



SOLAR CAR **CONFERENCE**

Virtual 2023



On-Road Operations

Jake Herbers (he/him)
January 14th, 2023

About Me

- ~5 years on UMNSVP
- Competed in ASC x2 & WSC x2
- Lead Navigator & Strategy Support
- Mechanical Engineer
- Sponsor Relations Manager
- Volunteer Observer at ASC
- MS in Energy/Enviro Policy
- Ask me about careers in Government
- jacobherbers@gmail.com
- [linkedin.com/in/jacobherbers](https://www.linkedin.com/in/jacobherbers)



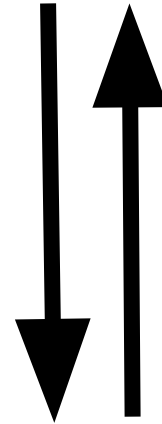
Overview

- Functional Roles
- Observers
- Radio / Comms
- Preparation
- Caravan Driving Maneuvers
- Passing / Dumps
- Pulling Over
- Navigation
- Conclusion



Minimum Functional Roles

Lead/Chase Flexible
Mechanical Crew
Electrical Crew
SC Driver Support
Safety Officer
Strategy



Truck & Trailer (TNT)	
Driver	Navigator

Lead Vehicle (LV)	
Driver	Lead Navigator
Nav Support	Cone Flagger

Solar Car (SC)	
Driver	Passengers?

Chase Vehicle (CV)	
Driver	Crew Chief or Observer
Crew Chief or Observer	Cone Flagger

Observers

- They write down everything
- They don't interpret regs / route book
- They stay in view of battery
- Driver changes / ballast
- Lights / horn / radio checks
- Safety compliance
- Penalty documentation
- Treat them well!!
- Food considerations
- Bathroom breaks
- Sleeping configuration
- Room for their luggage



Radio Protocols

- Know what channel / radio you're using, who's on it
- Plan your transmissions ahead of time, if possible
- Start talking after holding button for 1 second
- Enunciate clearly and slowly
- Describe the subject precisely and concisely
- Explicit state who you are, and who you're talking to
- "Copy" / "Roger that" / "Please repeat" / "Stand" / "Affirmative" / "Negative"
- Avoid "stop" / "pulled over" unless intended
- Say "correct" instead of "right"
- No monosyllabic transmissions
- Hold button or 1 second after you finish talking
- Avoid immediately retransmitting



Communications

- Need clear/respected chain of command
- Avoid arguing over the radio
- Lead Navigator calls out hazards & route instructions to SC
- Crew Chief warns SC for passing vehicles
- Don't talk excessively w/ SC, unless they want jokes in the middle of nowhere
- Vehicle drivers don't touch radios or phones - **keep your hands on the wheel**
- Keep the music low in support vehicles, and turn it off in urban areas
- Respond promptly to ASC On-Road Inspectors via CB



Prepare your Crew

- Scrutineer caravan vehicles
- Good night's sleep for tomorrow's drivers
- Navs / Crew Chief too
- Lead Driver frequently looking in rearview mirror
- Chase Driver protects SC
- SC Drivers can't have a 'tough guy' / hero mentality
- Swap out ALL drivers part way thru a full race day
- Register 3-4 SC drivers
- TNT Drivers need practice



Caravan Driving Safely

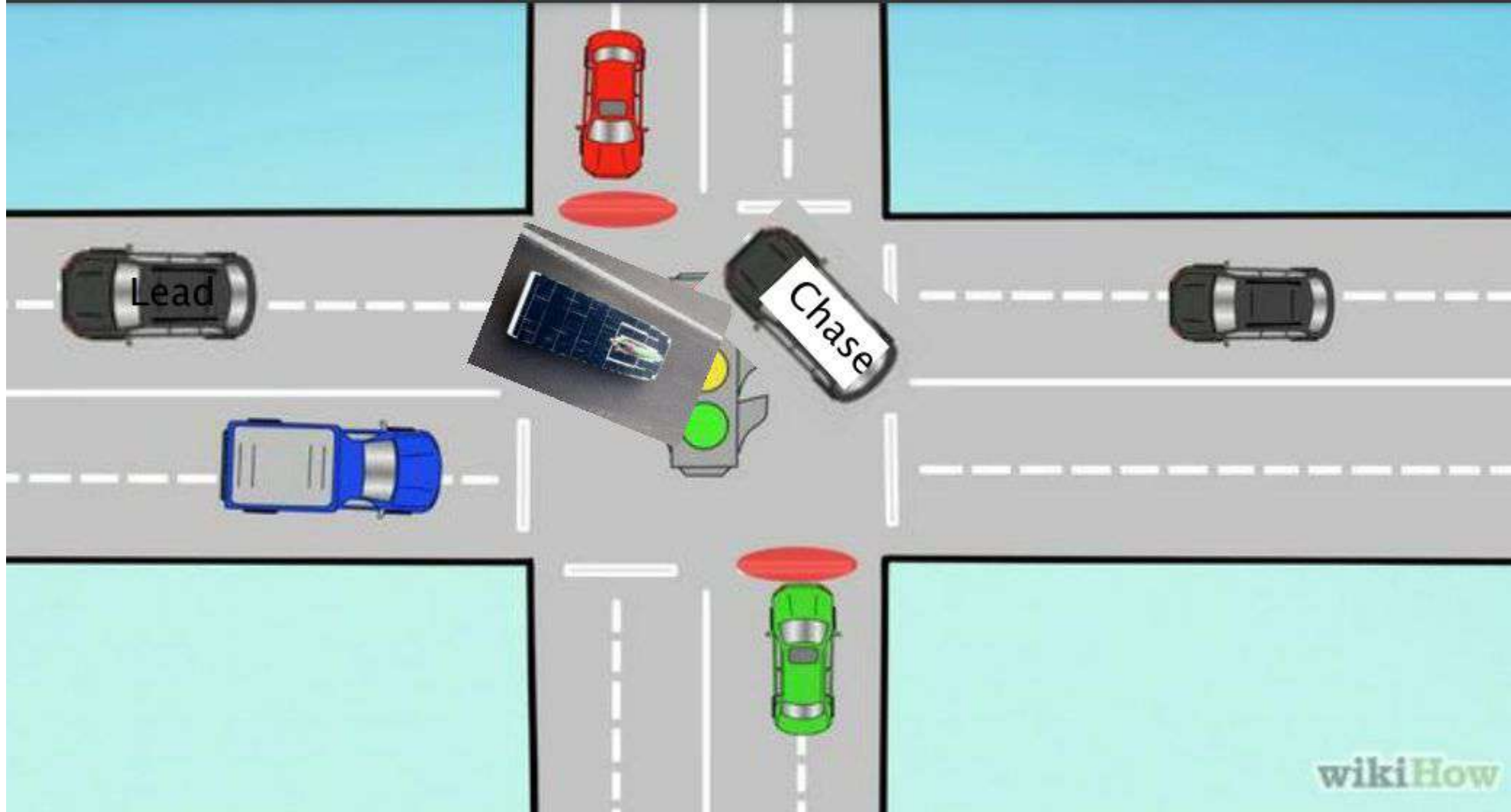
- LV <500 m ahead of SC, but >3 s ahead unless <25 mph
- CV & SC go thru intersections together, but avoid rear-ending
- Partly separate TNT route, >1 km away from all SCs unless passing
- Any other affiliated vehicles >1 km away from all SCs unless passing
- License/Regist./Insurance
- No teammates left behind



