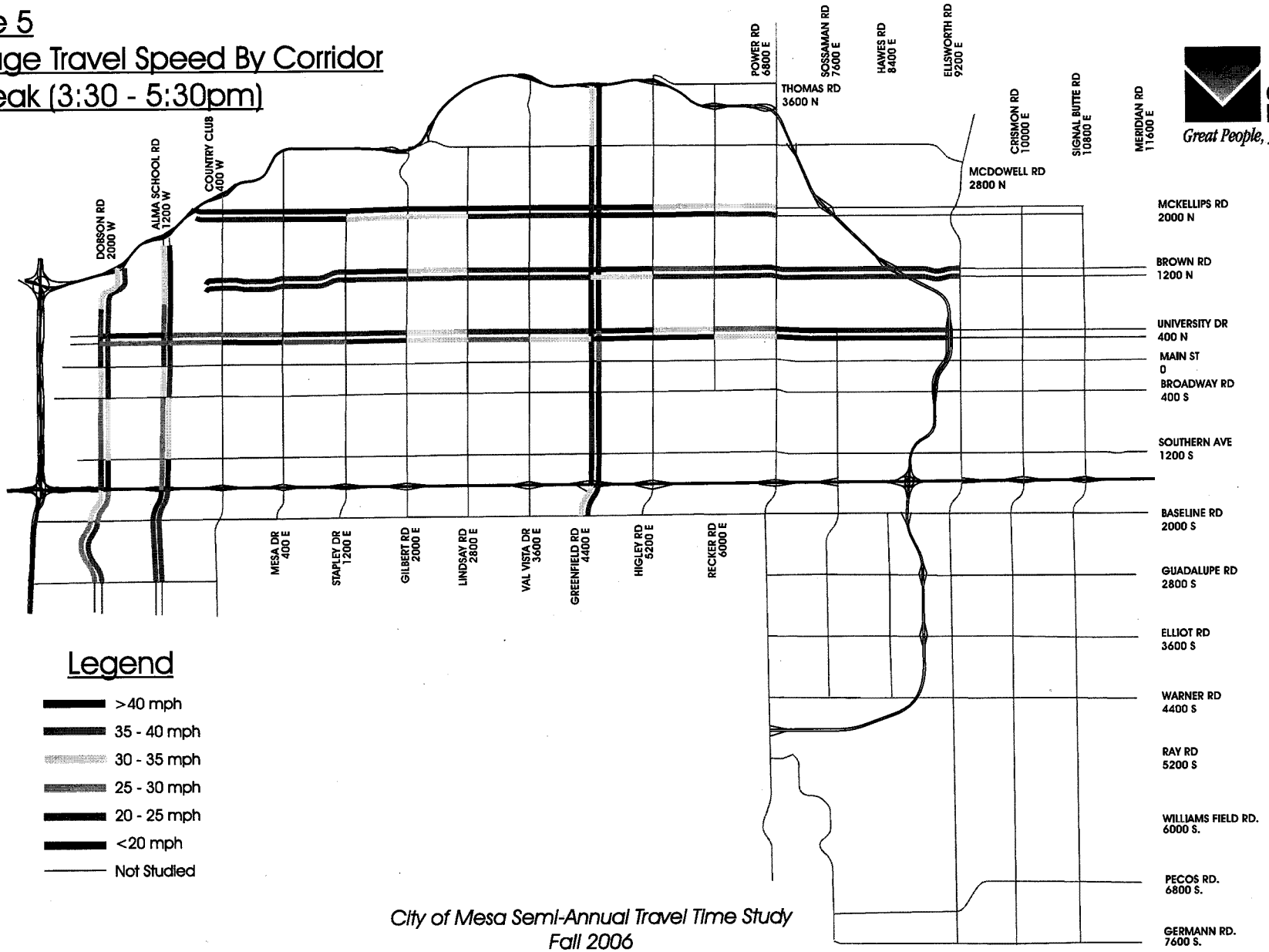
Legend

- >40 mph
- 35 - 40 mph
- 30 - 35 mph
- 25 - 30 mph
- 20 - 25 mph
- <20 mph
- Not Studied

City of Mesa Semi-Annual Travel Time Study
Fall 2006

Figure 5
Average Travel Speed By Corridor
PM Peak (3:30 - 5:30pm)



Legend

- >40 mph
- 35 - 40 mph
- 30 - 35 mph
- 25 - 30 mph
- 20 - 25 mph
- <20 mph
- Not Studied

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4.0 APPENDIX

Included in the appendix:

- Initial Travel Time Schedule
- Follow Up Travel Time Schedule
- Site Code Explanation
- Travel Time Data Collection Procedures Sheet
- Statistical Data Validation Calculation Sheets
- Weighted Average Volume and Travel Speed Calculation Sheets
- Average Daily Traffic Calculation Sheets
- Output Tables From PC Travel
- Speed-Distance Plots From PC Travel
- Raw Data Sheets from PC Travel

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Brown Road
Dobson Road
Greenfield Road

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1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION AND BACKGROUND

In the fall of 2006, the City of Mesa began performing semi-annual travel time studies. This study is the sixth semi-annual study performed.

The decision to perform travel time studies was a result of a performance measurement program initiated by the City of Mesa. These performance measures were put in place to measure how well the services Mesa provides are serving its citizens. One of the original performance measures given to Responsibility Center 364 (RC 364), or Traffic Engineering, was to monitor travel times. The specific goal was to:

- keep the rate of travel time increases below the growth rate of traffic volumes.

In November 2007, the Transportation Department presented the results from its performance measures to the City Manager. Just prior to the presentation, it was decided to present a simpler measure. The updated performance measure now tracks the average travel speed during the PM peak for all corridors studied during a given year (both directions).

Once a history of travel time studies has been built, an acceptable change in travel speed will be chosen as a goal (i.e. keep reduction in average travel speeds below .5% annually). The previous performance measure (keep the rate of travel time increases below the growth rate of traffic volumes) will continue to be calculated, and will be presented in the body of the report.

