



Gale Associates, Inc.

6 Bedford Farms Drive, Suite 101 | Bedford, NH 03110

P 603.471.1887 F 603.471.1809

www.galeassociates.com

April 7, 2023
(Rev. 04/19/23)

Sanbornton Highway Department
Sanbornton Town Office
17 Meetinghouse Hill Road
Sanbornton, New Hampshire 03269

Attn: Mr. Johnny Van Tassell, Highway Department Director
E: highway@sanborntonnh.org

Re: Dr. True Road – Gravel Roadway Evaluation Study
Sanbornton, NH
Gale 719100

Dear Mr. Van Tassell:

Gale Associates, Inc. (Gale) is pleased to present this study to the Town of Sanbornton (Town) for the surface gravel evaluation along Dr. True Road in Sanbornton, NH.

INTRODUCTION

The Town of Sanbornton (Town) currently maintains approximately 68 miles of Class V roads with nearly fifty percent (50%) of the road network consisting of an unpaved surface. Annually, during the “spring thaw”, the gravel surface material of the Town’s unpaved roadway network becomes saturated making the unpaved network impassable for days to weeks at a time. The impassable condition of the unpaved network not only impacts the livelihood of the residents but is also a significant safety concern for emergency vehicles. In step with the spring thaw, the Town’s Highway Department invests labor, equipment, and material resources to stabilize the unpaved network.

Dr. True Road is an approximately 3,400 linear-foot long unpaved roadway located along the east side of Town, off Lower Bay Road, and adjacent to Lake Winnisquam; please see Figure 1. Based on the Town’s tax map, Dr. True Road services 70 residential parcels along the roadway and Maple Circle located at the end of Dr. True Road. In-line with other unpaved roadways within the Town, Dr. True Road is annually susceptible to moisture conditions associated with spring thaw. Residents, emergency vehicles, and the Highway Department have endured saturated gravel surface, compressible roadway materials, and surface rutting. Similar to other unpaved roadways within the Town, the Highway Department has attempted to stabilize the gravel surface with the placement of clean 3/4-inch crushed stone over the roadway surface. According to the Highway Department, while the corrective measure does stabilize the unpaved surface, the longevity of the improvement has not met expectations.

SINCE 1964

Connecticut | Florida | Maine | Maryland | Massachusetts | New Hampshire | Virginia

In March 2023, the Sanbornton Highway Department contracted Gale Associates, Inc. (Gale) to evaluate the existing conditions, provide a summary of findings, and propose opinions for the Town's consideration to improve the stability of Dr. True Road. Gale conducted a general project site review, performed a gradation analysis of collected roadway soil samples, completed a brief average daily traffic (ADT) traffic analysis, assessed roadway improvement alternatives, and prepared an Engineer's Opinion of Probable Construction Costs (EOPCC) of the preferred alternative. This letter summarizes Gale's existing conditions evaluations, design alternative findings, and opinions.



Figure 1 – Project Limits

SITE WALK EVALUATION

On March 22, 2023 Gale performed a site walk evaluation along Dr. True Road. The evaluation encompassed the assumed right-of-way width of 50 feet, centered along the roadway centerline, from the intersection of Lower Bay Road to the intersection of Maple Circle; approximate distance of 3,400 linear-feet. The evaluation was a visual evaluation of existing surface site conditions. The evaluation was performed during a spring thaw event to observe unpaved roadway conditions the Town typically experiences this time of year. A field report was prepared as part of the visual site walk evaluation which recorded existing conditions within the project limits and contained sample site photographs. A copy of the field report has been included herein.



Based on the visual site walk evaluation, the gravel roadway surface of Dr. True Road generally appears to be susceptible to snow melt and precipitation. At the time of the site visit, Gale observed the unpaved roadway surface to be saturated and unstable with evidence of surface pumping under loading and unloading conditions from passing vehicles. While there was little evidence of surface rutting at the time of the site visit, a resident of Dr. True Road shared photographs documenting surface conditions during previous spring thaw events; photographs shared by the resident have been included in the field report attached herein this study.

The drainage infrastructure along Dr. True Road is either well-defined or not apparent. From the intersection of Lower Bay Road to the 6-foot wide by 4-foot high pre-cast concrete box culvert at station 10+45 (1,045 feet from Lower Bay Road intersection), Dr. True Road consists of a well-defined drainage swale located along the right side of the roadway. The drainage swale not only collects stormwater runoff from the gravel roadway, but intercepts stormwater runoff from higher-elevated upland areas. The drainage swale is lined with riprap stone material and contains stone check dams that are intended to reduce runoff velocity and settle out sedimentation suspended within the stormwater. The drainage swales ultimately discharge into woodland areas through one of the two 12-inch corrugated smooth-interior High-density Polyethylene (HDPE) roadway cross-culverts, at stations 4+18 or 7+60, or into a plunge pool that ultimately discharges to the stream crossing at station 10+45. While the left side of the roadway does not appear to consist of a well-defined drainage swale, the roadway's side-slope embankment allows runoff to sheet flow off the roadway surface and discharge into a woodland area.

At the Town Beach (station 17+11), there is a closed drainage system consisting of two (2) catch basins, connecting drainage pipes, and a riprap outlet apron. It appears the closed-drainage system collects stormwater runoff within the vicinity of the Town Beach parking lot and does not contribute to the overall stormwater management of Dr. True Road.

From the 6' x 4' pre-cast concrete box culvert at station 10+45 to the Town Beach at station 17+11, there does not appear to be evidence of drainage infrastructure. Throughout this portion of Dr. True Road, the roadway is lower in elevation in comparison to the abutting site conditions. The lower roadway elevation confines snow melt and precipitation to the unpaved roadway surface; thus, saturating the gravel roadway surface and destabilizing the roadway base and subbase materials. Ultimately, stormwater runoff confined to the limits of the roadway is conveyed, by gravity down the roadway profile, to either the Town Beach or to the 6' x 4' pre-cast concrete box culvert stream crossing.

Last, from the Town Beach to the intersection of Maple Circle there is no apparent evidence of drainage infrastructure. While the roadway's left side-slope embankment allows runoff to sheet flow off the roadway surface, the roadway as a whole is lower in elevation in comparison to the right-side abutting site conditions. Similarly to other portions of Dr. True Road, it appears the lack of drainage infrastructure contributes to the saturation of the unpaved roadway surface.



GRADATION ANALYSIS

Seven (7) test pits were performed and soils samples collected within the roadway limits of Dr. True Road at the locations and depths listed below.

- Station 8+50, 17+00, and 25+50: samples obtained from zero to 6-inches below existing finish grade. Test pits were labeled as TP #1, TP #4, and TP #7; respectively.
- Station 11+50 and 23+00: samples obtained from 6 to 12-inches below existing finish grade. Test pits were labeled as TP #2 and TP #5.
- Station 11+50 and 23+00: samples obtained from 12 to 24-inches below existing finish grade. Test pits were labeled as TP #3 and TP #6.

