

A Cost-Path Analysis of the Chehalem Mountain Wine Region



Chris Smitherman and Neil Loehlein
Digital Terrain Analysis (GEOG 4/593)

Wine tasting plan:

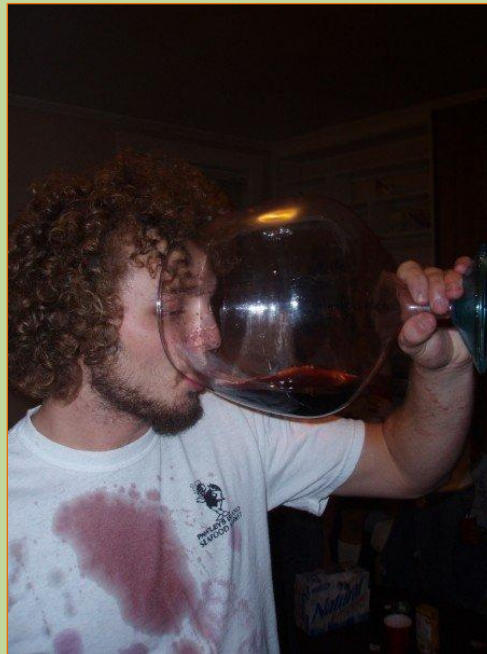
Schedule of wineries to visit:

- 1) Meet at Cooper Mountain
- 2) Beau Freres
- 3) Oak Knoll
- 4) Adelsheim
- 5) Montinore
- 6) Lawton
- 7) Hawk's View
- 8) Back to Cooper Mountain

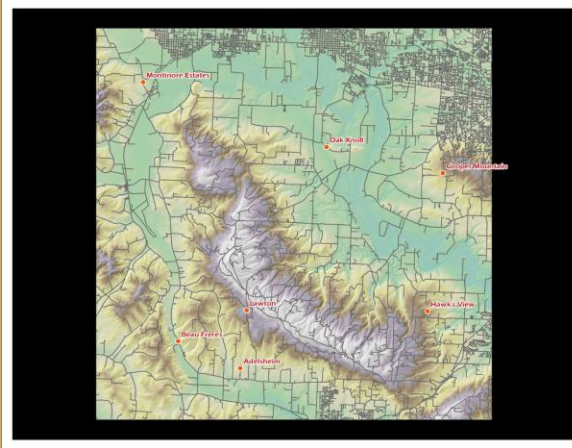
Our Question:



What routes between the wineries will require the least work? The least distance?

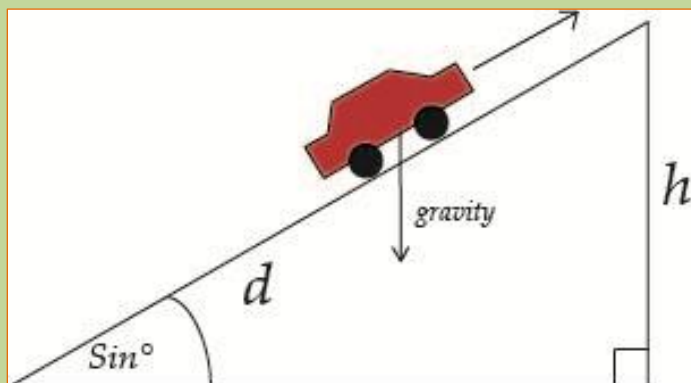


Study Area:



Chehalem Mountains AVA

The Physics of Work



$$\text{Force} = \text{mass of object} \times \text{gravity} \times (\text{Sin } ^\circ)$$