The goal of keeping increases in travel time to a minimum (the exact rate yet to be determined) can be achieved by increasing the capacity of the roadways in Mesa through constructing new roadways and widening existing roadways, by making adjustments to traffic signal timing in response to evolving traffic patterns and volumes, and by reducing demand by promoting alternative modes of transportation.

The City of Mesa has a number of arterial roadway widening projects in the planning stages that are part of the Regional Transportation Plan (RTP). The City is also investing in Intelligent Transportation Systems (ITS), which will enable the City to be more responsive to changes in traffic patterns or volumes by adjusting the timing of the traffic signals.

In addition to providing data for the City's performance measurement program, the semi-annual travel time studies allow Staff to:

- compare current traffic conditions to those of the past,
- identify congested areas, and make adjustments to traffic signal timings as necessary, and
- identify congested areas, which will provide decision makers with information that can be used to decide where to spend money intended for roadway improvements.

Twenty major arterial streets are included in the travel time study program. Two of these arterials, University Drive and Greenfield Road, are studied every fall and used as control corridors. The other 18 arterials are studied once every three years. The studies are conducted twice per year: once in the spring, and once in the fall.

Prior to the fall of 2006, the City of Mesa had conducted travel time studies two other times. The first study was in 1985, and the second in 2000. The results from the first round of the new travel time studies (studies done from fall of 2006 through spring of 2009) will be compared with results from the 2000 study (if the specific arterial was studied in 2000). However, the most accurate comparisons likely won't be achieved until the second round of travel time studies, as methodologies will now be consistent, the study schedule will be consistent, and the corridor begin/end points will be consistent.

In addition to travel times, this report will also present travel speeds through a number of figures, graphs, and tables.

1.2 PRINCIPAL FINDINGS

The primary purpose of this study is to determine the average travel speed of selected corridors during the PM peak.

For the fall 2009 study, one east/west arterial street and two north/south arterial streets were studied. They were Brown Road, Dobson Road and Greenfield Road. University Drive was not studied because the intersection of Gilbert Road and University Drive was under construction at the time of the study. These arterials are illustrated in **Figure 1**.

Although the performance measure only compares travel speeds during the PM peak, the arterials were studied during three time periods:

- AM Peak (6:30am to 8:30am)
- Off Peak (9:30am - 11:30am)
- PM Peak (3:30pm to 5:30pm)

Table 1, below, shows the average travel speed of all corridors studied in the fall of 2009, as well as the average travel speeds of all corridors studied in the spring of 2009, fall of 2008, spring of 2008, fall of 2007, spring of 2007, and fall of 2006. Comparisons of individual corridors studied during the fall of 2009 to previous studies are contained in the body of report.

Figure 1
Fall 2009 Travel Time Study Corridors

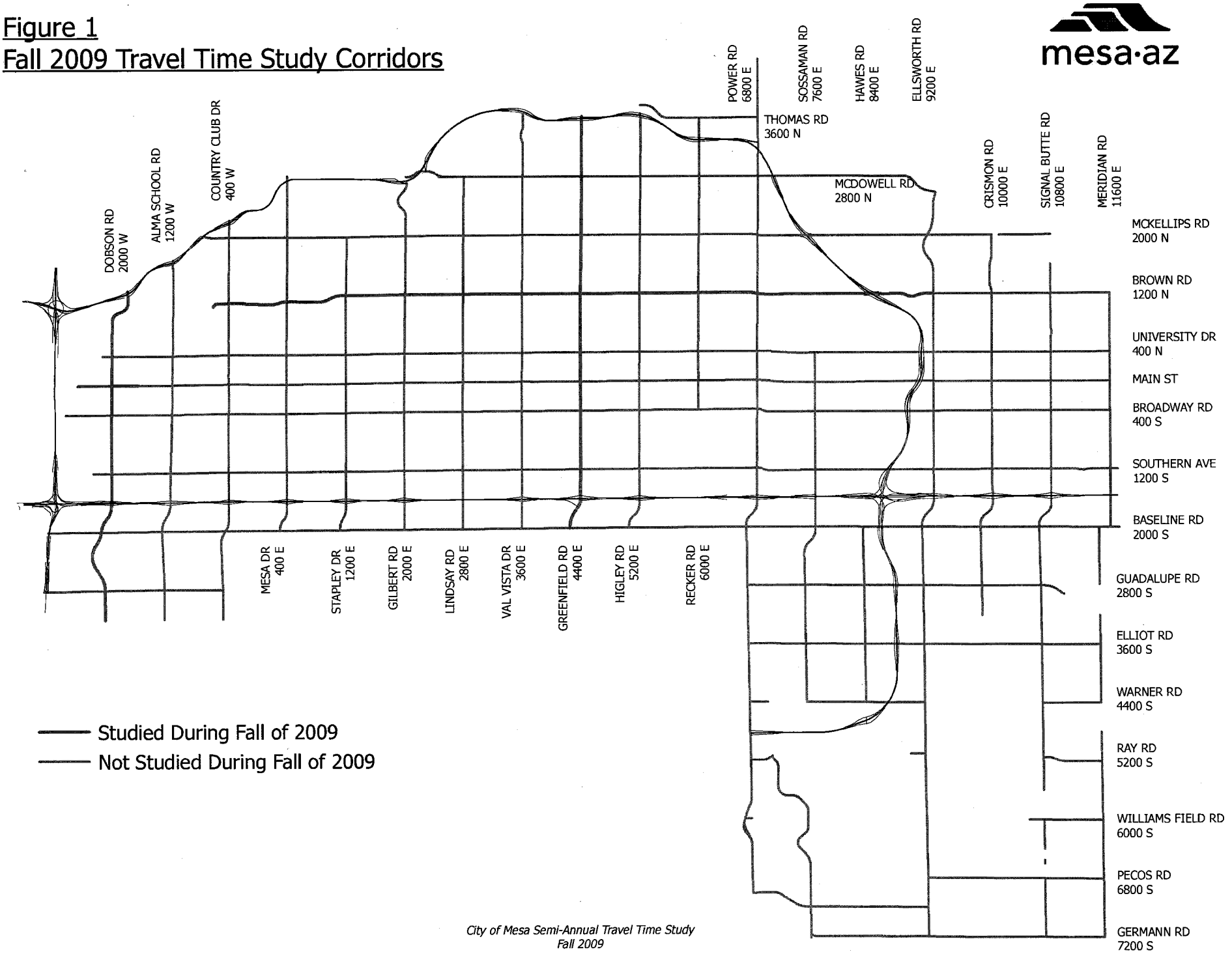

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Table 1 - Average Travel Speed (PM Peak)