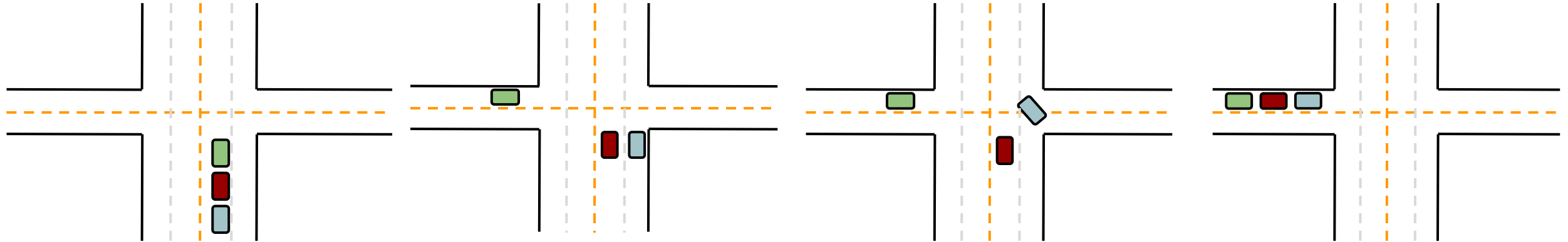


Turning

- CV blocks oncoming traffic
- CV & SC go thru together
- LV may need to block, or wait, but don't impede traffic



Turning



Nav: “ We will be taking a left turn at the upcoming traffic signal. Currently red.”

SC: “Solar car copies”

Chief: “Solar car, we will perform a chase block on your right. Please shift left”

Lead continues into intersection, and chase moves next to SC.

Lead may need to briefly block oncoming lane if necessary

When safe, Chase moves into intersection and blocks lane.

(flip chase block for right turn)

When in position...

Chase: “Solar Car, you are clear to proceed”

Solar car continues into intersection and performs the left turn

Caravan moves back into formation.

Make sure Lead doesn't get in the way!

Traffic Dumping

- Required if >5 vehicles lined up behind CV
- Not required if speed limited
- This # includes other SC caravans
- Doesn't include ASC Officials or non-caravan team vehicles
- Must find spot to pull over as soon as it's safe
- Look for passing lanes or pull-offs
- Shoulders can end abruptly
- NEVER let bogeys between CV-SC
- Ok to have bogeys between LV-SC
- Trailing team dumps first



Lane Change

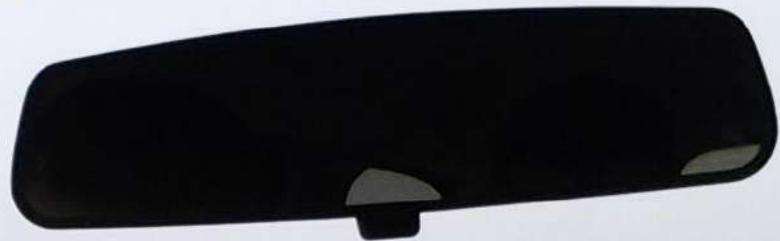
- Default = right lane
- One final decision-maker
- Turn signals on
- CV shifts over SLIGHTLY before SC
- CV & SC communicating without interruptions
- LV shifts after traffic clears



Passing Other Teams

- Have scout give advance notice via CB if possible
- Trailing team LV flashes headlights at leading team CV
- Trailing team Lead Nav contacts leading team Crew Chief via CB
- If multiple lanes, trailing team give notice of passing
- If single lane, trailing team requests to pass when it's safe & legal
- Leading team **must respond via CB** in a collaborative manner
- Leading team may ask for trailing team's target speed, **they must respond truthfully**
- Leading team Lead Nav radios when it's clear to pass - may need to play telephone
- Leading team **must slow down by 5 mph, or pull over** to facilitate pass
- LV passes first, then SC+CV together, ok to bogey between LV-SC







