

APPENDIX P: SUMMARY OF WEATHER CONDITIONS DURING THE FIELD MESAUREMENTS

Table P-1. Summary table of weather conditions at locations near each of the 2 proposed range sites during the field measurements.

Location	Time	Temperature (°F)	Barometric Pressure (inches of mercury)	Relative Humidity %	Wind Speed (mph)
MCRC	10:06 am	49	28.48	86	0
MCRC	10:40 am	52	28.48	78	0
MCRC	11:10 am	48	28.30	85	1 to 1.5
MCRC	11:40 am	49	28.50	86	0 to 0.9
Sands West	2:28 pm	55	28.57	72	1 to 1.9
Sands West	2:55 pm	53	28.50	75	2.2 to 3
Sands West	3:26 pm	54	28.60	74	1.6 to 2.8
Sands West	4:04 pm	55	28.61	70	2.6 to 3.1

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APPENDIX Q: LIST OF GPS LOCATIONS FOR THE MEASUREMENT LOCATIONS OF THE EXISTING AMBIENT SOUND LEVELS AND THE SOUNDS OF FIREARMS EXPERIMENTS

Table Q-1. List of GPS coordinates for the locations where measurements of the existing ambient sound levels and sounds of firearms were measured during the field studies.

Site	Receiver Location	North Coordinate	West Coordinate	Elevation
MCRC	A New	N46° 28.733'	W87° 27.933'	1248 ft
MCRC	B	N46° 28.345'	W87° 27.689'	NA
MCRC	C	N46° 28.453'	W87° 28.146'	NA
MCRC	D	N46° 28.533'	W87° 28.264'	NA
MCRC	E Alt	N46° 28.997'	W87° 28.316'	1332 ft
MCRC	F Alt	N46° 28.703'	W87° 27.342'	1251 ft
MCRC	G	N46° 28.175'	W87° 28.242'	NA
MCRC	I	N46° 29.388'	W87° 28.273'	NA
MCRC	J Alt	N46° 28.264'	W87° 26.383'	1182 ft
MCRC	K	N46° 27.761'	W87° 28.172'	NA
MCRC	N Landfill	N46° 30.071'	W87° 27.388'	1150 ft
MCRC	Arrowhead	N46° 28.080'	W87° 25.860'	1125 ft
MCRC	N Alt	N46° 27.961'	W87° 25.463'	1125 ft
MCRC	O	N46° 26.939'	W87° 28.144'	NA
MCRC	P	N46° 27.426'	W87° 29.764'	NA
MCRC	NW Alt	N46° 29.477'	W87° 29.999'	1286 ft
SANDS	A	N46° 23.816'	W87° 26.326'	NA
SANDS	B	N46° 23.781'	W87° 25.942'	NA
SANDS	C	N46° 23.448'	W87° 26.051'	NA
SANDS	D	N46° 23.681'	W87° 26.465'	NA
SANDS	E	N46° 24.015'	W87° 25.912'	NA
SANDS	F	N46° 23.651'	W87° 25.384'	NA
SANDS	G	N46° 23.192'	W87° 25.951'	NA
SANDS	H ALT	N46° 23.820'	W87° 26.645'	1186 ft
SANDS	I	N46° 24.443'	W87° 25.847'	NA
SANDS	J New	N46° 23.446'	W87° 24.895'	1212 ft
SANDS	K	N46° 22.723'	W87° 25.778'	NA
SANDS	L	N46° 23.828'	W87° 27.365'	NA
SANDS	M	N46° 25.169'	W87° 25.055'	NA
SANDS	N	N46° 23.446'	W87° 23.621'	NA
SANDS	2 MI	N46° 21.891'	W87° 25.925'	1142 ft
SANDS	P	N46° 23.453'	W87° 28.642'	NA

**APPENDIX R: CONCEPT COST ESTIMATES FOR VARIOUS NOISE MITIGATION
OPTIONS FOR THE RANGES**

CONCEPTUAL COST REPORT

Project: **Michigan Dept of Natural Resources - Firing Range**
Date: September 15, 2017
Scope of Work: Acoustical Mitigation Systems & Materials for a Shooting Range

#17-646

The following is a conceptual cost estimate for budgetary purposes for the installation of various options for acoustical mitigation at three shooting ranges in Michigan. The locations are Marquette (in the upper peninsula), Allegan (near Kalamazoo), and Lapeer (near Flint).