The Physics of Work

Object mass—Honda Accord + Chris + Neil

Accord is 3375 lbs

Chris and Neil are 300 lbs

This adds up to 3675 lbs

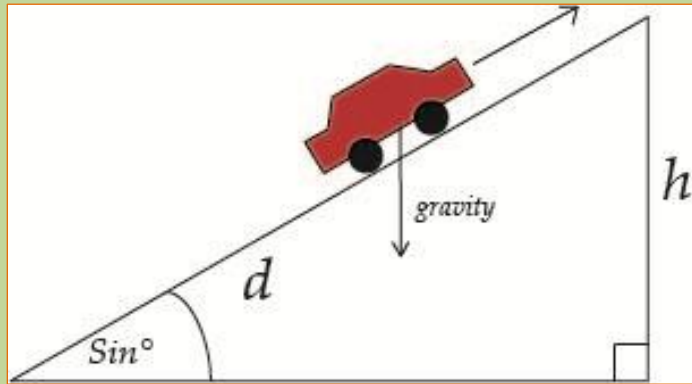
Which is equivalent to ~1530 kilograms

The Physics of Work

Gravity is 9.80 m/s^2

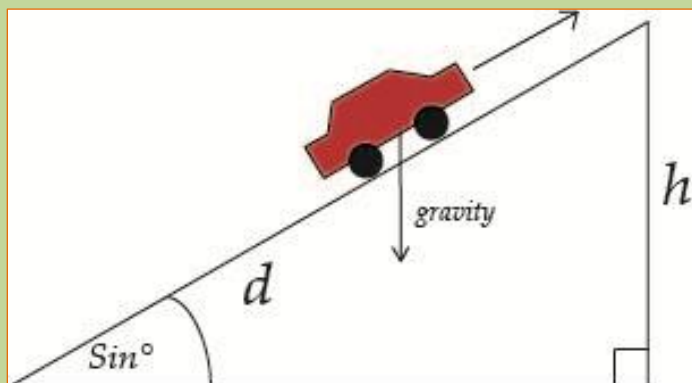
Which is equivalent to 32.2 ft/s^2

The Physics of Work



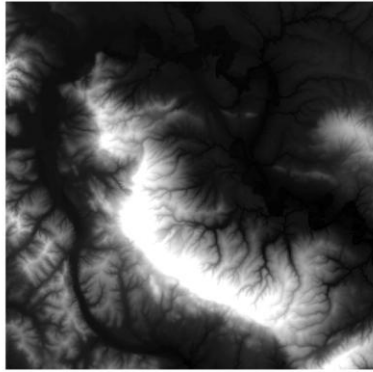
$$\text{Force} = 1530 \text{ kg} \times 32.2 \text{ ft/s}^2 \times (h/d)$$

The Physics of Work



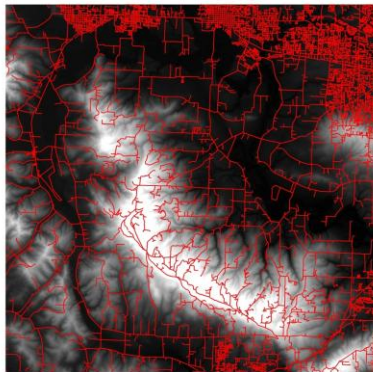
$$\text{Work} = \text{force} \times \text{distance } (d)$$

Setting up the Networks: Layers needed



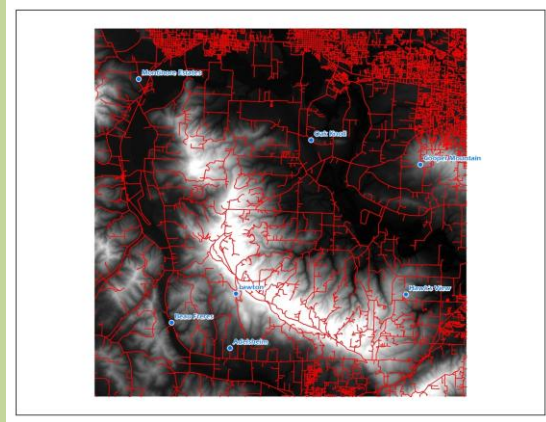
1) 10-meter Digital Elevation Model (DEM)