Study	Arterials Studied	Study Period	Study Direction	Average Travel Speed (mph)*
Fall 2009	• Brown Road • Dobson Road • Greenfield Road	PM Peak	Both (for each arterial)	31.6
Spring 2009	• McKellips Road • Alma School Road • Stapley Drive • Val Vista Drive	PM Peak	Both (for each arterial)	31.3
Fall 2008	• Greenfield Road • Guadalupe Road • Lindsay Road • University Drive	PM Peak	Both (for each arterial)	33.8
Spring 2008	• Broadway Road • Gilbert Road • Mesa Drive • Southern Avenue	PM Peak	Both (for each arterial)	29.1
Fall 2007	• Country Club Drive • Greenfield Road • Main Street • University Drive	PM Peak	Both (for each arterial)	30.1
Spring 2007	• Baseline Road • Higley Road • McDowell Road • Power Road	PM Peak	Both (for each arterial)	33.6
Fall 2006	• Alma School Road • Brown Road • Dobson Road • Greenfield Road • McKellips Road • University	PM Peak	Both (for each arterial)	32.8

*Sum of all travel times, divided by total corridors lengths. Calculations are shown in the appendix.

As illustrated in **Table 1**, above, the average travel speeds vary from study to study. This can be attributed to the performance of the different arterials studied during each overall study, as well as the error deemed tolerable in the data collection (3 mph, 95% of the time).

Once the first three-year cycle of travel time studies has been completed, better comparisons can be made against the same arterials (i.e. fall of 2009 results will be compared with fall of 2006 results, because the same arterials will be studied).

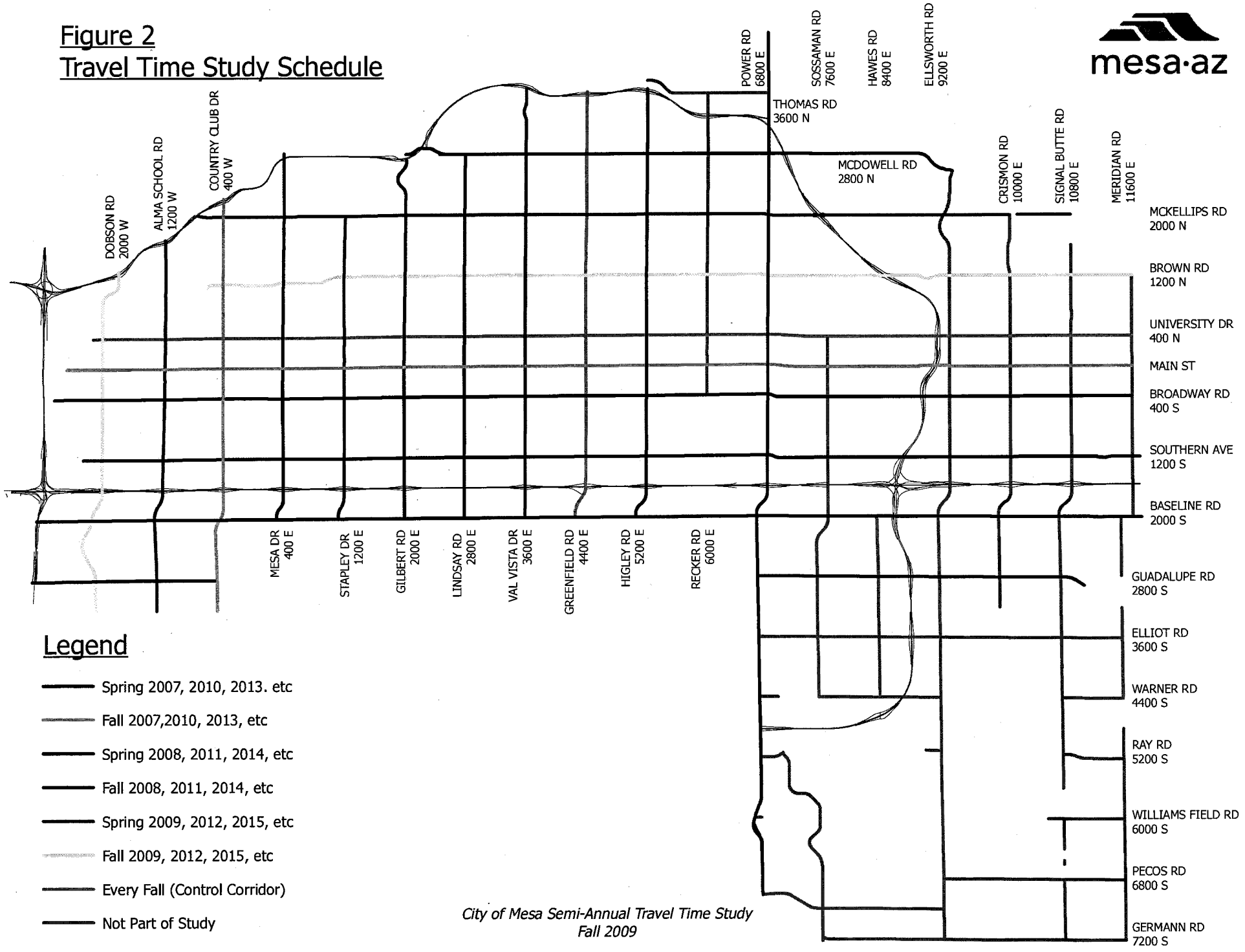
1.3 FUTURE STUDIES

The future schedule is shown in **Table 2** and illustrated in **Figure 2**. This schedule allows all arterials to be studied every three years, and the control corridors of University Drive and Greenfield Road to be studied every year.