Please note that these costs are for comparison purposes only and do not represent a detailed cost estimate, as such these costs include a contingency to account for differences in interpretation of the actual scope of work. The costs below have been rounded to the nearest hundred dollars for the sake of simplicity.

Option #1a – Apply acoustic absorbing boards and wool insulation to the underside of the roof over the shooters.

Cost for Marquette = **\$55,400**
Cost for Allegan = **\$55,800**
Cost for Lapeer = **\$56,000**

This cost assumes that the roof structure is existing or provided by others, although the cost of providing the required blocking for installation of the boards is included. The area of the structure is assumed to be 20' deep x 200' long based on preliminary sketches of the range. The cost includes a waste factor for the installation of the boards and includes installing wool between the rafters above the boards.

Option #1b – Construct side walls separating each shooting lane.

Cost for Marquette = **\$29,900**
Cost for Allegan = **\$30,100**
Cost for Lapeer = **\$31,800**

This cost includes construction of wood framed walls with Troy acoustic absorbing boards over (2) layers of plywood sheathing on both sides, and the cavity filled with Troy acoustic wool. The walls are assumed to be 8' High x 6' Long. This cost assumes that a suitable floor and roof exists to brace the walls.

Option #1c – Construct a wall enclosing the rear of the range.

Cost for Marquette = **\$48,200**
Cost for Allegan = **\$48,600**
Cost for Lapeer = **\$51,300**

This cost includes construction of wood framed walls with Troy acoustic absorbing boards over (2) layers of plywood sheathing on the interior side, and fiber cement siding (HardiePlank or similar) over (1) layer plywood sheathing on the exterior, and the cavity filled with Troy acoustic wool. The wall is assumed to be 8' High x 200' Long. This cost assumes that a suitable floor and roof exists to brace the wall.

Option #1d – Construct a roof extension over the shooters with the acoustic absorbing boards and wool insulation applied to the underside.

Cost for Marquette = **\$307,100**
Cost for Allegan = **\$309,600**
Cost for Lapeer = **\$326,800**

This cost includes construction of a wood framed roof structure with a simple metal roof (this is not an architectural grade standing seam roof). The area of the structure is calculated as 40' deep x 200' long. The cost includes acoustical boards and wool as described above. No floor or walls are included in the cost.

Option #2a – Construct a 10' high berm on 3 sides of the range.

Cost for Marquette = **\$81,900**
Cost for Allegan = **\$82,600**
Cost for Lapeer = **\$87,200**

Option #2b – Construct a 20' high berm on 3 sides of the range.

Cost for Marquette = **\$315,800**
Cost for Allegan = **\$318,300**
Cost for Lapeer = **\$336,000**

Option #2c – Construct a 30' high berm on 3 sides of the range.

Cost for Marquette = **\$752,800**
Cost for Allegan = **\$758,800**
Cost for Lapeer = **\$801,000**

This cost for Options 2a, 2b, & 2c assumes a slope of 1/1.5 for the berms and lengths based on preliminary sketches of the range. This cost assumes all imported fill to build up the berm, if local soils (that is, within 500 feet of the range) are available, \$3 per cubic yard can be deducted from the cost indicated. It should also be noted that maintaining the same slope for the higher berms results in longer as well as higher berms and some cost can be reduced by allowing for a steeper slope as the berm increases in height. The maximum slope that can be achieved depends on the type of soils used in the berm and the 1/1.5 slope is a safe assumption at a conceptual stage.

Option #3a – Construct a 10' high berm on the 4th side of the range, for a fully enclosed range.

Cost for Marquette = **\$32,600**
Cost for Allegan = **\$32,900**
Cost for Lapeer = **\$34,700**

Option #3b – Construct a 20' high berm on the 4th side of the range, for a fully enclosed range.