CAUTION
SLOW VEHICLE AHEAD

UHF
20

VCE 532

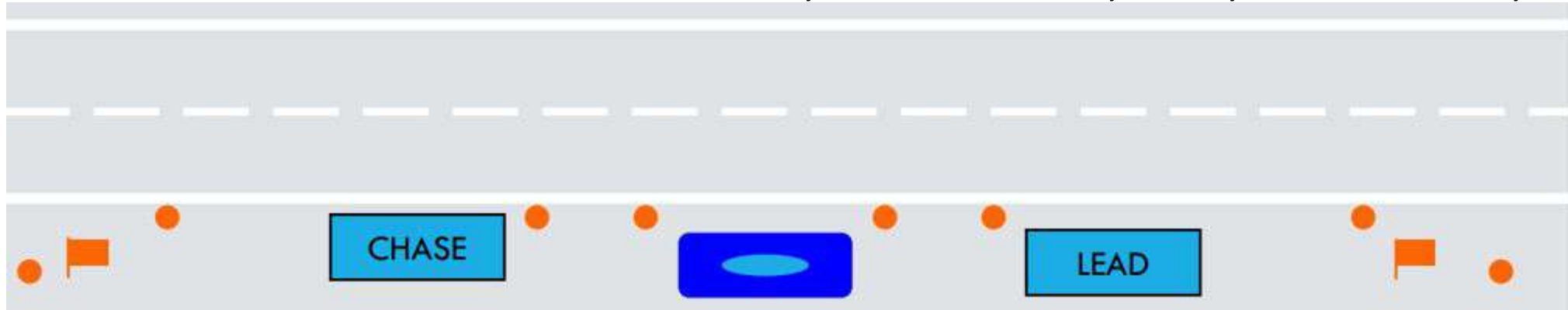
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TOKAI UNIVERSITY

SAT + 081641410306

Pulling Over

- Crew Chief should have situational awareness at all times
- Most important position: CV cone flagger
- LV cone flagger not needed if on a divided highway or 1-way street
- **Stay out of the traffic lanes** if at all possible
- Nobody else exits the vehicles until cone flaggers in position
- Cone flaggers don't break formation until EVERYONE else is back in vehicles
- Drill your team's procedures for both simple repairs, and emergencies - & in different conditions: wide shoulder, no shoulder, hills, urban area, etc.



Pulling Over

CV cone
flagger
looking
backwards



Pulling Over

Wide pull
off
location
and good
vehicle
placement



Pulling Over

Not
Blocking
side road,
good cones



Pulling Over

ASC
On-Road
Inspector
helping out



Pulling Over

CV protects
SC, and LV
nearby to
help but
tires should
be pointed
towards
ditch



Pulling Over

Good
position
but raise
that flag



Pulling Over

Good vehicle placement but flagger should be in front of LV and don't use road side doors



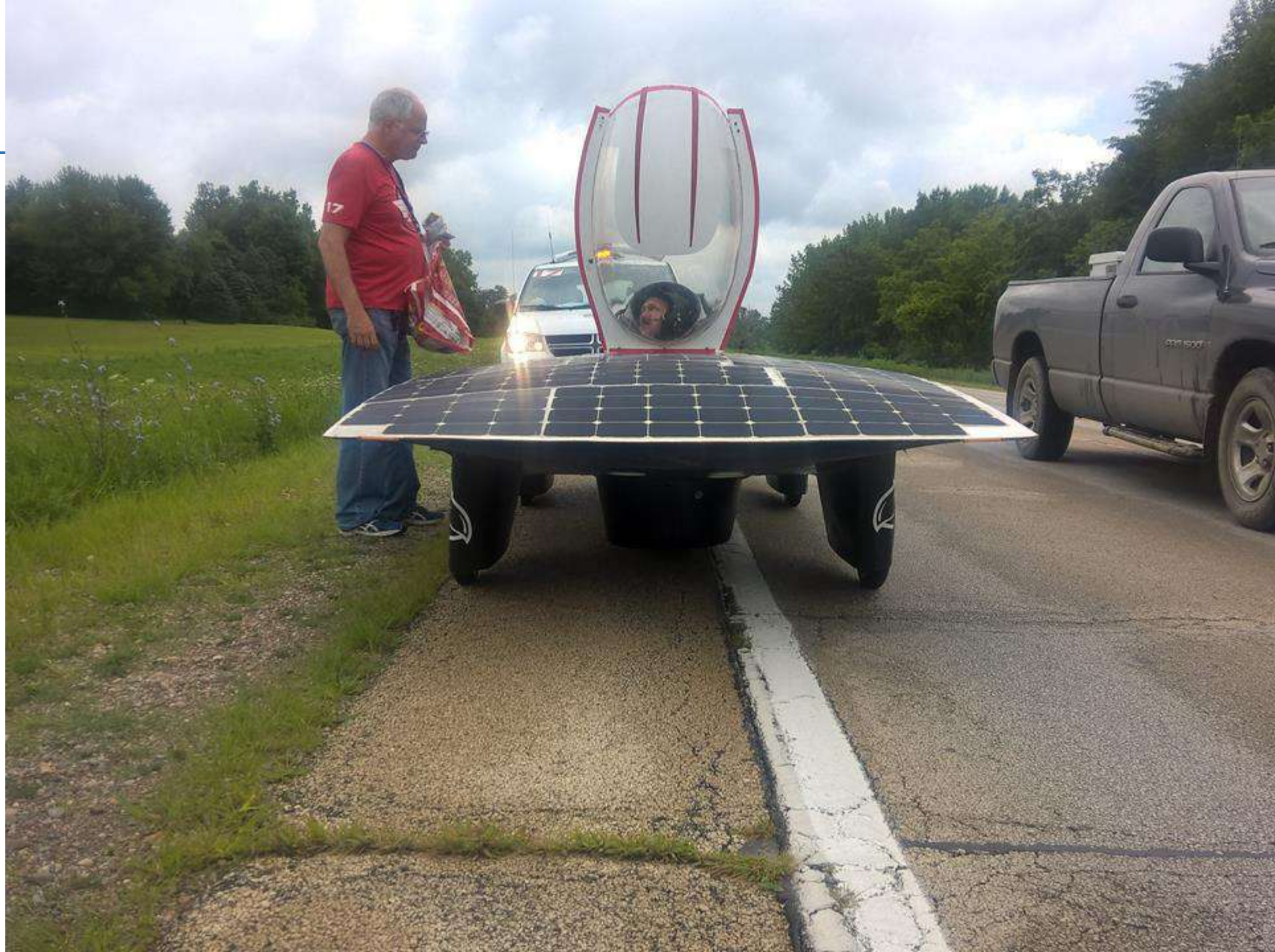
Pulling Over

Situational
Awareness



Pulling Over

Situational
Awareness



Pulling Over

Wide pull
off
location



Pulling Over

Bring in
TNT if
needed



Pulling Over

LV cone
flagger
keep your
head on a
swivel



Pulling Over

LV too far
into road



Pulling Over

Don't
block side
roads also
where is
the flagger



Pulling Over

Blocking
side road
without
protection



Pulling Over

Blocking
side
road



Pulling Over

Bathroom
break but
where are
the flaggers



Pulling Over

Situational
Awareness



Pulling Over

Move it to
the grass
if you're
gonna be
a while



Navigation - Prepare and Focus!