Table 2 - Future Travel Time Schedule

Year	Season	East – West Arterials	North – South Arterials
2007, 2010, 2013, etc.	Spring	• McDowell Road • Baseline Road	• Higley Road • Power Road
	Fall	• University Drive • Main Street	• Greenfield Road • Country Club Drive
2008, 2011, 2014, etc.	Spring	• Broadway Road • Southern Avenue	• Mesa Drive • Gilbert Road
	Fall	• University Drive • Guadalupe Road	• Greenfield Road • Lindsay Road
2009, 2012, 2015, etc.	Spring	• McKellips	• Stapley Drive • Val Vista Drive • Alma School Road
	Fall	• University Drive • Brown Road	• Greenfield Road • Dobson Road

Figure 2
Travel Time Study Schedule



Legend

- Spring 2007, 2010, 2013. etc
- Fall 2007,2010, 2013, etc
- Spring 2008, 2011, 2014, etc
- Fall 2008, 2011, 2014, etc
- Spring 2009, 2012, 2015, etc
- Fall 2009, 2012, 2015, etc
- Every Fall (Control Corridor)
- Not Part of Study

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2.0 STUDY METHODOLOGY

2.1 STUDY SCHEDULE

Most of the major arterial streets in Mesa are being studied as part of the travel time study program. Some arterials in the eastern and southeastern parts of Mesa are not entirely within Mesa's jurisdiction (i.e. still controlled by Maricopa County), or have not yet been improved to the point where conducting travel time studies on them makes sense. However, at some point in the future, additional corridors may be added to the travel time study program.

The arterials included in the current study program are listed in **Table 3**.

Table 3 - Arterial Streets Included in Travel Time Study Program

East – West Arterials	North – South Arterials
• McDowell Road	• Dobson Road
• McKellips Road	• Alma School Road
• Brown Road	• Country Club Drive
• University Drive	• Mesa Drive
• Main Street	• Stapley Drive
• Broadway Road	• Gilbert Road
• Southern Avenue	• Lindsay Road
• Baseline Road	• Val Vista Drive
• Guadalupe Road	• Greenfield Road
	• Higley Road
	• Power Road

Travel time studies are done twice per year, in the spring and again in the fall. The fall 2006 study included six arterials. However, given the amount of time that it took to study six arterials, it was decided to scale the semi-annual studies back to four, beginning spring 2007. From then on, each arterial would be studied every three years.

In addition, two "control" arterials are studied every fall. The control arterials are studied once per year, and allow the City to record any year over year changes that may occur. University Drive and Greenfield Road were chosen because of their central locations.

In identifying what order to schedule the arterial streets, the ITS/Traffic Signal Systems group preferred that corridors in which they have communications be studied first, so that the study reflects the benefits of coordination. The arterial streets studied during the fall of 2009 are shown in **Table 4**, and illustrated in **Figure 1**.

Table 4 – Fall 2009 Study Arterials

East – West Arterials	North – South Arterials
• Brown Road	• Dobson Road • Greenfield Road

Fall travel time studies are usually done during the first two weeks of October. This time frame was chosen because it represents "average" traffic conditions for Mesa. Traffic volumes drop during the summer, and rise during the winter season with the influx of winter visitors. Therefore, fall travel time studies are performed during the first week of October, which also represents average traffic conditions in Mesa because the winter visitors are just beginning to arrive. However, overlay projects on Brown Road and a School Fall Break delayed runs on Brown Road to the third week in November.

Studies were performed during three time periods as shown in **Table 5**. Off Peak travel time runs were performed in the morning, to capture conditions when the system is carrying relatively light traffic volumes. This differs from the fall 2006 study, when instead of an Off Peak time period, a Mid Day period was studied. The reason for a Mid Day study was to capture lunchtime traffic. However, the Mid Day period can have some unusual peaking characteristics, so it was decided to do an off peak period instead.

Table 5 - Travel Time Study Times

Time Period	Hours
AM Peak	6:30 AM – 8:30 AM
Off Peak	9:30 AM - 11:30 AM
PM Peak	3:30 PM – 5:30 PM

For the Fall 2009 study, as many runs in each direction were completed for each of the three arterials in the 2 hour time frame for each of the three periods per day.

The initial travel time schedule is contained within the **appendix**.

After the initial schedule was completed, a statistical analysis was performed for each time period and direction on each corridor to determine whether or not the results of the study were statistically valid. The methodology of the analysis will be discussed in more detail in Section Three.

A total of 113 individual travel time runs were done. The travel time runs took two weeks to complete, one week in October and one week in November. This was a substantial effort in terms of manpower.

2.2 DATA COLLECTION TECHNIQUES

Data was collected using Jamar TDC-12 hand held electronic data collection boards. These boards interface with in-vehicle distance measurement devices to collect speed data, and records it in reference to the distance traveled along a corridor. In vehicle measurement devices that are compatible with the TDC-12's are used. Two vehicles were used to collect travel time data: Unit 1966, a Chevrolet 1500 truck and Unit 781, a Ford Contour sedan.

Prior to the first travel time runs, Staff was given a tutorial on how to operate the Jamar units, and perform the travel time studies. Staff was given a unique site code for each individual travel time study. An explanation of the site code is contained in the **appendix**. A step by step procedure sheet that was given to staff is also contained in the **appendix**.