A gradation analysis in comparison to the New Hampshire Department of Transportation (NHDOT) Section 304.3 – Crushed Gravel specification as defined within Table 304-1 of the Standard Specifications for Road and Bridge Construction (dated March 2016) was performed by R.W. Gillespie & Associates, Inc. on March 28, 2023. The purpose of the gradation analysis is to understand the composition of the unpaved surface course (zero to 6-inch depth), base course (6 to 12-inch depth) and subbase course (12 to 24-inch depth) materials. The NHDOT Section 304.4 specification, highlighted in yellow, is as follows:

Table 304-1 - Base Course Materials Required Gradation

Item No.	304.1	304.2	304.3	304.32	304.33	304.4	304.5	304.6
Item	Sand	Gravel	Crushed Gravel	Crushed Gravel for Shoulder Leveling	Crushed Aggregate for Shoulders	Crushed Stone (Fine)	Crushed Stone (Coarse)	Crushed Stone (Very Coarse)
Sieve Size	Percent Passing By Weight							
6"	100	100	---	---	---	---	---	100
5"	---	---	---	---	---	---	---	---
4"	---	---	---	---	---	---	---	---
3 1/2"	---	---	---	---	---	---	100	---
3"	---	---	100	---	---	---	85 – 100	60-90
2 1/2"	---	---	---	---	---	---	---	---
2"	---	---	95 – 100	---	---	100	---	---
1 1/2"	---	---	---	100	100	85 – 100	60 – 90	45-75
1"	---	---	55 – 85	90-100	90 – 100	---	---	---
3/4"	---	---	---	---	---	45 – 75	40 – 70	35-65
1/2"	---	---	---	65-90	---	---	---	---
#4	70 – 100	25 – 70	27 – 52	30-55	30 – 65	10 – 45	15 – 40	15-40
# 200 (In Sand Portion)*	0 – 12	0 – 12	0 – 12	---	---	---	---	---
# 200 (In Total Sample)	---	---	---	0-10	0 – 10	0 – 5	0 – 5	0-5

* Fraction passing the # 4 sieve



The seven (7) gradation test results do not meet the NHDOT Section 304.3 specification. Copies of the sieve/gradation test results are included herein this letter.

The gradation analysis indicates the existing surface, base, and subbase roadway materials of Dr. True Road have a low content of aggregate (material larger than the No. 4 sieve), a high content of sand (material between the No. 4 and No. 200 sieves), and a high content of silt (material passing the No. 200 sieve). The issue with an unbalanced blend of aggregate and sand base materials is it can impact the roadway structure's ability to support vehicular loads. This issue can be corrected by the addition of specified size and quantity aggregate materials to the base course. The issue with high silt content is that it can retain a high moisture content. While moisture can help to bond/stabilize the aggregate and fines, too high of a moisture content can impact the structural stability of a roadway.

AVERAGE DAILY TRAFFIC (ADT) ANALYSIS

In the summer of 1992, the Link Kentucky Local Technical Assistance Program (LTAP) published a paper titled "When to Pave a Gravel Road", which studied the appropriateness to convert an unpaved roadway network into a paved network. The paper provided guidance for unpaved roadways that experience an Average Daily Traffic (ADT) count of less than 50 to remain as an unpaved surface. Unpaved roadways that experience an ADT count of greater than 200 should be converted to a paved surface. However, unpaved roadways that experience an ADT count between 50 to 200 should be further evaluated, which should include vehicular traffic loads/weight, past performance, and a cost comparison to a paved surface. Based on this study, the traffic industry have used this as a rule of thumb to identify which roads should be unpaved, paved, or further evaluated.

Gale utilized traffic data from the Institute of Transportation Engineers (ITE) [Trip Generation Manual, 11th Edition](#) for Land Use: 210 – Single-Family Detached Housing. Based on the ITE data, Gale calculated the Average Daily Traffic (ADT) count expected to be experienced along Dr. True Road, which included the residential parcels located along Maple Circle. According to the Town's 2022 Tax Map 10, 11, and 12, there are forty-nine (49) residential parcels along Dr. True Road and twenty-one (21) residential parcels along Maple Circle; totaling 70 residential parcels. The total parcel count did not include land owned by the Town. The calculated ADT count for Dr. True Road is 660.

IMPROVEMENT ALTERNATIVE ANALYSIS

Three (3) improvement alternatives were evaluated as part of this study. The proposed improvement alternatives are listed below which include a brief description, positive/negative attributes, and an Engineer's Opinion of Probable Construction Costs (EOPCC) for each alternative.

The EOPCC are based on the general description of improvement for each alternative and the cost is estimated by multiplying the quantity of materials for an assumed improvements by the anticipated construction unit costs and then adding a 15% construction contingency of the total construction cost. The anticipated construction unit rates were obtained from the NHDOT current weighted average for the past four quarters. A 15% contingency is added to cover any unexpected costs that could arise throughout a construction project and is not allocated to any specific area of work. Mobilization for the



proposed scope of work was not included in each EOPCC. Typically this cost is estimated to be 10% of the total construction cost and is identified in each improvement alternative as an “add to the total cost option”. EOPCC for each improvement alternative is included herein this letter.

Please note, Gale has no control over the cost or availability of labor, equipment or materials, market conditions or the contractor's methods of pricing. The EOPCC prepared for this study has been prepared based on Gale’s professional judgment and experience. Quantities established for preparing the probable construction costs are only an estimate and are assumed to become more accurate upon completion of the design; but can only be considered true upon completion of construction. Gale makes no warranty (expressed or implied) that bids or the negotiated costs of the work will not vary from the EOPCC provided herein.

Improvement Alternative No. 1: Reconstruction

Reconstruction is the process of excavating and disposing of the existing material and replacing with new material that meets design specifications. For this option, the reconstruction would generally consist of the following:

- Excavate 18-inches of existing roadway material from Lower Bay Road to Maple Circle.
- Install 6-inch underdrain along both the right and left side of roadway from the 6’ x 4’ concrete box culvert to the Town Beach, and along the right side of roadway from the Town Beach to Maple Circle.
- Install a medium strength, separation, monofilament, woven geotextile over the new excavated subgrade from Lower Bay Road to Maple Circle.
- Place and compact 18-inches of NHDOT 304.3 crushed gravel material.
- Add Option: 4-inches of pavement (2½-inches of binder and 1½-inches of wearing course).

Pro’s and Con’s for Alternative No. 1:

- + Reconstruction with well-draining material improves roadway stability.
- + Geotextile prevents the migration of the silty-sandy subgrade material into the newly placed well-draining crushed gravel roadway base course.
- + Installation of an underdrain system mitigates groundwater during seasonal high-groundwater.
- + Lower maintenance costs as compared to current maintenance plan.
- High capital cost.

EOPCC Alternative No. 1:

Gravel Surface Improvement Costs	\$ 470,000
Bituminous Concrete Surface (add option)	\$ 200,000
Mobilization (add to total cost options)	+ 10%



Improvement Alternative No. 2: Full-depth Reclamation (FDR)

Full-depth reclamation (FDR) is a roadway repair strategy process typically used for rehabilitating a paved roadway structure’s gravel base course. The FDR process consists of pulverizing the existing pavement course and blending with the existing gravel base course. This process improves the paved roadway structure’s gravel base course by changing the gradation properties. Chemical additives (i.e., cement, lime, fly ash, lignin-based biopolymers, foamed bitumen, combinations of, etc.) can be incorporated into the FDR process. The additives chemically modify the blended soil properties to improve workability, increase strength, enhance durability, and/or reduce plasticity. While this repair strategy is a more cost-effective solution in comparison to reconstruction, it is considered as a “betterment”.

While the FDR application for this would not include pulverizing existing pavement surface, it would consist of blending imported clean crushed gravel material and/or add chemical additives into the existing gravel structure. For this option, the FDR improvement would generally consist of the following:

- Blend clean crushed gravel the full width of the roadway from Lower Bay Road to Maple Circle.
- Add Option: 4-inches of pavement (2½-inches of binder and 1½-inches of wearing course)

Pro’s and Con’s for Alternative No. 2:

- + Cost-effective solution in comparison to reconstruction.
- + Lower maintenance costs as compared to current maintenance plan.
- Raised roadway profile.