- Worship the Route Book as much as the Sun
- Lead Navigator should NOT be looking at a screen
- Someone else can look at GPS, but it can sometimes be incorrect and laggy
- GPS is secondary, but should be able to quickly notify if you leave the route
- Pre-Drive the route, or at least google street view
- During ASC, attend all briefings, check ASC website and team email for route/regs changes
- If you deviate from the route, you must rejoin the route at the same intersection you departed from, or you'll be considered trailering

IF YOU DON'T
READ THE
ROUTE BOOK
AHEAD OF
TIME, YOU
WILL GET
LOST.

Navigation - Regs

12.2.A Completion of Base Route

Within each vehicle class, any team that fails to complete the Base Route of the Tour will automatically be ranked below all teams that successfully complete it. Loops, which are optional, are not considered part of the Base Route. Further class ranking is specified below.

12.11.C Teams Departing from the Tour Route

Any team leaving the Tour Route must rejoin the route at the same intersection or point where they left the route, or they will be considered to have trailered from their last completed route step before going off route. Their Load On Trailer Time will be the time that they went off route.

12.17.A.3 Only distance for valid Loops will be credited. Loops that are only partially completed by the Loop Close Time (for Checkpoints) or by the team's Stage Close Time (for Stage Finishes) are not valid. Teams that fail to complete a Loop before the Checkpoint Loop Close Time will resume the Event from the Checkpoint. If a team begins a Loop before finishing serving their prior mandatory Hold Time or Trailers their solar car during the Loop, that Loop is invalidated.

12.28.D Resumption of Driving

If a team has Trailered on a Segment they will not be eligible to start any additional loops on that Segment. After Trailering a team may resume driving via one of the following options:

12.28.D.1 At the point they started Trailering, or earlier along the route (if successful they will no longer be considered to have Trailered from that point)

12.28.D.2 At an open Checkpoint

12.28.D.3 At the start of the next Stage

Navigation - Prepare and Focus!

Step	Trip	Int	Major Turns/Instructions	Landmarks/Notes	Ln	Spd	Shoulder	Services
A 69	63.00	1.30		Entering Greenwich	1	35	curb	fuel
A 70	63.30	0.30				25		
A 71	63.50	0.20		RR Tracks		35		
A 72	64.20	0.70				55	narrow gravel/grass	
A 73	64.70	0.50		RR Tracks				
A 74	71.80	7.10		Entering New Haven		45		
A 75	72.00	0.20	Turn left at SL onto OH-61 South	BP gas station on far right corner.	1	45		fuel
A 76	72.40	0.40				55		
A 77	73.90	1.50		Entering Plymouth		35	curb	Fuel, grocery
A 78	74.30	0.40		SL for Mary Fate Park				

Case Study: ASC 2022 Route Step A 84

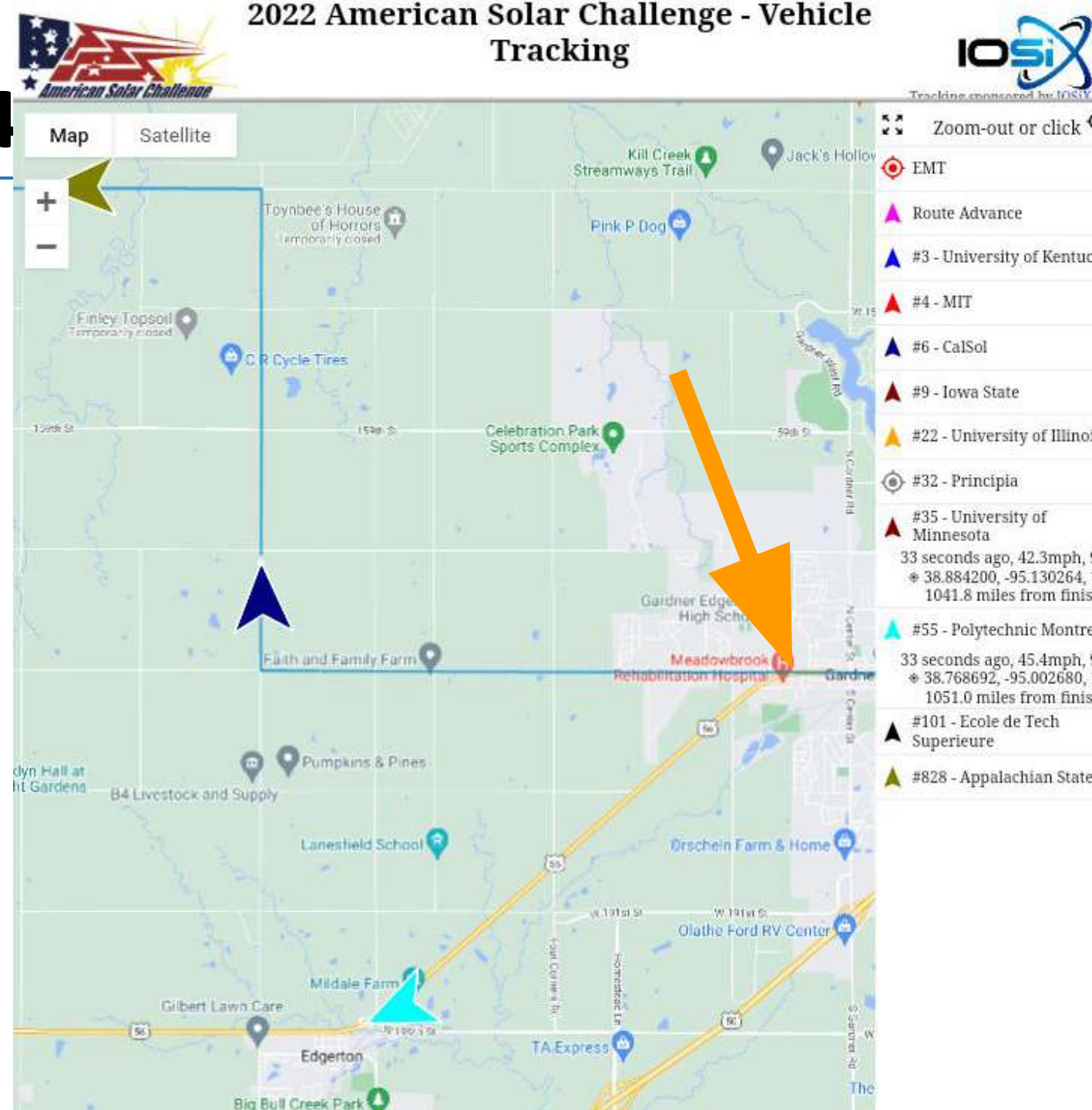
A 81	44.30	0.50		SL for Mulberry St
A 82	44.50	0.20		SL for Elm St, Gardner City Hall at right ahead, 2 lanes, 30 mph
A 83	44.60	0.10		SL for Center St
A 84	45.10	0.50	CONTINUE STRAIGHT in the right hand lane to continue on 175th St as Main St curves to the left	Continuing west on 175th St (This is where the route separates from the ASC 2021 route.)
A 85	45.60	0.50		All-way Stop at Waverly Rd
A 86	46.00	0.40		
A 87	48.20	2.20		Signs to miles to