Different from fall 2006, staff was only asked to record the beginning and end points on the corridor. In the fall of 2006, staff was asked to record the location of each traffic signal along a corridor. However, when all the travel time runs were compared side by side, there tended to be a large spread in location where the signals were located. For the spring 2007 study, the locations of the signals were manually entered into PC Travel based on distances obtained from the City's land database. After the data collection was completed, the data was downloaded and analyzed using PC-Travel traffic analysis software. Locating each traffic signal allows PC-Travel to calculate such statistics as average speed, travel time, and number of stops between nodes (traffic signals).

Starting in the spring of 2008, staff was asked to go beyond the ending point before stopping the study. Studies that are ended prior to the ending point, even slightly, can affect the speeds for the last segment (although the overall affect is minimal). The data collected beyond the ending point can be removed, whereas if the study is ended early, this data cannot be retrieved.

Staff was instructed to use the Average Speed Method for collecting data. This method requires the drivers to travel at a speed that they judge to be representative of all traffic at the time. This method was chosen over the Floating Car Technique, which requires drivers to pass the same number of vehicles that they are passed by. This technique can encourage erratic driving.

As mentioned in the previous section, once the initial round of travel time runs were complete, the runs were all analyzed to determine whether or not they are statistically valid. The risk of having a small number of runs is that there can be too much variation in the travel times for the data to be reliable. The City desires that the maximum variation in average travel speed be 3 mph, 95 percent of the time.

The error of each group of travel time runs was determined using the following formula obtained from the Institute of Transportation Engineer's *Traffic Engineering Fundamentals (Jan 2001)*:

$$\in = t_{\alpha} * \frac{s}{\sqrt{n}}$$

where: $\in$ = error of the mean at the selected confidence level (maximum 3mph at 95% confidence level)

s = standard deviation of the sample

t_α = (1 - α)th percentile of the t distribution with (n - 1) degrees of freedom

α = (1 – selected confidence level, .95 in this case)

n = sample size

After the initial set of travel time runs, it was determined that the error was below 3 mph, and therefore, no additional travel time runs were needed. The number of runs completed in each direction for the study to be statistically valid is listed below, in **Table 6**. Calculations are contained in the **appendix**.

Table 6 - Number of Runs Completed in Each Direction for Statistically Valid Study (Maximum Error of 3 mph, 95% of the time)

Arterial	AM Peak (6:30-8:30AM)	Off Peak (9:30-11:30AM)	PM Peak (3:30-5:30PM)
Brown	4	4	4
Dobson	7	7	8
Greenfield	8	8	8

2.3 ANALYSIS TECHNIQUES

2.3.1 Information Obtained from PC Travel

PC Travel provides information and data on the traffic studies in the form of tables and graphs. The information available in tabular form includes travel time, number of stops, average speed, total delay, time spent in pre-defined speed ranges, as well as information on amount of fuel used, and emissions. At the request of the ITS Group, the information includes the study summary, detailed statistics by run – travel time, detailed statistics by run – stops, detailed statistics by run – average speed, detailed statistics by run – total delay, and detailed statistics by run – time at speeds greater than 0 mph.

Graphical information available includes speed–distance plots, and time–space plots. For the purposes of this study, the speed-distance plots were used.

Tables from PC Travel, as well as speed distance plots are included in the **appendix**.

2.3.2 Comparison to Past Studies

For Average PM Peak Travel Speed

The comparison between the average travel speeds shown in **Table 1** (presented in the Executive Summary) is a comparison between results obtained from the City of Mesa's modern travel time study program. It does not compare results from the studies done in 1985 or 2000.

The average travel speed shown in **Table 1** represents an average travel speed of all corridors studied during the specified time frame (i.e. spring of 2009) for the PM peak, in both directions. It was calculated by adding the average travel time for each corridor, both directions, and dividing by the total length of the corridors studied, and then multiplying by .681 (for conversion

into mph). It was not weighted for traffic volumes. Sample calculations are shown in the **appendix**.

Results from one study period to the next are expected to vary. This can be attributed to the different characteristics of each of the arterials being studied (i.e. number of signals, signal spacing, traffic volumes, roadway capacity, amount of side street access, etc.). The fall of 2009 completed the cycle, meaning all twenty arterials have been studied at least once. So the study done in the fall of 2009 will compare results with those obtained in the fall of 2006. This will represent the first good comparison of system performance.

2.3.3 Average Daily Traffic Volume Comparison

The City of Mesa has historically performed traffic counts for half the city one year, and the other half the next year. So for any given year, the most recent volumes may be from the previous year. In other words, for the 2009 study, some volumes may have been from 2009, and for this study, some volumes may be from 2008. In either case, the rates of growth of these volumes were compared to travel time growth rates.

Traffic volumes along any given arterial vary by section. The City of Mesa generally collects one set of traffic volumes per one-mile section of arterial. In order to compare the travel time growth of an entire arterial to the traffic volume along an arterial, one number representing all the traffic volumes along an arterial must be obtained. To determine this number, a weighted average traffic volume was calculated. This number was obtained by multiplying the length of the section by the traffic volume, and then dividing by the entire arterial length. These calculations are contained in the **appendix**.

Once the average volume for an arterial was determined for both the prior study and this study, a rate of increase (or decrease) could be calculated.

2.4 CURRENT CONSTRUCTION PROJECTS THAT MAY IMPACT RESULTS

Current construction projects that likely had an impact on travel speeds are listed in **Table 7**, below. The effects of these projects should be considered when future travel time studies are compared with this study.

Table 7 - Current Construction Projects Along Study Corridors

Arterial	Project
Brown Road	• Overlay Projects - Stapley to Lindsay, Recker to Power
Dobson Road	• None
Greenfield Road	• None
University Drive (not studied)	• Complete intersection reconstruction at Gilbert Road

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3.0 ANALYSIS

3.1 COMPARISON AGAINST PAST STUDIES

3.1.1 Comparing Average Travel Times for the PM Peak

Results from one study period to the next are expected to vary. This can be attributed to the different characteristics of each of the arterials being studied (i.e. number of signals, signal spacing, traffic volumes, roadway capacity, amount of side street access, etc.). The fall of 2009 completed the cycle, meaning all twenty chosen arterials have been studied at least once. So the study done in the fall of 2009 will compare results with those obtained in the fall of 2006. This will represent the first good comparison of system performance.