EOPCC for Alternative No. 2:

Gravel Surface Improvement Costs	\$ 235,000*
Bituminous Concrete Surface (add option)	\$ 200,000
Mobilization (add to total cost options)	+ 10%

***Note:** Additional analysis would be required to determine the appropriate quantity of additional crushed gravel material and/or chemical additive.

Improvement Alternative No. 3: Do Nothing

Do Nothing is an option where the Town maintains the roadway infrastructure as is. No roadway and/or drainage improvements are proposed.

Pro’s and Con’s for Alternative No. 3:

- + Low capital cost.
- High annual maintenance cost.
- Continued potential unpassable roadway condition.
- Continued impact to residents and emergency vehicles.

EOPCC Alternative No. 3:

No Improvement Costs	\$ 0
----------------------------	------



DRAINAGE IMPROVEMENT ANALYSIS

A secondary concern of the Town was the reduction of sedimentation of Dr. True Road into Lake Winnisquam. As recorded during the site walk evaluation, a well-defined drainage swale is located along the right side of Dr. True Road from Lower Bay Road to the 6'x4' pre-cast concrete box culvert. This swale is stabilized with riprap and consists of stone check dams; which are intended to reduce runoff velocity and settle out sedimentation suspended within the stormwater. At two (2) locations, the well-defined drainage convey the stormwater runoff through a cross-culvert and discharges to a woodland area; which is expected to further reduce runoff velocity and settle out sedimentation suspended within the stormwater. At the down-gradient end of the well-defined drainage swale, the collected stormwater runoff discharges into a riprap plunge/sediment pool prior to being discharged to the adjacent stream being conveyed through the 6'x4' concrete box culvert. The left side of the roadway does not appear to consist of a well-defined drainage swale, the roadway's side-slope embankment allows runoff to sheet flow off the roadway surface and discharge into a woodland area; which is expected to reduce runoff velocity and settle out sedimentation suspended within the stormwater. It is the opinion of this study that the roadway drainage infrastructure from Lower Bay Road to the 6'x4' concrete box culvert is satisfactory. With that stated, it is this study's opinion to up-size the existing 12-inch corrugated smooth-interior High-density Polyethylene (HDPE) roadway cross-culverts to an 18-inch HDPE culvert to mitigate potential clogging of debris. The upsizing of these culverts would be allowed under the criteria of the New Hampshire Department of Environmental Services (NHDES) Wetlands Routine Roadway Maintenance Activity Registrations (RRMARs) permit.

From the 6'x4' concrete box culvert to Maple Circle, there was no apparent drainage infrastructure along either side of the roadway. While it is the opinion of this study to maintain existing conditions along the left side of the roadway, improvements should be made along the right side of the roadway. Similar to the first 1,000 feet of Dr. True Road, maintaining the roadway's left side-slope embankment to sheet flow off the roadway surface and discharge into a woodland area will continue to utilize the woodland as a buffer to reduce runoff velocity and settle out sedimentation suspended within the stormwater prior to ultimately discharging into Lake Winnisquam. A drainage swale along the right side of the roadway should be constructed to not only intercept upland runoff from flowing onto the roadway, but also treat the collected runoff from the roadway prior to ultimately discharging into Lake Winnisquam.

Last, it is the opinion of this study the existing gravel surface roadway be converted to a paved surface to reduce the volume of sedimentation from the gravel surface being conveyed to Lake Winnisquam.

For this add option, the drainage improvement would generally consist of the following:

- Maintain the existing drainage swale along the right side of the roadway from Lower Bay Road to the 6' x 4' concrete box culvert to Maple Circle.
- Construct a drainage swale along the left and right side of the roadway from the 6' x 4' concrete box culvert to the Town Beach.
- Construct a drainage swale along the right side of the roadway from the Town Beach to Maple Circle.
- Upsize the existing 12-inch cross-culverts at stations 4+18 and 7+60 to 24-inch culverts.



- Install riprap sedimentation pools at 500-foot intervals along the roadway at 500-foot intervals.
- Install 24-inch cross-culverts down-stream of the sedimentation pools (at 500-foot intervals).

EOPCC Drainage Add Option:

No Improvement Costs \$ 225,000

OPINION OF PREFERRED ALTERNATIVE

Dr. True Road is a Class V gravel surface roadway located off Lower Bay Road that is approximately 3,400 linear-feet and services approximately 70 residential parcels; including Maple Circle. The residents, emergency vehicles, Town’s Highway Department, and the Town’s Board of Selectmen have endured the annual spring thaw and associated impacts on the stability of Dr. True Road’s roadway structure. While the Town has attempted to improve the stability of the roadway structure, the results have not met the expectations of the community.

Based on the information collected and reviewed, it is Gale’s opinion the Town strongly consider the **reconstruction** improvement alternative with the add option of converting the existing gravel surface into a **paved surface**. While we understand cost is a considerable factor in the Town’s decision, it is our opinion the long-term benefits and expected cost savings of not investing annual resources to stabilize the roadway will provide a return on the Town’s investment.

Phasing

This study’s opinion of preferred alternative is to reconstruct the existing roadway structure, convert the gravel surface to a paved surface, and construct/install drainage improvements. The anticipated cost for this preferred alternative is \$962,000 (\$470,000 + \$200,000 + 10% Mobilization [\$67,000] + \$225,000). This study understand New Hampshire communities, like Sanbornton, have budget constraints. It is the opinion of this study the Town could consider **phasing** the project to meet budget constraints. If the Town decides to phase the project, this study suggest the following phases:

1. Year 1: Reconstruct Dr. True Road from Lower Bay Road to the 6’x4’ concrete box culvert and place/compact the binder course pavement. During this phase of the project, the Town should upgrade the existing 12-inch cross culverts, headwalls, and outlet protection riprap aprons.
2. Year 2: Reconstruct Dr. True Road from the 6’x4’ concrete box culvert to Maple Circle and place/compact the binder course pavement. During this phase of the project, the Town should construct the drainage infrastructure.
3. Year 3: Place/compact the wearing course pavement from Lower Bay Road to Maple Circle and place the gravel shoulder leveling material.

Mr. Johnny Van Tassell, Highway Department Director
Town of Sanbornton
Re: Dr. True Road – Gravel Roadway Evaluation Study
April 7, 2023 (Rev. 04/19/23)
Page 10



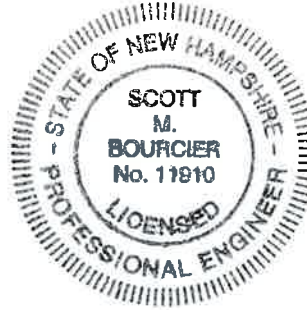
We hope you find this information helpful. Please do not hesitate to contact me if you have any questions or require additional information.

Thank you for this opportunity to be of service to the Sanbornton community.

Best regards,
GALE ASSOCIATES, Inc.

A handwritten signature in blue ink that reads "Scott M. Bourcier". The signature is fluid and cursive, with the first and last names being the most prominent.