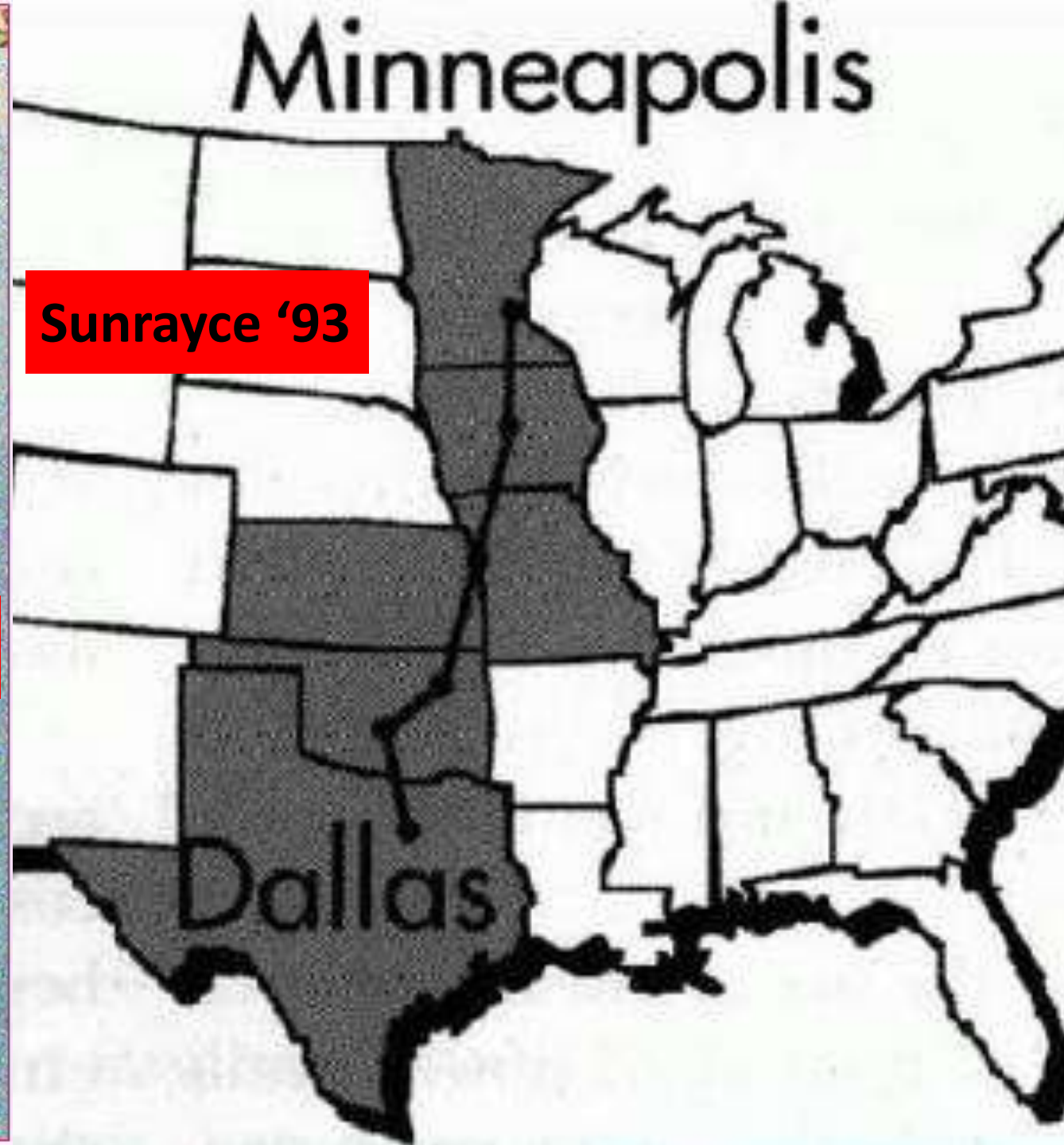
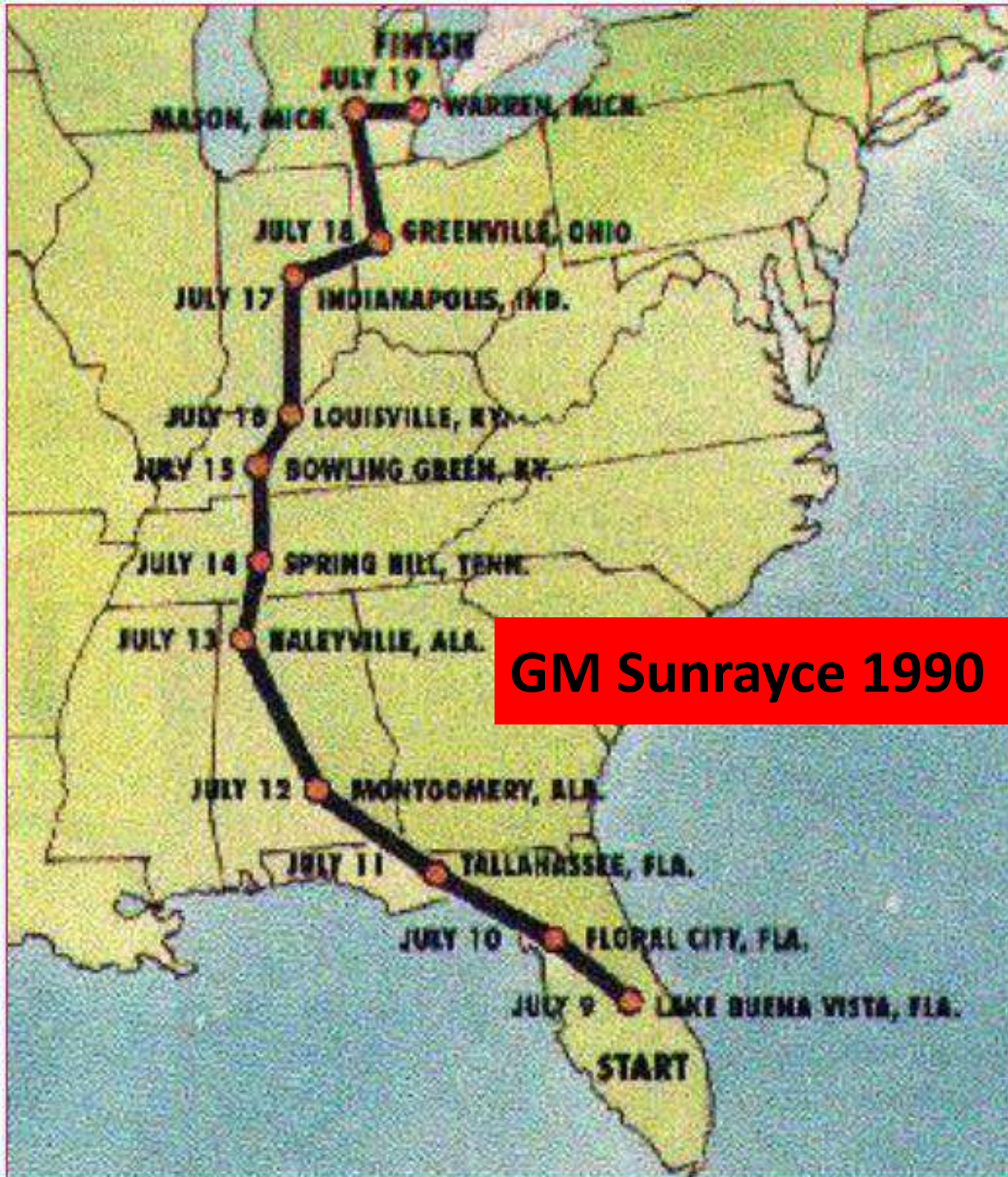
- Poorly worded - requires a lane change to the right
- However, Navigators should prepare in advance for all key steps
- Use later steps to confirm route