Results from the comparison are presented in **Table 1**. As expected, results varied when comparing results from fall 2006, spring 2007, fall 2007, spring 2008, fall 2008, spring 2009 and fall 2009.

As shown in **Table 2**, the fall of 2009 is the first opportunity to compare results obtained from the City of Mesa's travel time study program.

3.1.2 Comparing Change in Speed to Change in Traffic Volumes

In addition to tracking the average travel speed during the PM Peak, a comparison will be made between the rate of annual travel time increases (or decreases) versus the rate of annual traffic volume increases (or decreases).

Table 8 presents the comparison between the growth of travel times versus the growth in traffic volumes for the AM peak, and **Table 9** presents the comparison between the growth of the travel times versus the growth in traffic volumes for the PM peak.

The off peak study period is not compared.

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Table 8 - Growth of Travel Times vs. Growth of Traffic Volumes for Study Corridors (AM Peak)

Street	AM Peak						
	Travel Time			Traffic Volumes			Is Travel Time Growth Greater Than Traffic Volume Growth?
	Previous Travel Time (seconds)	Fall 2009 Travel Time (seconds)	Annual Growth (Decline)	Previous Average Daily Traffic Volume	Most Recent Average Daily Traffic Volume	Annual Growth (Decline)	
Brown EB	1183.3 (2006)	1195.8	.35%	20763 (2006)	18013 (2008)	-6.86%	Yes
Brown WB	1246 (2006)	1190.5	-1.51%	20763 (2006)	18013 (2008)	-6.86%	Yes
Dobson NB	705.6 (2006)	758	2.43%	29820 (2006)	28767 (2008)	-1.781%	Yes
Dobson SB	707.6 (2006)	757.4	2.29%	29820 (2006)	28767 (2008)	-1.781%	Yes
Greenfield NB	662.5 (2008)	673.4	1.64%	20861 (2006)	21437 (2008)	1.37%	Yes
Greenfield SB	709.5 (2008)	656.3	-7.51%	20861 (2006)	21437 (2008)	1.37%	No

Table 9 - Growth of Travel Times vs. Growth of Traffic Volumes for Study Corridors (PM Peak)

Street	PM Peak						
	Travel Time			Traffic Volumes			Is Travel Time Growth Greater Than Traffic Volume Growth?
	Previous Travel Time (seconds)	Fall 2009 Travel Time (seconds)	Annual Growth (Decline)	Previous Average Daily Traffic Volume	Most Recent Average Daily Traffic Volume	Annual Growth (Decline)	
Brown EB	1241.7 (2006)	1237.0	-0.126%	20763 (2006)	18013 (2008)	-6.86%	Yes
Brown WB	1191.33 (2006)	1227.5	1.00%	20763 (2006)	18013 (2008)	-6.86%	Yes
Dobson NB	740.6 (2006)	814	3.201%	29820 (2006)	28767 (2008)	-1.781%	Yes
Dobson SB	788.9 (2006)	886.37	3.96%	29820 (2006)	28767 (2008)	-1.781%	Yes
Greenfield NB	734.55 (2008)	718.87	-2.13%	20861 (2006)	21437 (2008)	1.37%	No
Greenfield SB	794.33 (2008)	794.63	.0%	20861 (2006)	21437 (2008)	1.37%	No

In total, 12 comparisons were made. Of the 12 comparisons, there were 9 instances where growth in travel times were greater than growth in traffic volumes and 3 instances where travel time growth was smaller than the growth in traffic volume .

3.2 IDENTIFICATION OF CONGESTED AREAS

The average travel speeds were summarized, and are displayed graphically in **Figure 3, Figure 4**, and **Figure 5**. The speeds were divided into six ranges, and each range was given a color code. Any segment that showed an average speed of greater than 40 mph was considered good, and is indicated by a green line. Anything below 20 mph is considered poor, and is indicated by red. Speeds in between are divided into 5 mph increments, and are indicated by lines going from shades of green to red.

Generally speaking, the slowest moving traffic during the AM peak is northbound on Greenfield Road between the US 60 and Southern and southbound Dobson between Loop 202 and University Drive.