Setting up the Networks: Layers needed



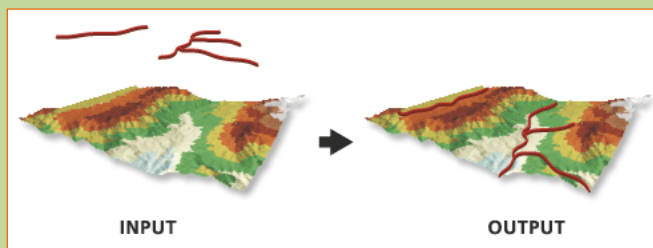
2) Streets layer

Setting up the Network: Layers needed



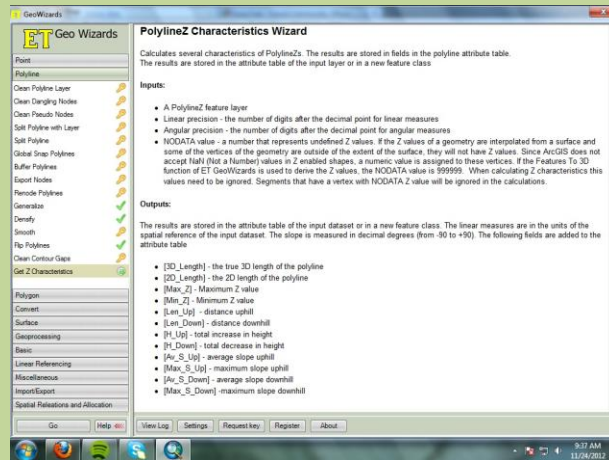
3) Wineries layer

Setting up the Networks



Interpolate Shape: Interpolates z-values for our roads layer based off of our DEM.

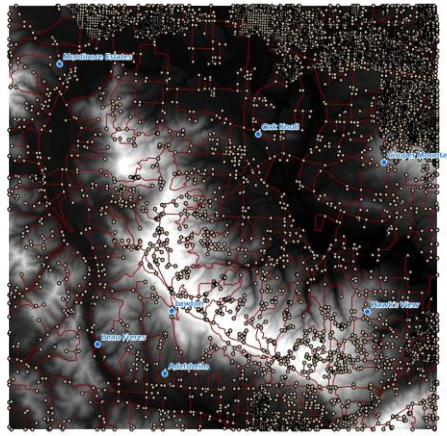
Setting up the Networks



Get Z Characteristics: calculates increases and decreases in elevation along our 3D road layer.