Scott M. Bourcier, P.E.
Project Manager



SMB/gmt

Enclosures:

- Field Report, dated 03/22/2023
- Gradation Analysis TP-1 through TP-7, dated 03/28/2023:
- ITE Land Use: 210 – Single-Family Detached Housing ADT Calculation worksheet
- EOPCC – Reconstruction Gravel Surface, dated 03/30/2023
- EOPCC – FDR Gravel Surface, dated 03/30/2023
- EOPCC – Bituminous Concrete Surface add option, dated 03/30/2023
- EOPCC – Drainage Infrastructure add option, dated 03/30/2023



6 Bedford Farms Drive, Suite 101 | Bedford, NH 03110
 P | 603.471.1887 F | 603.471.1809
 www.galeassociates.com

FIELD OBSERVATION REPORT

PROJECT:	Dr. True Road
PROJECT No.:	719100
DATE:	March 22, 2023
CONTRACTOR:	None
LOCATION:	Sanbornton, NH
FIELD ENGINEER:	Scott Bourcier

TEMPERATURE:

35 °F at 8:05 a.m.
 °F at p.m.

SKY:

- CLEAR
- OVERCAST
- PRT CLOUDY
- CLOUDY
- OTHER: _____

PRECIPITATION:

- MISTY
- DRIZZLE
- SPRINKLE
- RAIN
- SNOW
- OTHER: _____

EQUIPMENT ON-SITE:

(1) Caterpillar 420E Backhoe

PRESENT AT SITE:

Scott Bourcier (Gale Associates)

OBSERVATIONS:

1. Arrived at approximately 8:05am.
2. Test pits were performed at the following locations:
 - a. Sta 8+50, 17+00, and 25+50: samples obtained from zero to 6-inches below existing finish grade. Test pits were labeled as TP #1, TP #4, and TP #7; respectively.
 - b. Sta 11+50, 23+00: samples obtained from 6 to 12-inches below and 12 to 24-inches below existing finish grade. Test pits were labeled as TP #2 and TP #3 (Sta. 11+50), and TP #5 and TP #6 (Sta. 23+00).
3. During the excavation of the test pits, resident Jeffrey Caira of 89 Dr. True Road inquired about the activities being conducted. I reported test pits were being performed, noted roadway material samples were being collected for analysis, and explained the Town’s goals. Jeff showed existing roadway conditions he has recorded, and (per my request) shared the photographs; see Figures 5 through 8. The date and location of the photographs are unknown.
4. Upon completion of the test pits, Johnny Van Tassle (Sanbornton Highway Department Director) and I discussed the challenges his Department have experienced maintaining the stability of Dr. True Road. Johnny reported that his crew, almost annually, place and compact approximately 2-inches of clean 3/4-inch gravel over the existing gravel surface of the roadway. Johnny noted that while the additional gravel material has helped to improve the stability of the gravel surface, the longevity was short lived. Johnny added, the additional gravel material appears to be “absorbed” by the existing gravel roadway; thus, ultimately showing no evidence additional material was ever placed.
5. The following brief existing conditions inventory was performed.
 - a. Sta. 0+00: Intersection of Dr. True Road and Lower Bay Road, aerial utility located on right side (utility crosses both sides of roadway), drainage swale along on right side only.

- b. Sta. 4+18: Drainage swale located on right side only, 12-inch HDPE cross-culvert with inlet headwall.
 - c. Sta. 7+60: Drainage swale located on right side only, 12-inch HDPE cross-culvert with inlet headwall.
 - d. Sta. 10+45: Drainage swale located on right side only, 6' wide by 4' high pre-cast concrete box culvert, no drainage swale (either side) past box culvert.
 - e. Sta. 17+11: Town Beach, closed drainage infrastructure consisting of two (2) catch basin structures and associated pipe, no drainage swale.
 - f. Sta. 21+05: No drainage swale, 10' wide by 6' high pre-cast concrete box culvert.
 - g. Sta. 34+20: Intersection of Dr. True Road and Maple Circle no drainage swale.
6. The following evaluation was performed.
- a. Gravel roadway: From approximate Sta. 0+00 to 4+00 the surface appeared to be saturated with evidence of approximate 2 to 3-inch deep rutting. The remaining length of roadway appeared to be compressible and saturated, with no evidence of rutting.
 - b. Site drainage: From the intersection of Lower Bay Road to the first pre-cast concrete box culvert (Sta. 10+45), a well-defined drainage swale is located along the right side of the road (no evidence of a drainage swale along the left side of the road). Sta. 4+18 and 7+60 cross-culverts appeared to be clean and in satisfactory condition. From approximate Sta. 10+45 to the intersection of Maple Circle, there is no evidence of drainage infrastructure along both sides of the roadway. Within the area of Dr. True Road, grade generally slope from the higher elevation of Lower Bay Road to the lower elevation of Lake Winnisquam.
 - c. Erosion control: With the exception of sedimentation being conveyed due to the gravel roadway, the approximate right-of-way limits appear to be in stable condition.
7. Departed at approximately 11:40am.

PROJECT PHOTOGRAPHS:



Figure 1 – Sta. 0+00 gravel roadway surface condition.



Figure 2 – Sta. 5+40 gravel roadway surface condition.

PROJECT PHOTOGRAPHS (continued):



Figure 3 – Sta. 21+05 gravel roadway surface condition.



Figure 4 – Sta. 30+60 gravel roadway surface condition.



Figure 5 – Photograph shared by Jeffrey Caira, unknown location and date.



Figure 6 – Photograph shared by Jeffrey Caira, unknown location and date.

PROJECT PHOTOGRAPHS (continued):



Figure 7 – Photograph shared by Jeffrey Caira, unknown location and date.