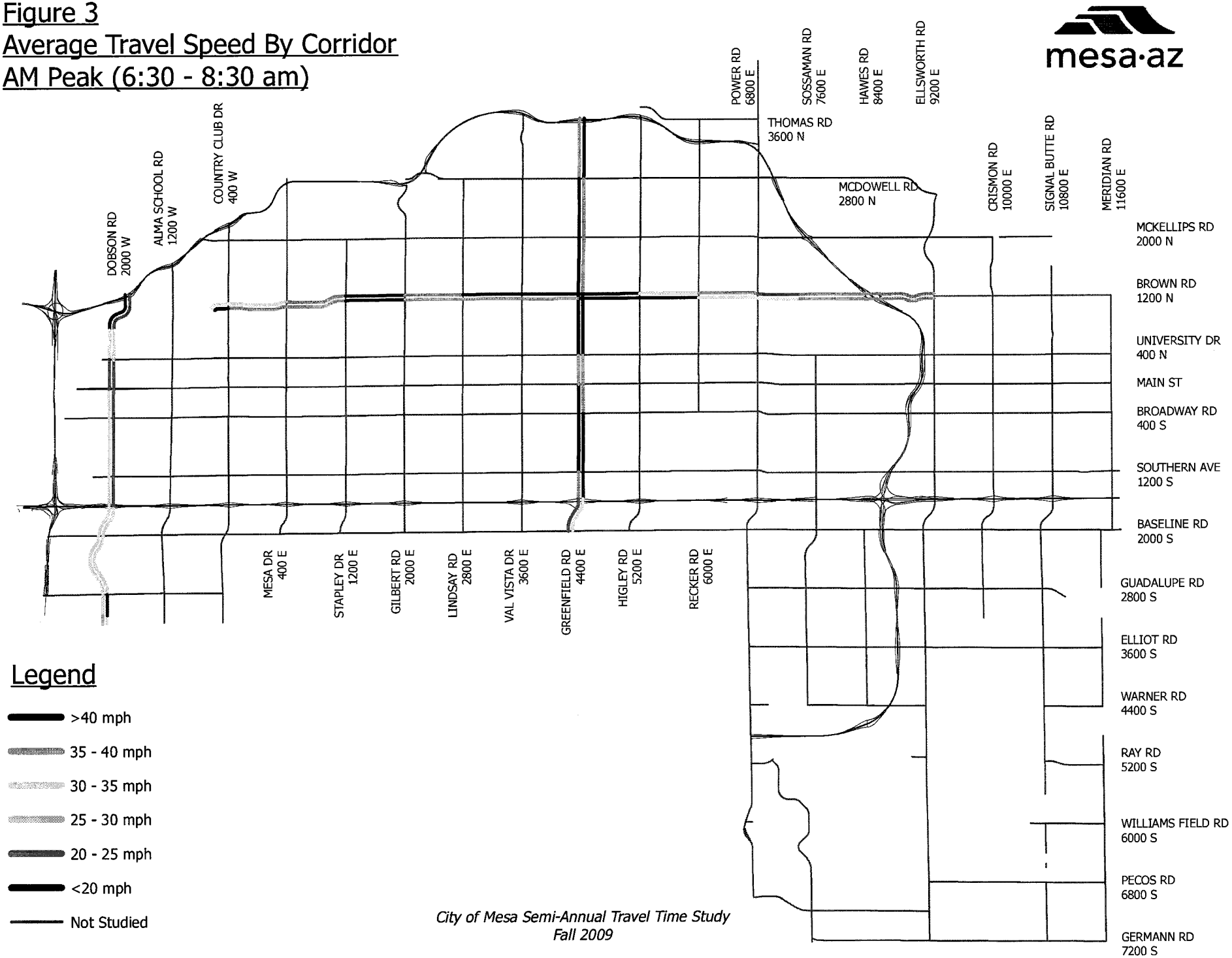
The slowest moving traffic during the off peak is Dobson Road between the US 60 and Broadway Road in both directions.

The slowest moving traffic during the PM peak is on Dobson Road between University Drive and Baseline Road in both directions.

3.3 EFFECTS OF FUTURE CAPITAL IMPROVEMENT PROJECTS

According to the Five-Year Capital Improvement Program 2008-2013, sections of 16 arterials included in this study are planned to have major capacity improvements within the next five years. This will likely improve travel times on these corridors. It may also attract traffic from other congested corridors, improving the travel times on these corridors as well. The City of Mesa also has plans to make major improvements to 15 intersections along the corridors in this study.

Figure 3
Average Travel Speed By Corridor
AM Peak (6:30 - 8:30 am)



Legend

- >40 mph
- 35 - 40 mph
- 30 - 35 mph
- 25 - 30 mph
- 20 - 25 mph
- <20 mph
- Not Studied

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Figure 4
Average Travel Speed By Corridor
Off Peak (9:30 - 11:30 am)