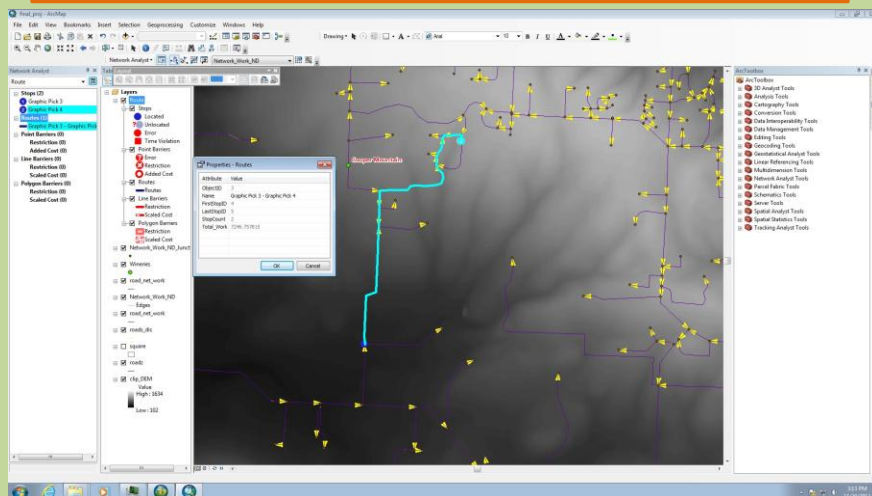
Road Cost Attributes

Length_3D	Len_Up	Len_Down	To Up	To Down	Fr Up	Fr Down	To force	from force	To work	from work	To KJoiles	From KJoiles	Miles_3D
340.481069	189.954515	150.517354	76.6959	5.0709	5.0709	76.6959	19890.5580	1659.7818	377520.2	249822.959	1151.68066	76.146038	0.084485
169.784715	169.784715	<null>	58.2431	0	0	58.2431	16900.2526	<null>	2889404.5	<null>	874.594513	<null>	0.032156
271.989143	271.989143	<null>	92.4858	0	0	92.4858	16752.3439	<null>	4556405.4	<null>	1388.792376	<null>	0.051513
177.052148	177.052148	<null>	55.3839	0	0	55.3839	15419.9580	<null>	2725642.2	<null>	831.659975	<null>	0.033553
1435.395484	1435.395484	<null>	428.234801	0	0	428.2348	14897.9811	<null>	21097415	<null>	6430.492306	<null>	0.271855
245.03785	245.03785	<null>	70.2546	0	0	70.2546	14125.0142	<null>	3481163.1	<null>	1054.962522	<null>	0.046409
1409.397649	446.106523	963.291126	125.4644	170.9594	170.9594	126.4644	13555.7246	8743.4479	6181129.1	842485.81	1884.008163	2567.17367	0.268931
407.840692	165.276462	242.363959	45.8362	27.1615	27.1615	45.8362	13683.8624	5525.2683	225314.0	1339126.78	688.334117	498.164929	0.073725
1108.007544	891.553801	216.453743	238.912101	5.2708	5.2708	238.9121	13267.2028	1199.6615	11819509	2596701.233	3602.596509	78.147792	0.101747
358.921588	230.677562	128.244026	54.7373	17.5359	17.5359	54.7373	11690.2910	6736.5606	2696687.8	863923.651	821.95045	263.323929	0.067978
97.069236	97.069236	<null>	22.5034	0	0	22.5034	11421.2551	<null>	1108652.5	<null>	337.917284	<null>	0.018364
206.928531	206.928531	<null>	65.9545	0	0	65.9545	11324.4730	<null>	3249314.4	<null>	990.39103	<null>	0.054343
399.109851	399.109851	<null>	89.812	0	0	89.812	11086.6218	<null>	4424678.0	<null>	1348.641855	<null>	0.075587
290.723352	290.723352	<null>	65.0099	0	0	65.0099	11016.5823	<null>	3202777.7	<null>	976.206655	<null>	0.055061
537.225165	537.225165	<null>	118.5851	0	0	118.5851	10874.7950	<null>	5842213.5	<null>	1780.70669	<null>	0.101747
659.795664	557.46549	302.284075	117.2696	67.5317	67.5317	117.2696	10363.6862	11005.894	577444.1	3327016.73	1760.952778	1014.07470	0.162033
57.753331	57.753331	<null>	7.9099	0	0	7.9099	10321.9802	<null>	388698.13	<null>	116.777249	<null>	0.00715
730.111659	730.111659	<null>	148.5306	0	0	148.5306	10022.4513	<null>	7317506.5	<null>	2230.376608	<null>	0.138279