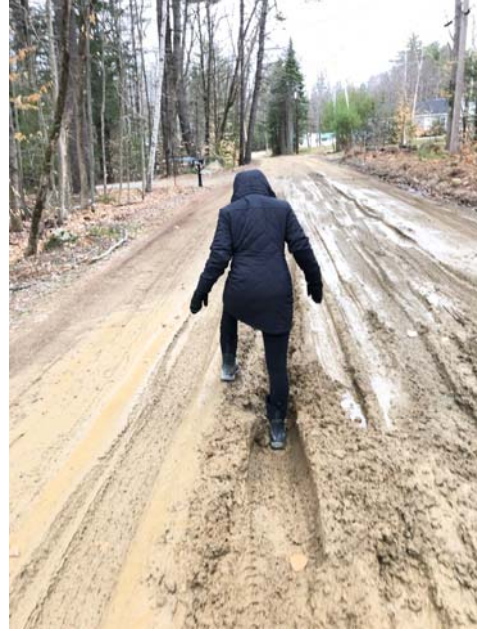
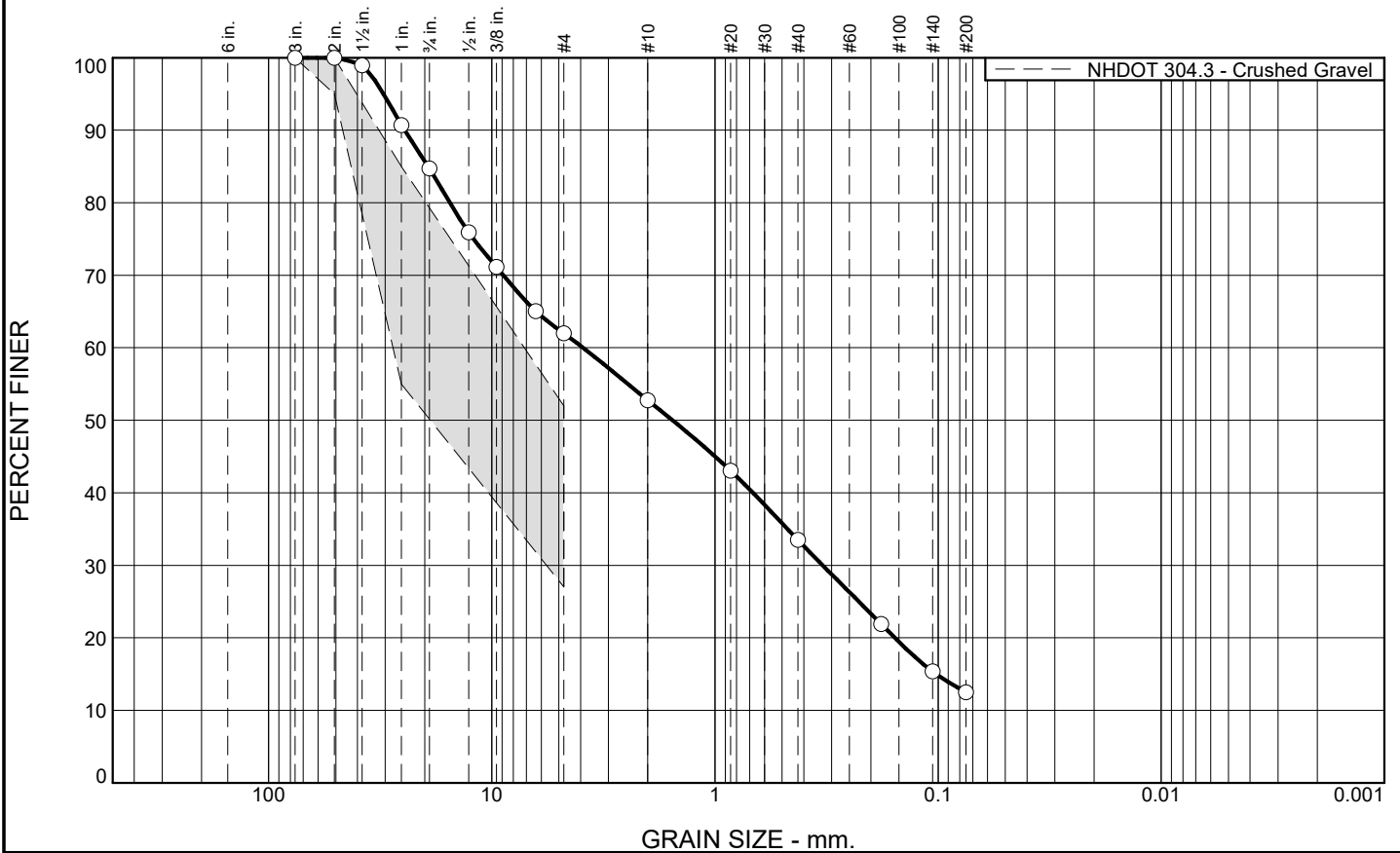


Figure 8 – Photograph shared by Jeffrey Caira, unknown location and date.

END OF REPORT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	15.3	22.7	9.2	19.3	21.0	12.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0	100.0	
2"	100.0	95.0 - 100.0	
1 1/2"	98.9		
1"	90.7	55.0 - 85.0	X
3/4"	84.7		
1/2"	75.9		
3/8"	71.1		
1/4"	65.0		
#4	62.0	27.0 - 52.0	X
#10	52.8		
#20	43.0		
#40	33.5		
#80	21.9		
#140	15.4		
#200	12.5		

Soil Description
silty sand with gravel

Atterberg Limits
 PL= LL= PI=

Coefficients
 D₉₀= 24.5835 D₈₅= 19.2953 D₆₀= 3.9029
 D₅₀= 1.5502 D₃₀= 0.3291 D₁₅= 0.1021
 D₁₀= C_u= C_c=

Classification
 USCS= SM AASHTO= A-1-b

Remarks
 Natural Moisture Content: 6.3%
 20.2% passing the #200 sieve based on the portion the #4 sieve.
 Specification requires 0-12%.

* NHDOT 304.3 - Crushed Gravel

Location: TP-1
 Sample Number: Bulk

Date: 03/28/2023

R.W. Gillespie & Associates, Inc. Biddeford, Maine	Client: Gale Associates, Inc. Project: Doctor True Road Sanborton, NH Project No: 0851-059 Lab No. 17446-01
---	---

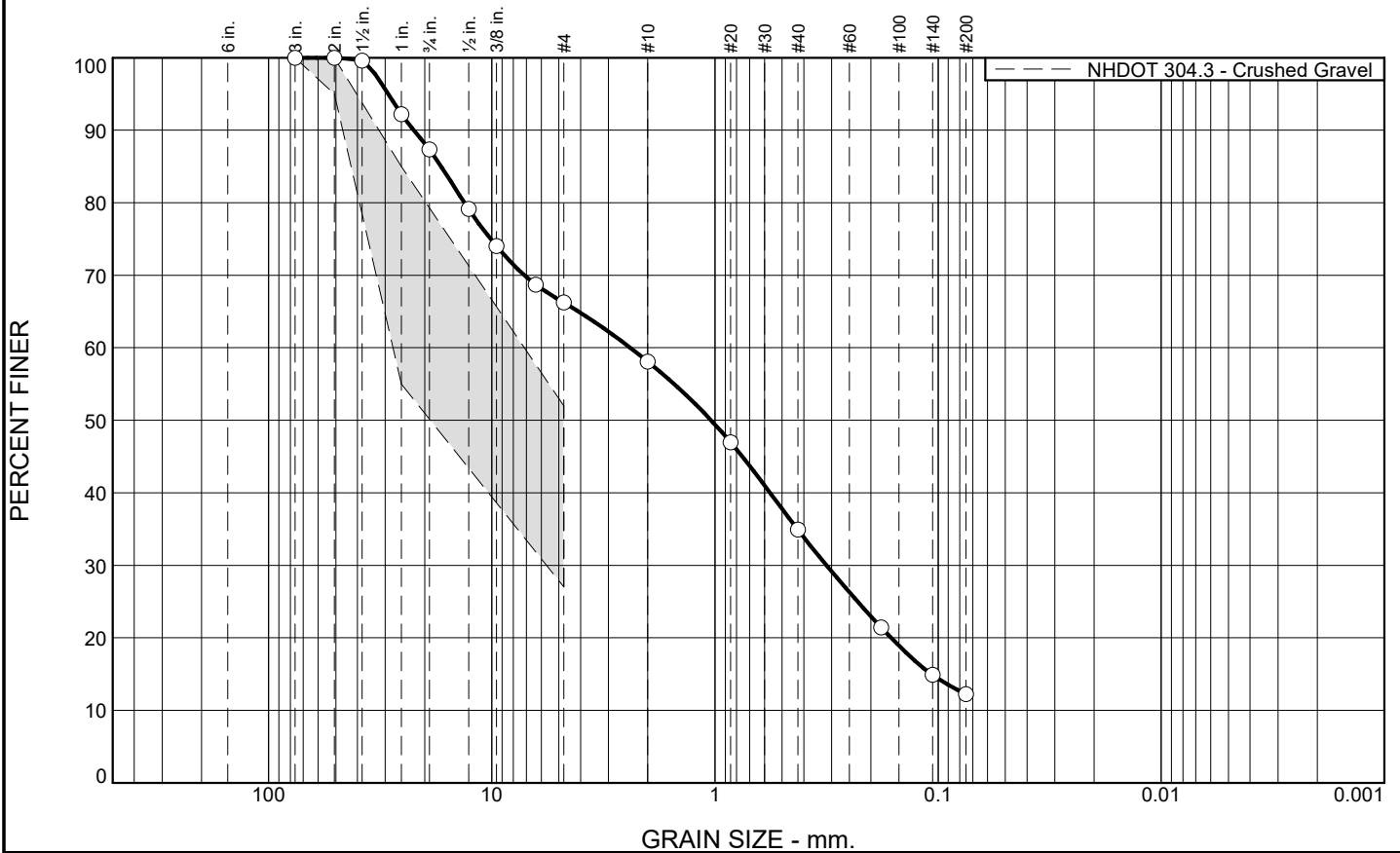
Tested By: MES/AGS

Checked By: MTG

MTG

This page intentionally left blank

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.7	21.1	8.1	23.2	22.7	12.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0	100.0	
2"	100.0	95.0 - 100.0	
1 1/2"	99.6		
1"	92.2	55.0 - 85.0	X
3/4"	87.3		
1/2"	79.1		
3/8"	74.0		
1/4"	68.7		
#4	66.2	27.0 - 52.0	X
#10	58.1		
#20	46.9		
#40	34.9		
#80	21.5		
#140	14.9		
#200	12.2		