Cost for Marquette = **\$113,000**
Cost for Allegan = **\$113,900**
Cost for Lapeer = **\$120,300**

Option #3c – Construct a 30' high berm on the 4th side of the range, for a fully enclosed range.

Cost for Marquette = **\$489,200**

Cost for Allegan = **\$493,100**

Cost for Lapeer = **\$520,500**

This cost for Options 3a, 3b, & 3c includes the same assumptions and qualifications as indicated for Option 2a, b, c. The configuration of this berm allowed for the passage of people between the berms at the entrance end of the range with an overlap of the berms as indicated in the conceptual sketches.

Attached are the following backup documents: a spreadsheet with a more detailed breakdown of costs, sketches used in calculating quantities of materials.

Please do not hesitate to call if you have any questions or need a clarification on anything in this report.

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Conceptual Cost Estimate **#17-646**

Project: Michigan Dept of Natural Resources - Firing Range
Description of Work: Acoustical Mitigation Systems & Materials for a Shooting Range September 15, 2017

ITEM	QTY	UNIT	U/L	LABOR	U/M	MATERIAL	Burden + OHP	TOTAL
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Apply Acoustic Treatment to Underside of Roof

Troy Boards Installed @ Ceiling of Range Roof	4,400	SF	1.18	\$ 5,211.80	8.19	\$ 36,052.72	\$ 9,322.88	\$ 50,587.40
Additional Wood Blocking	1,680	LF	1.31	\$ 2,200.80	0.41	\$ 688.80	\$ 1,611.15	\$ 4,500.75
Screws, Nails, & Connectors	1	LS	74.13	\$ 74.13	183.71	\$ 183.71	\$ 79.95	\$ 337.78

Note: Structure by others. Assumed 20' x 200' roof area over shooters + waste factor. Includes wool insulation between rafters.

TOTAL COST CALCULATED FOR MARQUETTE = \$ 55,425.94
TOTAL COST ADJUSTED FOR ALLEGAN = \$ 55,869.34
TOTAL COST ADJUSTED FOR LAPEER = \$ 58,973.20

Add Side Walls Between Shooters w/ Acoustic Treatment

2x4 Wood Framed Side Walls	1,232	LF	1.53	\$ 1,882.08	1.51	\$ 1,861.72	\$ 1,581.45	\$ 5,325.25
3/4" CDX Plywood Sheathing	4,224	SF	0.76	\$ 3,206.02	1.11	\$ 4,671.76	\$ 2,933.98	\$ 10,811.76
Connectors, Hangers, Nails, Etc.	1	LS	508.81	\$ 508.81	653.35	\$ 653.35	\$ 451.54	\$ 1,613.70
Troy Boards & Wool Fill	1,056	SF	1.18	\$ 1,250.83	8.19	\$ 8,652.65	\$ 2,237.49	\$ 12,140.98

Note: Assumed 8'H x 6'W walls, (2) layers of plywood w/ (1) layer Troy Board

TOTAL COST CALCULATED FOR MARQUETTE = \$ 29,891.69
TOTAL COST ADJUSTED FOR ALLEGAN = \$ 30,130.82
TOTAL COST ADJUSTED FOR LAPEER = \$ 31,804.76

Add Wall Enclosing Rear of Range w/ Acoustic Treatment (1 side) & Siding (other side)

2x4 Wood Framed Side Walls	1,232	LF	1.53	\$ 1,882.08	1.51	\$ 1,861.72	\$ 1,581.45	\$ 5,325.25
3/4" CDX Plywood Sheathing	4,800	SF	0.76	\$ 3,643.20	1.11	\$ 5,308.82	\$ 3,334.07	\$ 12,286.09
30# Asphalt Felt	1,600	SF	0.18	\$ 285.60	0.33	\$ 526.61	\$ 279.04	\$ 1,091.24
Cement Fiber Siding	1,600	SF	2.13	\$ 3,404.00	1.96	\$ 3,140.14	\$ 2,823.95	\$ 9,368.10
Connectors, Hangers, Nails, Etc.	1	LS	552.53	\$ 552.53	717.05	\$ 717.05	\$ 491.55	\$ 1,761.13
Troy Boards & Wool Fill	1,600	SF	1.18	\$ 1,895.20	8.19	\$ 13,110.08	\$ 3,390.14	\$ 18,395.42