146.486745	146.486745	<null>	29.1695	0	0	29.1695	9810.20224	<null>	1437064.5	<null>	438.017287	<null>	0.027744
74.871007	74.871007	<null>	14.6486	0	0	14.6486	9638.95054	<null>	721677.92	<null>	219.967433	<null>	0.01418
864.68678	864.68678	<null>	168.3431	0	0	168.3431	9591.66163	<null>	6259591.1	<null>	2527.889593	<null>	0.163763
243.030251	127.711261	115.31669	24.8113	9.9816	9.9816	24.8113	9571.07740	4284.3630	122235.5	491753.506	372.573349	149.886469	0.046020
174.939716	174.939716	<null>	33.9736	0	0	33.9736	9567.54370	<null>	1673743.3	<null>	510.156893	<null>	0.033133
548.296344	548.296344	<null>	103.6315	0	0	103.6315	9311.58789	<null>	5105509.4	<null>	1556.159293	<null>	0.103844
1451.410244	233.501557	1217.90968	44.0697	107.3002	107.3002	44.0697	9296.17288	4340.4335	2171137.8	5296251.66	681.762815	1811.24950	0.071499
148.952824	148.952824	<null>	27.4127	0	0	27.4127	9132.86723	<null>	1360367.2	<null>	414.639947	<null>	0.023211
983.076235	983.076235	<null>	181.0616	0	0	181.0616	9073.74269	<null>	8920180.8	<null>	2718.871109	<null>	0.196189
582.274333	389.922557	192.351776	71.1831	4.5918	4.5918	71.1831	8993.85416	1176.0724	3506906.6	226219.619	1068.905135	68.95174	0.102729
545.558277	400.400692	145.157585	73.0378	7.0904	7.0904	73.0378	8986.69842	2406.4581	3598280.2	349315.647	1096.755824	106.471409	0.071499
50.401135	50.401135	<null>	8.6823	0	0	8.6823	8682.25281	<null>	437595.39	<null>	133.379076	<null>	0.005946
862.589923	268.438439	594.149483	46.5857	22.2187	22.2187	46.5857	8546.11502	2777.1931	2294105.7	1094626.47	699.243442	333.64215	0.12549
35.463375	35.463375	<null>	6.1447	0	0	6.1447	8536.26576	<null>	302724.79	<null>	92.705516	<null>	0.006717
621.951212	423.456328	378.494886	42.1353	25.3134	25.3134	42.1353	8526.53010	3294.8680	2075837.6	1247089.96	632.715329	380.113022	0.086214
375.409844	375.409844	<null>	84.9611	0	0	84.9611	8525.01008	<null>	3200373.5	<null>	875.473881	<null>	0.0711
1402.662072	1402.662072	<null>	241.521791	0	0	241.5217	8463.08860	<null>	1189896	<null>	3626.788741	<null>	0.265666
228.227679	228.227679	<null>	38.8559	0	0	38.8559	8387.56622	<null>	1914274.7	<null>	583.470951	<null>	0.043225
455.211766	455.211766	<null>	76.4502	0	0	76.4502	8273.94159	<null>	3766395.5	<null>	1147.997367	<null>	0.086214
243.308928	243.308928	<null>	40.6914	0	0	40.6914	8239.32992	<null>	2004702.5	<null>	611.033327	<null>	0.046081