Soil Description

silty sand with gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 22.3787 D₈₅= 16.8612 D₆₀= 2.3950
D₅₀= 1.0405 D₃₀= 0.3166 D₁₅= 0.1073
D₁₀= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 7.1%

18.5% passing the #200 sieve based on the portion the #4 sieve.

Specification requires 0-12%.

* NHDOT 304.3 - Crushed Gravel

Location: TP-2
Sample Number: Bulk

Date: 03/28/2023

R.W. Gillespie & Associates, Inc. Biddeford, Maine	Client: Gale Associates, Inc. Project: Doctor True Road Sanborton, NH Project No: 0851-059
Lab No. 17446-02	

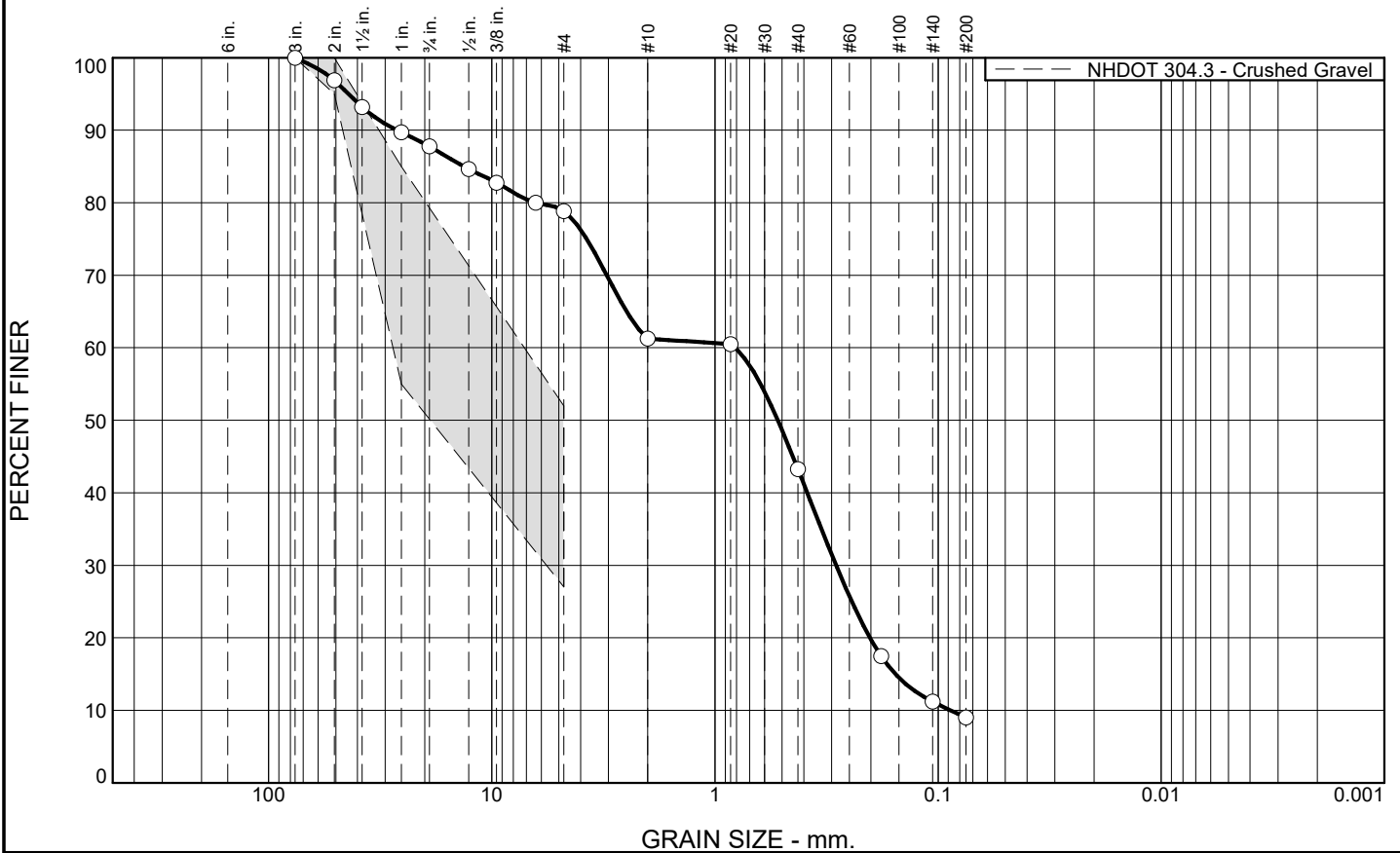
Tested By: MAS/AGS

Checked By: MTG

MTG

This page intentionally left blank

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.2	9.0	17.5	18.0	34.3	9.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0	100.0	
2"	96.9	95.0 - 100.0	
1 1/2"	93.2		
1"	89.7	55.0 - 85.0	X
3/4"	87.8		
1/2"	84.6		
3/8"	82.8		
1/4"	80.0		
#4	78.8	27.0 - 52.0	X
#10	61.3		
#20	60.5		
#40	43.3		
#80	17.5		
#140	11.2		
#200	9.0		

Soil Description
well-graded sand with silt and gravel

Atterberg Limits
 PL= LL= PI=

Coefficients
 D₉₀= 26.5178 D₈₅= 13.3576 D₆₀= 0.8116
 D₅₀= 0.5227 D₃₀= 0.2866 D₁₅= 0.1552
 D₁₀= 0.0883 C_u= 9.19 C_c= 1.15

Classification
 USCS= SW-SM AASHTO= A-1-b

Remarks
 Natural Moisture Content: 14.8%
 11.4% passing the #200 sieve based on the portion the #4 sieve.
 Specification requires 0-12%.