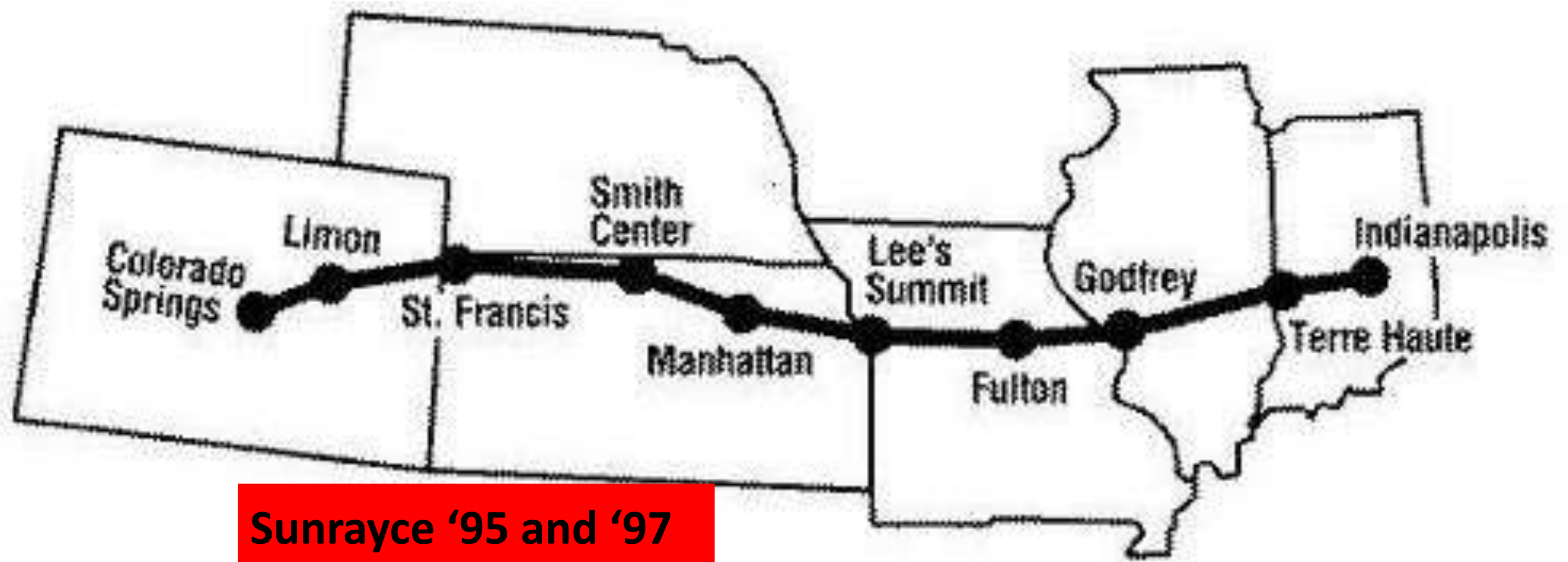


Case Study: ASC22 A84

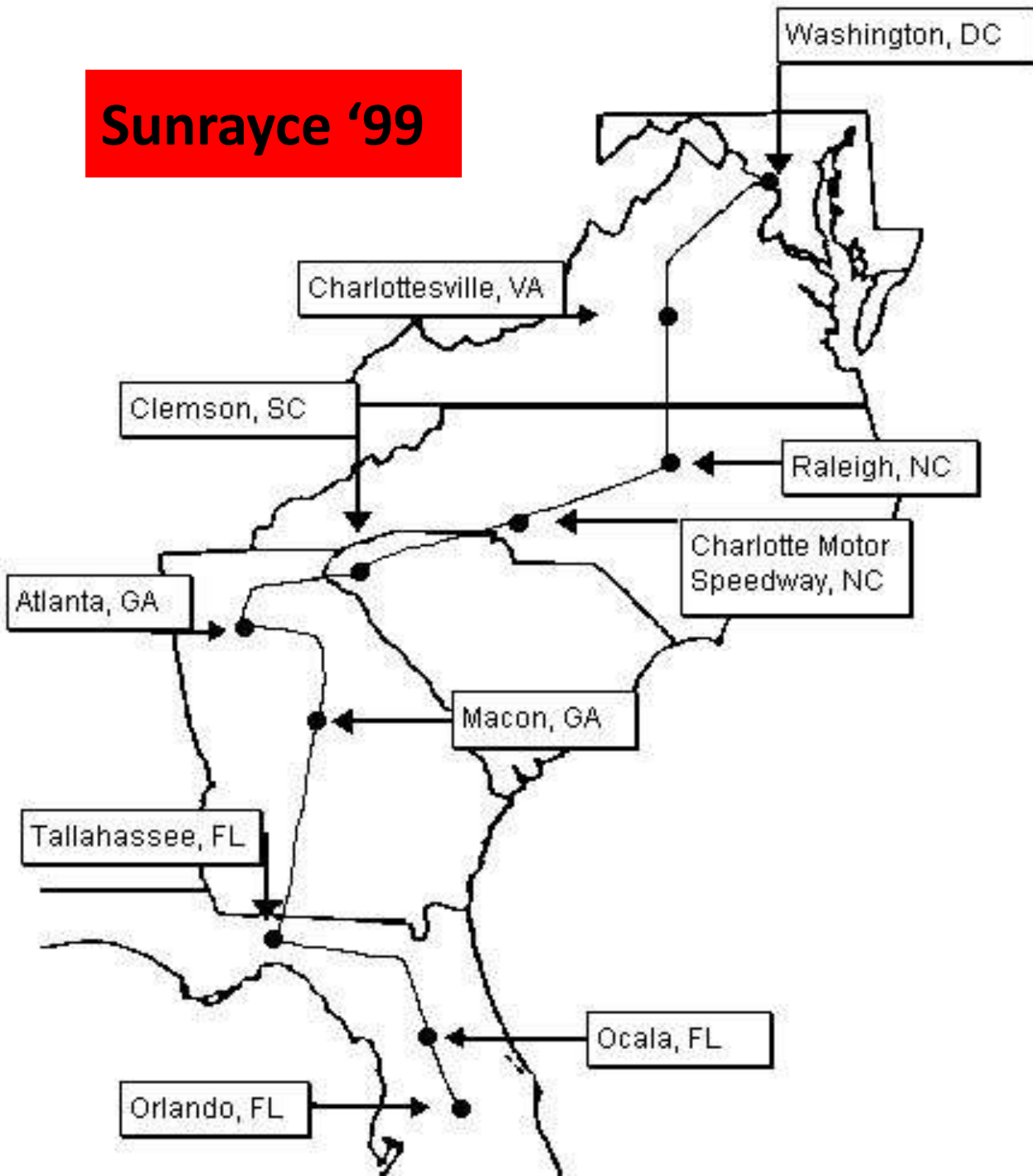
- Minnesota missed the turn in their pre-drive, then correctly navigated it during ASC*
- App State missed the turn during ASC, but immediately realized their mistake and returned to the point they departed the route
- Esteban missed the turn, returned to an intersection further along the base route, proceeded to the open checkpoint, then declined to return to the point of departure







Sunrayce '99



NASC 2005 (2008 similar)





ASC 2001 & 2003

ASC 2010

1326.77 straight lines
1648.8 Real Route?