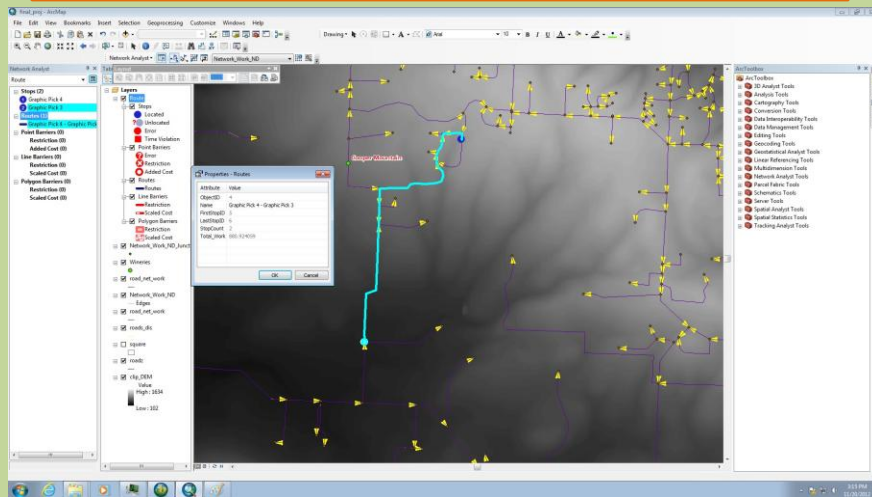
Costs: Network 1—work
Network 2—3D distance

Testing the work cost (uphill)