* NHDOT 304.3 - Crushed Gravel

Location: TP-3
 Sample Number: Bulk

Date: 03/30/2023

R.W. Gillespie & Associates, Inc. Biddeford, Maine	Client: Gale Associates, Inc. Project: Doctor True Road Sanborton, NH Project No: 0851-059 Lab No. 17446-03
---	---

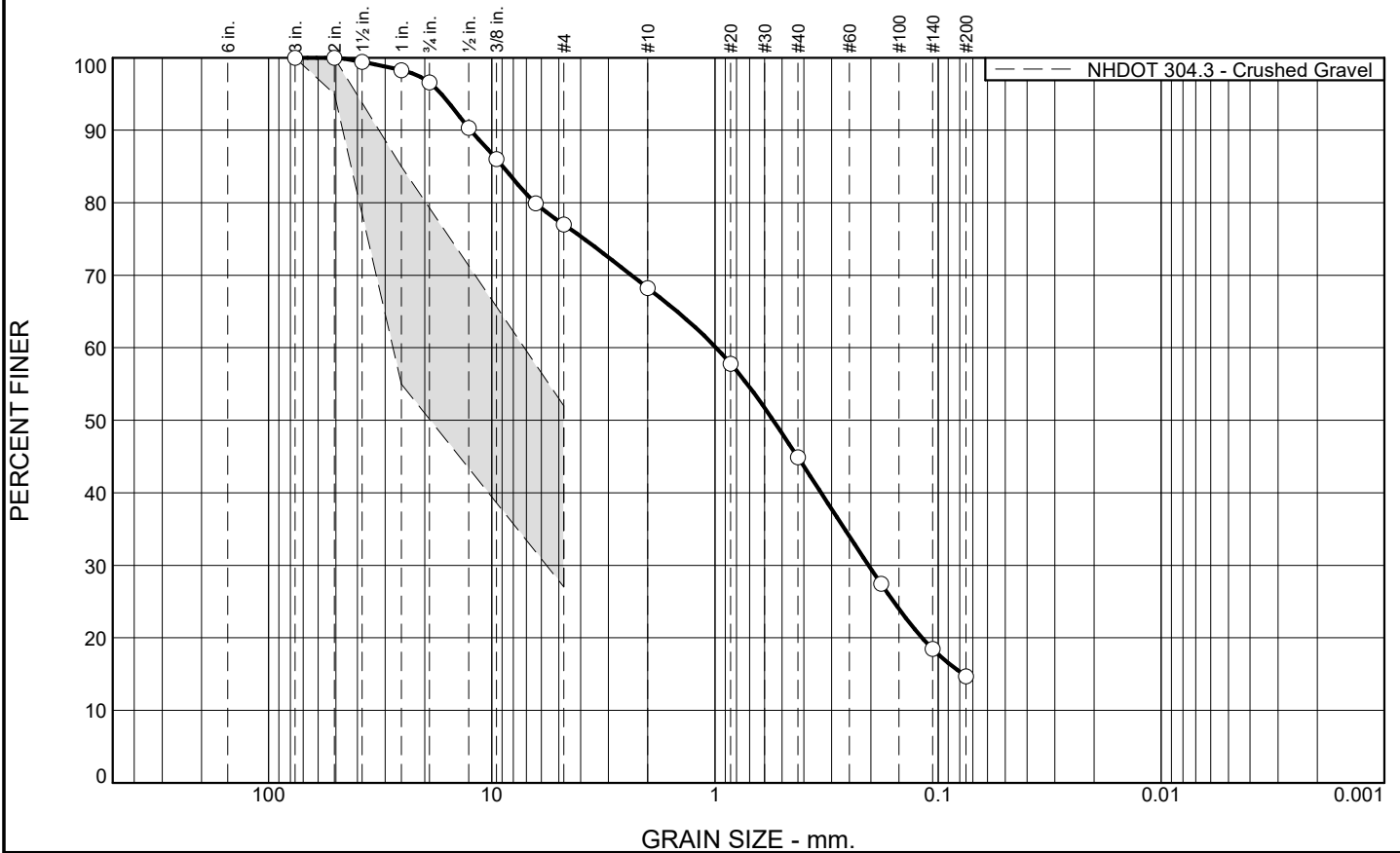
Tested By: NRP/CAG

Checked By: MTG

MTG

This page intentionally left blank

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.4	19.6	8.8	23.3	30.2	14.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0	100.0	
2"	100.0	95.0 - 100.0	
1 1/2"	99.4		
1"	98.3	55.0 - 85.0	X
3/4"	96.6		
1/2"	90.3		
3/8"	86.0		
1/4"	79.9		
#4	77.0	27.0 - 52.0	X
#10	68.2		
#20	57.8		
#40	44.9		
#80	27.5		
#140	18.5		
#200	14.7		

Soil Description

silty sand with gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 12.4415 D₈₅= 8.9276 D₆₀= 0.9866
D₅₀= 0.5482 D₃₀= 0.2048 D₁₅= 0.0775
D₁₀= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 6.9%

19.1% passing the #200 sieve based on the portion the #4 sieve.

Specification requires 0-12%.

* NHDOT 304.3 - Crushed Gravel

Location: TP-4
Sample Number: Bulk

Date: 03/30/2023

R.W. Gillespie & Associates, Inc. Biddeford, Maine	Client: Gale Associates, Inc. Project: Doctor True Road Sanborton, NH Project No: 0851-059
Lab No. 17446-04	