Note: Assumed 8'H x 200'W wall, (2) layers plywood w/ Troy Board one side, (1) layer plywood w/ siding over felt other side

TOTAL COST CALCULATED FOR MARQUETTE = \$ 48,227.23
TOTAL COST ADJUSTED FOR ALLEGAN = \$ 48,613.05
TOTAL COST ADJUSTED FOR LAPEER = \$ 51,313.78

Conceptual Cost Estimate

#17-646

Project:

Michigan Dept of Natural Resources - Firing Range

Description of Work:

Acoustical Mitigation Systems & Materials for a Shooting Range

September 15, 2017

ITEM	QTY	UNIT	U/L	LABOR	U/M	MATERIAL	Burden + OHP	TOTAL
Extended Roof Structure w/ Acoustic Treatment								
6x6 x 12'L - PT Posts	30	Ea	47.52	\$ 1,425.60	69.30	\$ 2,079.00	\$ 1,304.90	\$ 4,809.50
Concrete Footings (w/ excavation)	5	CY	196.50	\$ 884.25	231.08	\$ 1,039.86	\$ 769.44	\$ 2,693.55
2x12 Wood Beams	800	LF	2.01	\$ 1,610.00	1.70	\$ 1,356.80	\$ 1,315.11	\$ 4,281.91
2x8 Wood Rafters	4,200	LF	1.51	\$ 6,327.30	1.40	\$ 5,876.64	\$ 5,255.48	\$ 17,459.42
2x2 Wood Blocking	3,600	LF	1.51	\$ 5,423.40	0.41	\$ 1,476.00	\$ 3,934.92	\$ 10,834.32
Connectors, Hangers, Nails, Etc.	1	LS	1,567.06	\$ 1,567.06	1,774.25	\$ 1,774.25	\$ 1,352.61	\$ 4,693.91
3/4" CDX Plywood Sheathing	8,000	SF	0.76	\$ 6,072.00	1.11	\$ 8,848.03	\$ 5,556.79	\$ 20,476.82
Metal Roof over Membrane	8,000	SF	4.59	\$ 36,720.00	5.26	\$ 42,060.80	\$ 31,772.77	\$ 110,553.57
Flashing	480	LF	1.90	\$ 913.92	1.25	\$ 597.84	\$ 718.95	\$ 2,230.71
Troy Boards Installed @ Ceiling of Range Roof	8,800	SF	1.18	\$ 10,423.60	8.19	\$ 72,105.44	\$ 18,645.77	\$ 101,174.81
Contingency @ 10%	1	LS						\$ 27,920.85

Note: Includes structure. Assumed 40' x 200' extended roof area.

TOTAL COST CALCULATED FOR MARQUETTE = \$ 307,129.36

TOTAL COST ADJUSTED FOR ALLEGAN = \$ 309,586.39

TOTAL COST ADJUSTED FOR LAPEER = \$ 326,785.64

ITEM	QTY	UNIT	UNIT COST	Marquette	Allegan	Lapeer
10' High Berms						
3 sides of range	7,670	CY	\$10.68	\$ 81,937.36	\$ 82,592.86	\$ 87,181.36
4th side of range	3,056	CY	\$10.68	\$ 32,642.52	\$ 32,903.66	\$ 34,731.64
20' High Berms						
3 sides of range	34,147	CY	\$9.25	\$ 315,770.66	\$ 318,296.83	\$ 335,979.99
4th side of range	12,222	CY	\$9.25	\$ 113,023.44	\$ 113,927.63	\$ 120,256.94
30' High Berms						
3 sides of range	84,630	CY	\$8.89	\$ 752,751.81	\$ 758,773.82	\$ 800,927.92
4th side of range	55,000	CY	\$8.89	\$ 489,203.74	\$ 493,117.37	\$ 520,512.78