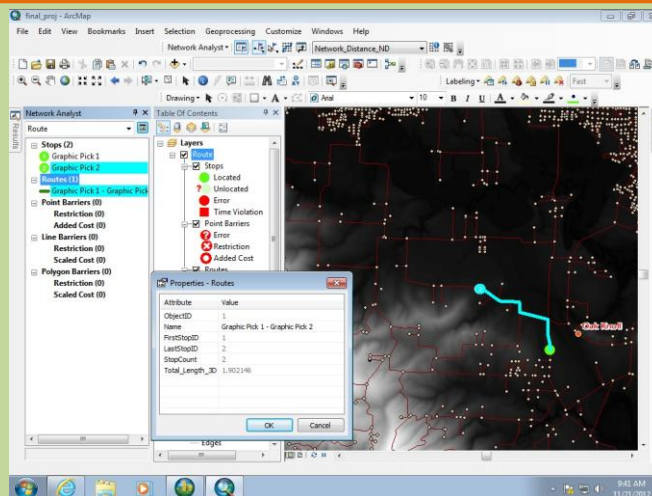
Total_work = 7246.75 Kilojoules

Testing the work cost (downhill)



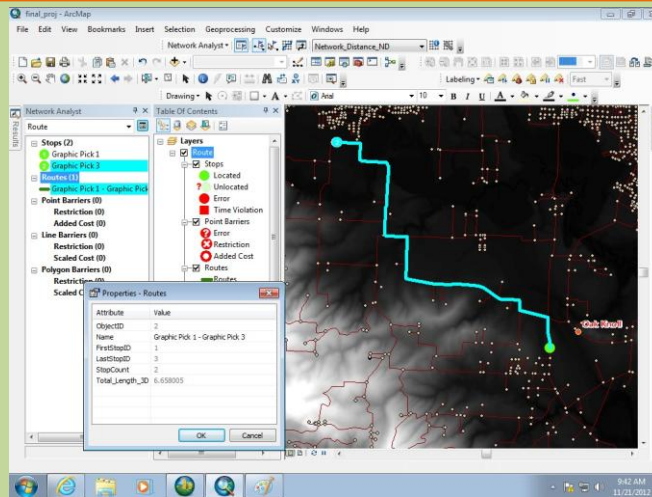
Total_work = 880.92 Kilojoules

Testing the distance cost (near)



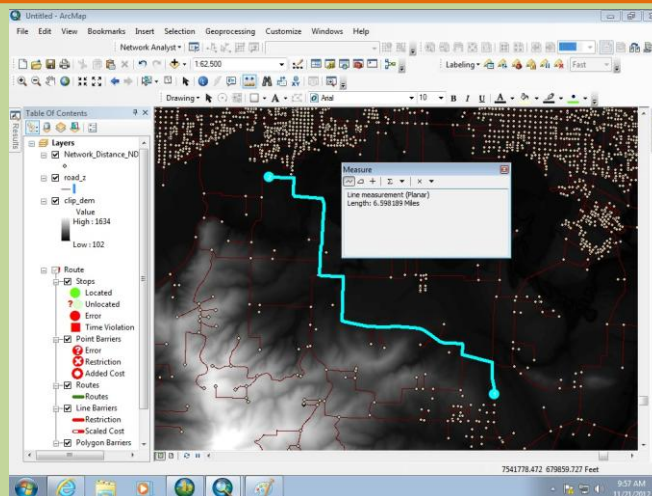
Total_length_3D = 1.902 miles

Testing the distance cost (far)



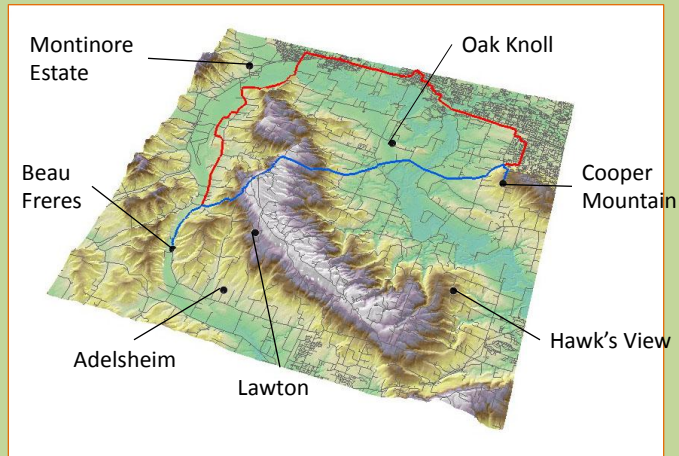
Total_length_3D = 6.658 miles

Testing the distance cost (far)