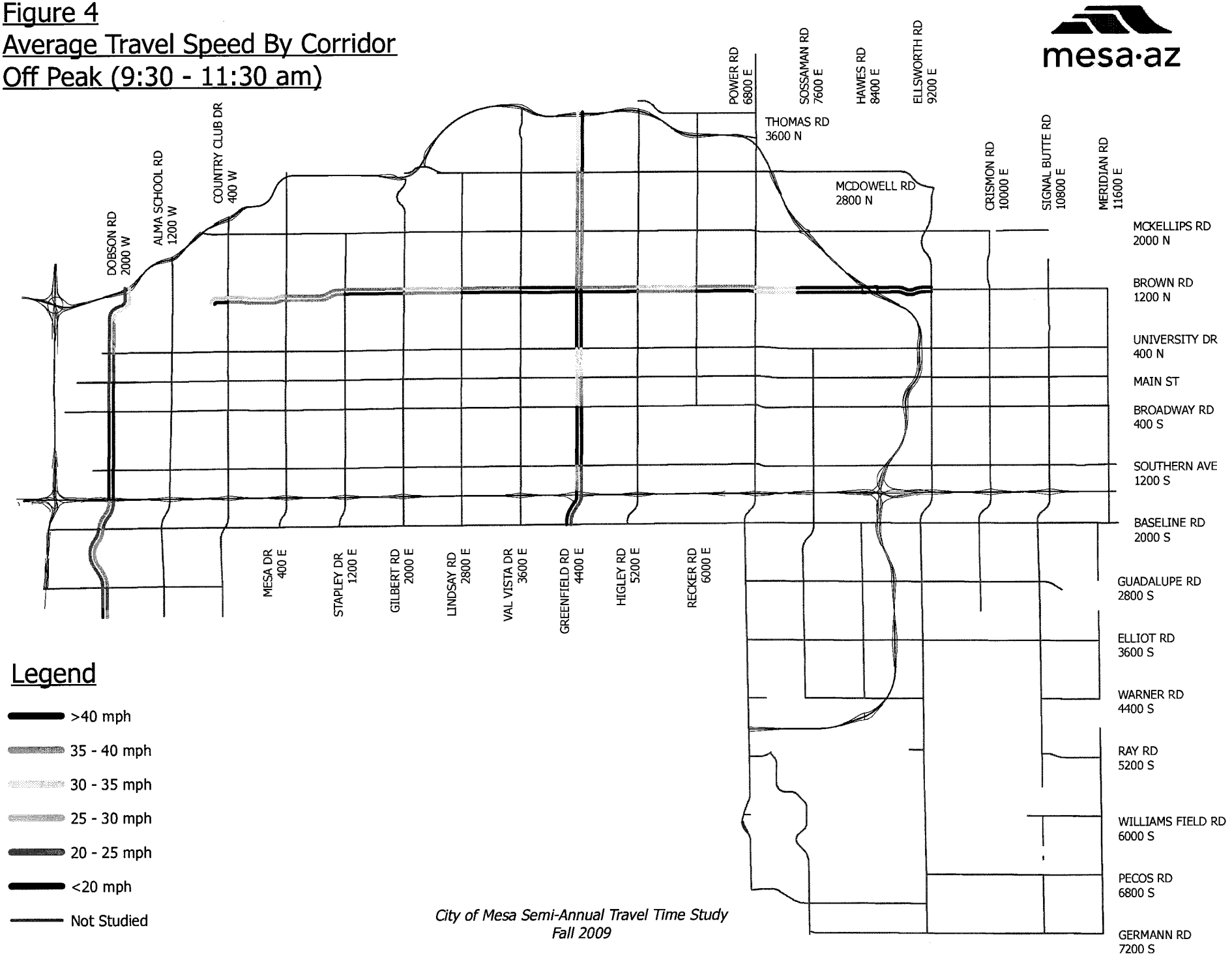
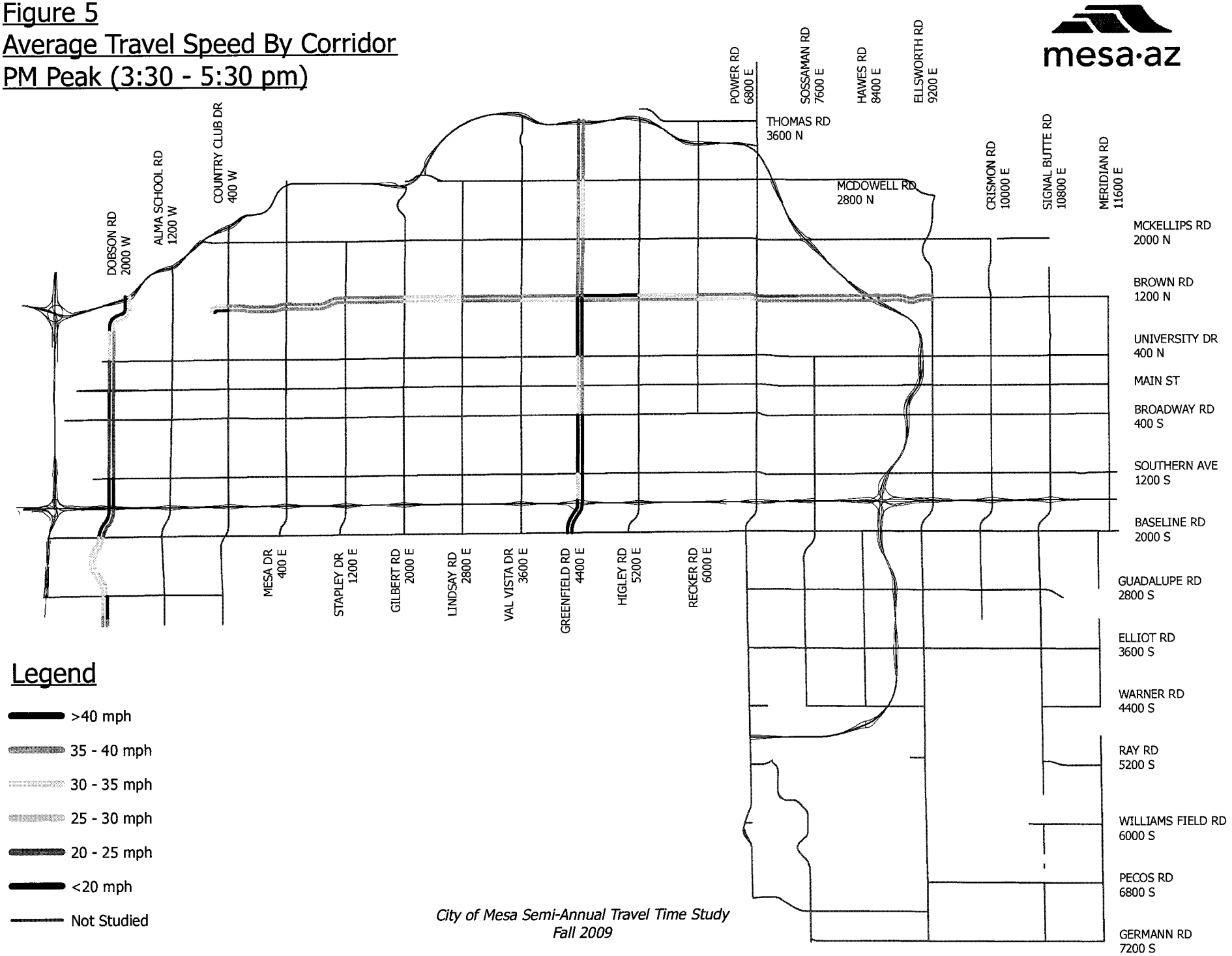


Figure 5
Average Travel Speed By Corridor
PM Peak (3:30 - 5:30 pm)



Legend

- >40 mph
- 35 - 40 mph
- 30 - 35 mph
- 25 - 30 mph
- 20 - 25 mph
- <20 mph
- Not Studied

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4.0 APPENDIX

Included in the appendix:

- Travel Time Schedule
- Site Code Explanation
- Travel Time Data Collection Procedures Sheet
- Statistical Data Validation Calculation Sheets
- Weighted Average Volume and Travel Speed Calculation Sheets
- Average Daily Traffic Calculation Sheets
- Output Tables From PC Travel