ASC 2012



→ → → www.americansolarchallenge.org

2012

→ → → 8 STATES
8 DAYS
ALL SOLAR

FINISH ←
St. Paul, MN

La Crosse, WI

Verona, WI

Kalamazoo, MI

Normal, IL

Ann Arbor, MI

Mansfield, OH

Erie, PA

START ←
Rochester, NY

START → Rochester, NY Sat, Jul 14 @ Rochester Institute of Technology

STAGE POINT → Erie, PA Sat-Sun, Jul 14-15 @ Tom Ridge Environmental Center

CHECKPOINT → Mansfield, OH Sun, Jul 15 @ The Ohio State University at Mansfield

STAGE POINT → Ann Arbor, MI Mon, Jul 16 @ University of Michigan
Tue, Jul 17 @ Black & Veatch

CHECKPOINT → Kalamazoo, MI Tue, Jul 17 @ Western Michigan University

STAGE POINT → Normal, IL Wed-Thu, Jul 18-19 @ Illinois State University

CHECKPOINT → Verona, WI Thu, Jul 19 @ Reddan Soccer Park

STAGE POINT → La Crosse, WI Fri-Sat, Jul 20-21 @ Western Technical College

FINISH → St. Paul, MN Sat, Jul 21 @ Minnesota State Capitol



SCRUTINEERING → Fri-Mon, Jul 6-9

FORMULA SUN GRAND PRIX → Tue-Thu, Jul 10-12

@ Monticello Motor Club, Monticello, NY

SOLARING UP THE MIDWEST



1700+ Miles

All Solar

7 States

8 Days



Powered By



Scrutineering

Mon-Wed July 14-16 at COTA

FSGP Track Qualifier

Thu-Sat, July 17-19 at COTA

Race Schedule

Austin, TX Starting Line

Mon, July 21 at UT Austin

Weatherford, TX Check Point

Mon, July 21 at Weatherford College

Norman, OK Stage Stop

Tue-Wed, July 22-23 at University of Oklahoma

Wichita, KS Check Point

Wed, July 23 at Wichita Aviation Museum

Overland Park, KS Stage Stop

Thu-Fri, July 24-25 at Black & Veatch

Omaha, NE Stage Stop

Fri-Sat, July 25-26 at HDR

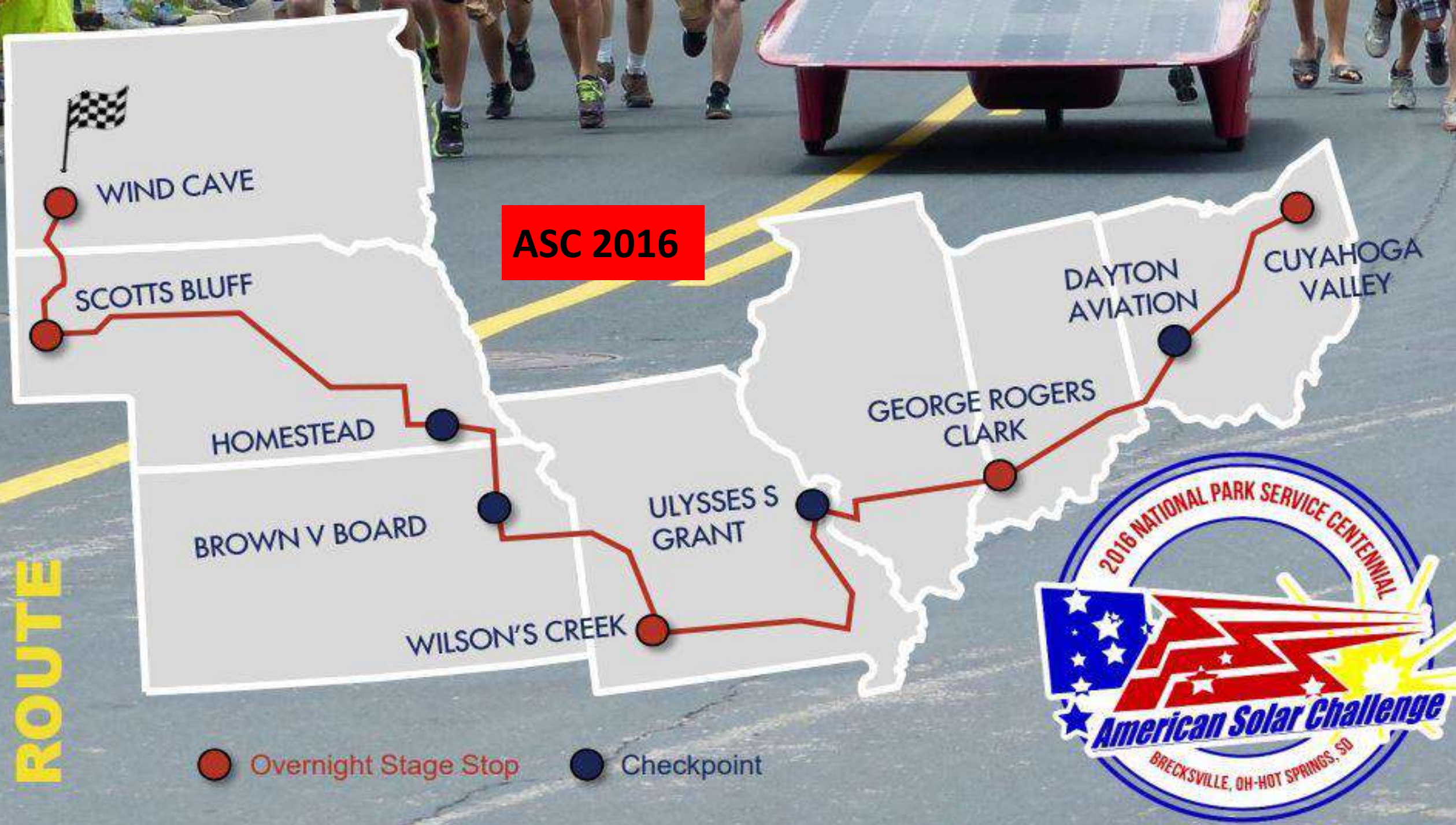
Ames, IA Check Point

Sat, July 26 at Iowa State University

ASC 2014

ROUTE

ASC 2016



ASC 2018



ASC 2021



CARS ON THE TRAIL

Grand Prix
American
(ASC) are
student design
design, build,
ve a solar-
providing a
experiential
ity. FSGP is
ck event;
y style
st pass
qualify at

ASC 2022



2022



Conclusion

- Safety First
- Read The Regs
- Read The Route Book
- Plan & Coordinate Communications
- Situational Awareness
- Good Sportsmanship
- Practice makes perfect