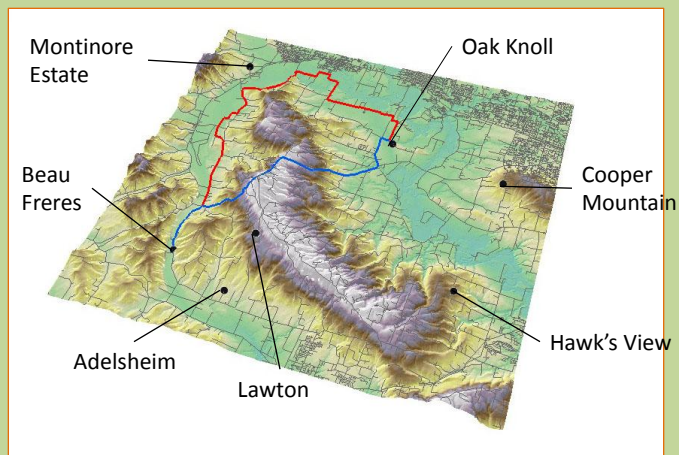
Total_length_3D = 6.658 miles
Manual measurement = 6.598 miles

Finding routes for our wine tour



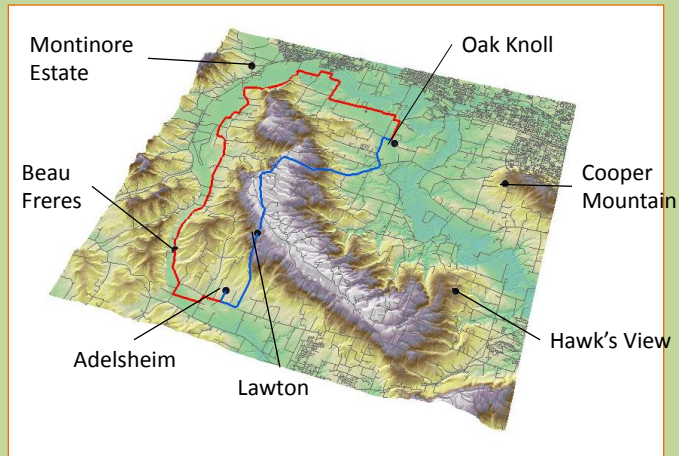
Cooper Mountain to Beau Freres

Finding routes for our wine tour



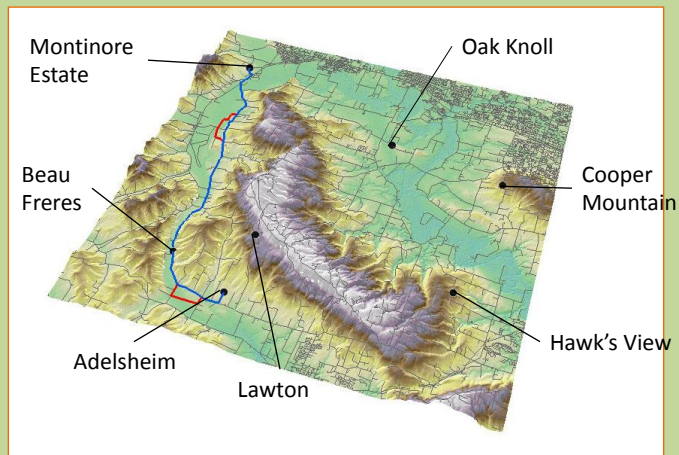
Beau Freres to Oak Knoll

Finding routes for our wine tour



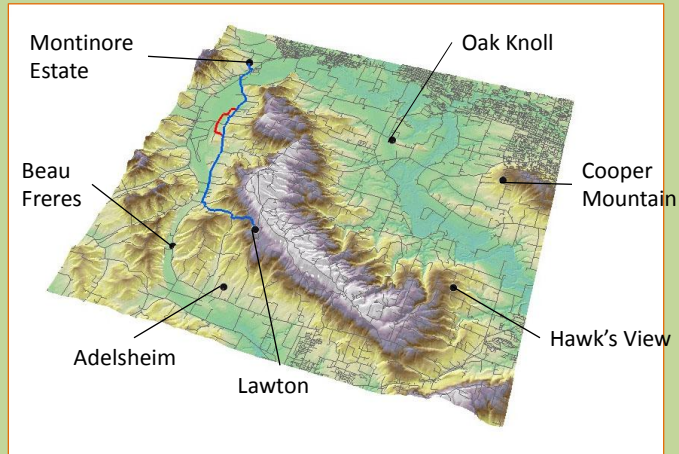
Oak Knoll to Adelsheim

Finding routes for our wine tour



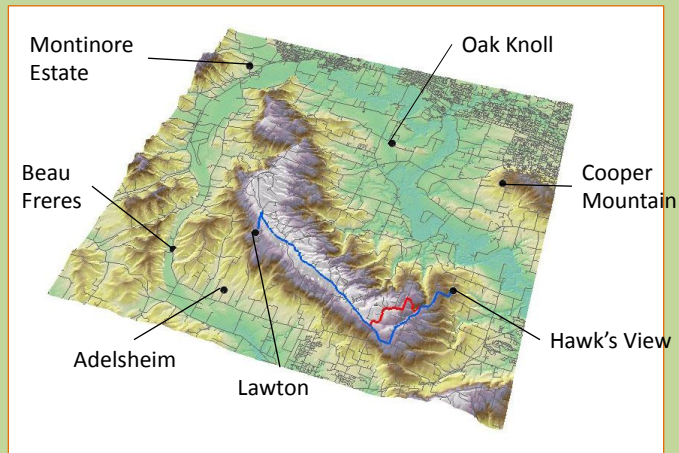
Adelsheim to Montinore

Finding routes for our wine tour



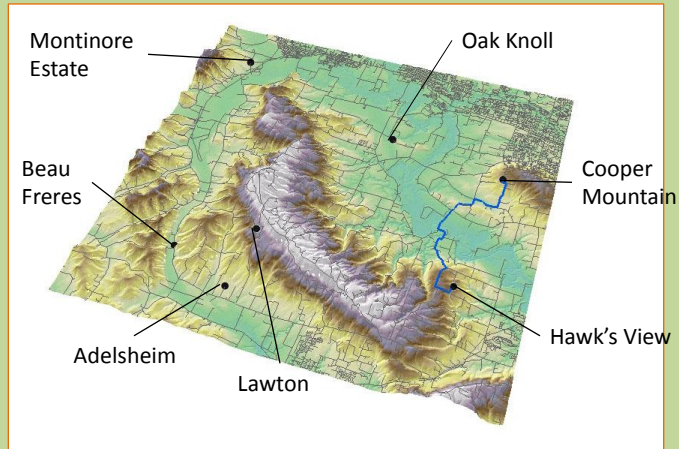
Montinore to Lawton

Finding routes for our wine tour



Lawton to Hawk's View

Finding routes for our wine tour



Hawk's View to Cooper Mountain

Improvements?

- 1) Larger, more varied study area
- 2) Calculate Wind resistance
- 3) Estimate actual gas mileage

References:

Honda website--<http://automobiles.honda.com/civic-sedan/specifications.aspx>

<http://www.winesofwoi.com/Images/chehalem.jpg>

<http://resources.arcgis.com/en/help/main/10.1/index.html#//00q90000006m000000>

Haliday and Resnick. 1974. *Fundamentals of Physics*. New York: Wiley.

"Alternative Impedances for Shortest Path Network Analysis for Cycling", Mike Martello, 2009 last accessed 11/05/12 (<http://www.gis-t.org/files/Uz8W2.pdf>)

<http://3.bp.blogspot.com/-I7CQdcmXLTc/Tzeox6sQY1I/AAAAAAAAADU/JRLgzHxXB14/s1600/people-drinking-wine-de.jpg>

<http://blogs.villagevoice.com/runninscared/drinking-red-wine.jpg>