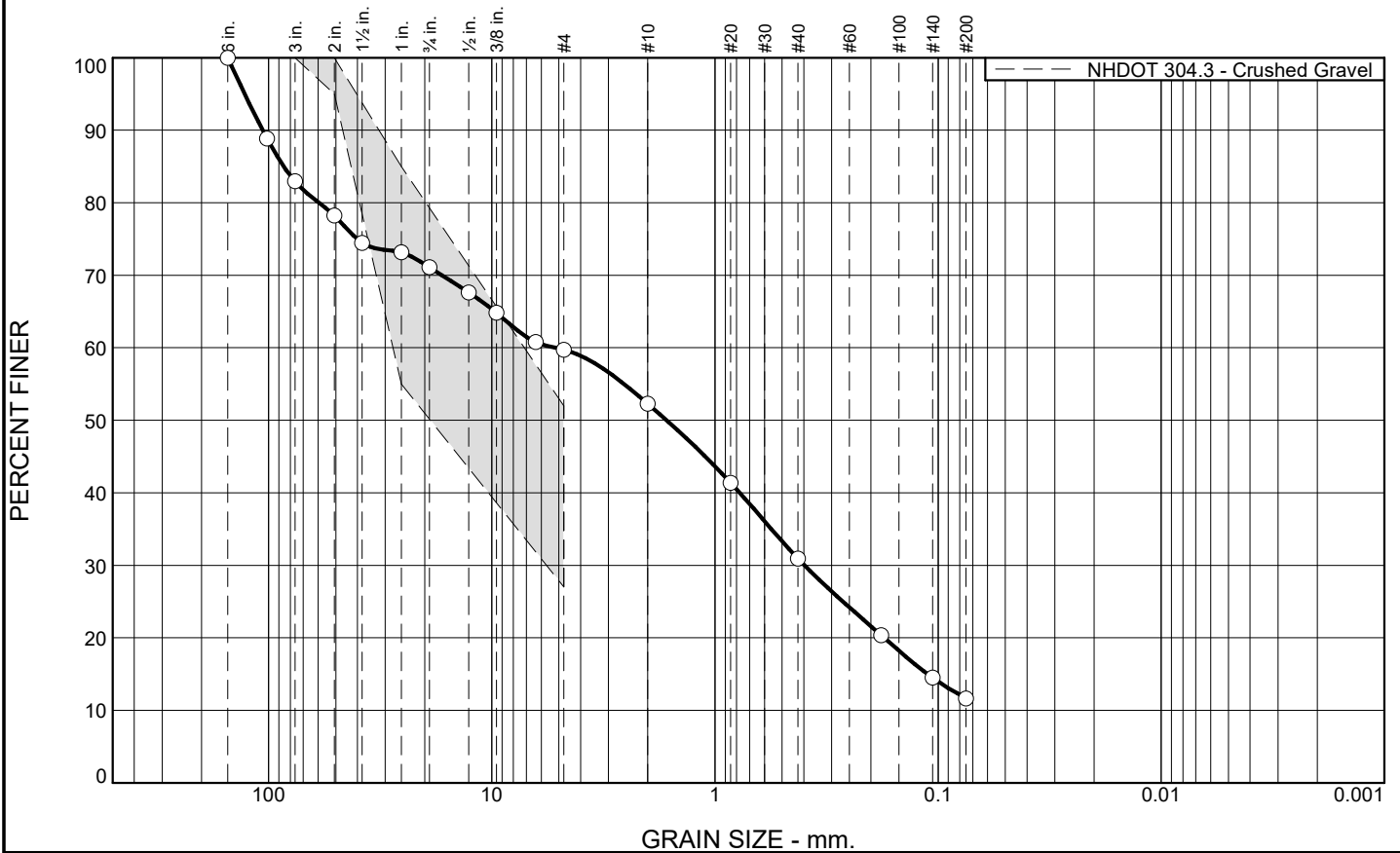
Tested By: NRP/CAG

Checked By: MTG

MTG

This page intentionally left blank

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
17.1	11.8	11.4	7.4	21.3	19.4	11.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
6"	100.0		
4"	88.9		
3"	82.9	100.0	X
2"	78.3	95.0 - 100.0	X
1 1/2"	74.5		
1"	73.2	55.0 - 85.0	
3/4"	71.1		
1/2"	67.6		
3/8"	64.8		
1/4"	60.8		
#4	59.7	27.0 - 52.0	X
#10	52.3		
#20	41.4		
#40	31.0		
#80	20.4		
#140	14.5		
#200	11.6		

Soil Description

silty sand with gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 106.3044 D₈₅= 85.5640 D₆₀= 5.1802
D₅₀= 1.6467 D₃₀= 0.3968 D₁₅= 0.1116
D₁₀= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 8.1%

19.5% passing the #200 sieve based on the portion the #4 sieve.

Specification requires 0-12%.

* NHDOT 304.3 - Crushed Gravel

Location: TP-5
Sample Number: Bulk

Date: 03/30/2023

R.W. Gillespie & Associates, Inc. Biddeford, Maine	<p>Client: Gale Associates, Inc.</p> <p>Project: Doctor True Road Sanborton, NH</p> <p>Project No: 0851-059</p>
<p>Lab No. 17446-05</p>	

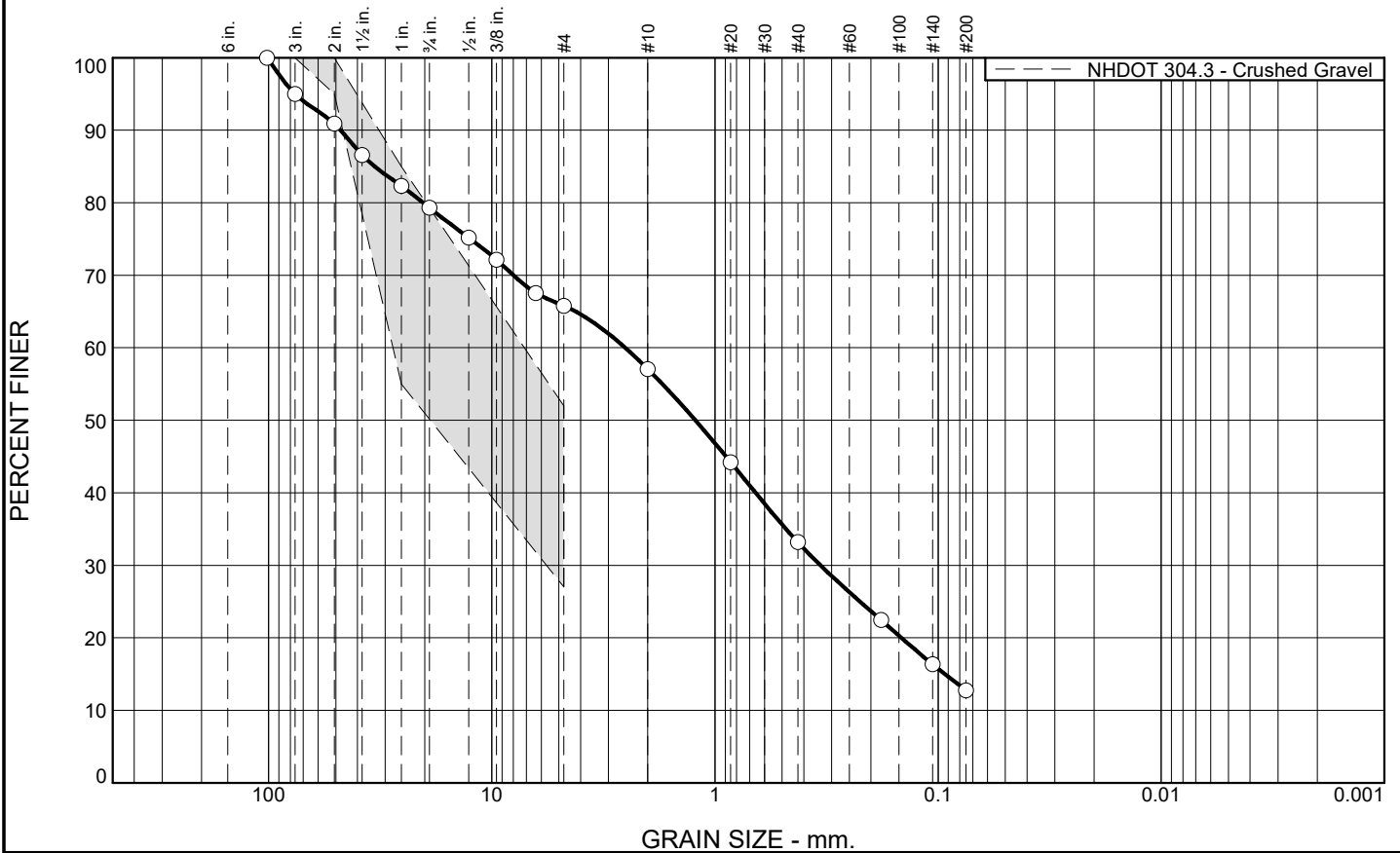
Tested By: NRP/MES

Checked By: MTG

MTG

This page intentionally left blank

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
5.0	15.7	13.5	8.7	23.9	20.5	12.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4"	100.0		
3"	95.0	100.0	X
2"	90.9	95.0 - 100.0	X
1 1/2"	86.6		
1"	82.3	55.0 - 85.0	
3/4"	79.3		
1/2"	75.2		
3/8"	72.1		
1/4"	67.6		
#4	65.8	27.0 - 52.0	X
#10	57.1		
#20	44.2		
#40	33.2		
#80	22.4		
#140	16.4		
#200	12.7		

Soil Description

silty sand with gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 47.5933 D₈₅= 33.4910 D₆₀= 2.5240
D₅₀= 1.2245 D₃₀= 0.3368 D₁₅= 0.0934
D₁₀= C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Natural Moisture Content: 10.0%

19.4% passing the #200 sieve based on the portion the #4 sieve.

Specification requires 0-12%.

* NHDOT 304.3 - Crushed Gravel

Location: TP 6
Sample Number: Bulk

Date: 03/30/2023

R.W. Gillespie & Associates, Inc. Biddeford, Maine	Client: Gale Associates, Inc. Project: Doctor True Road Sanborton, NH Project No: 0851-059
Lab No. 17446-06	

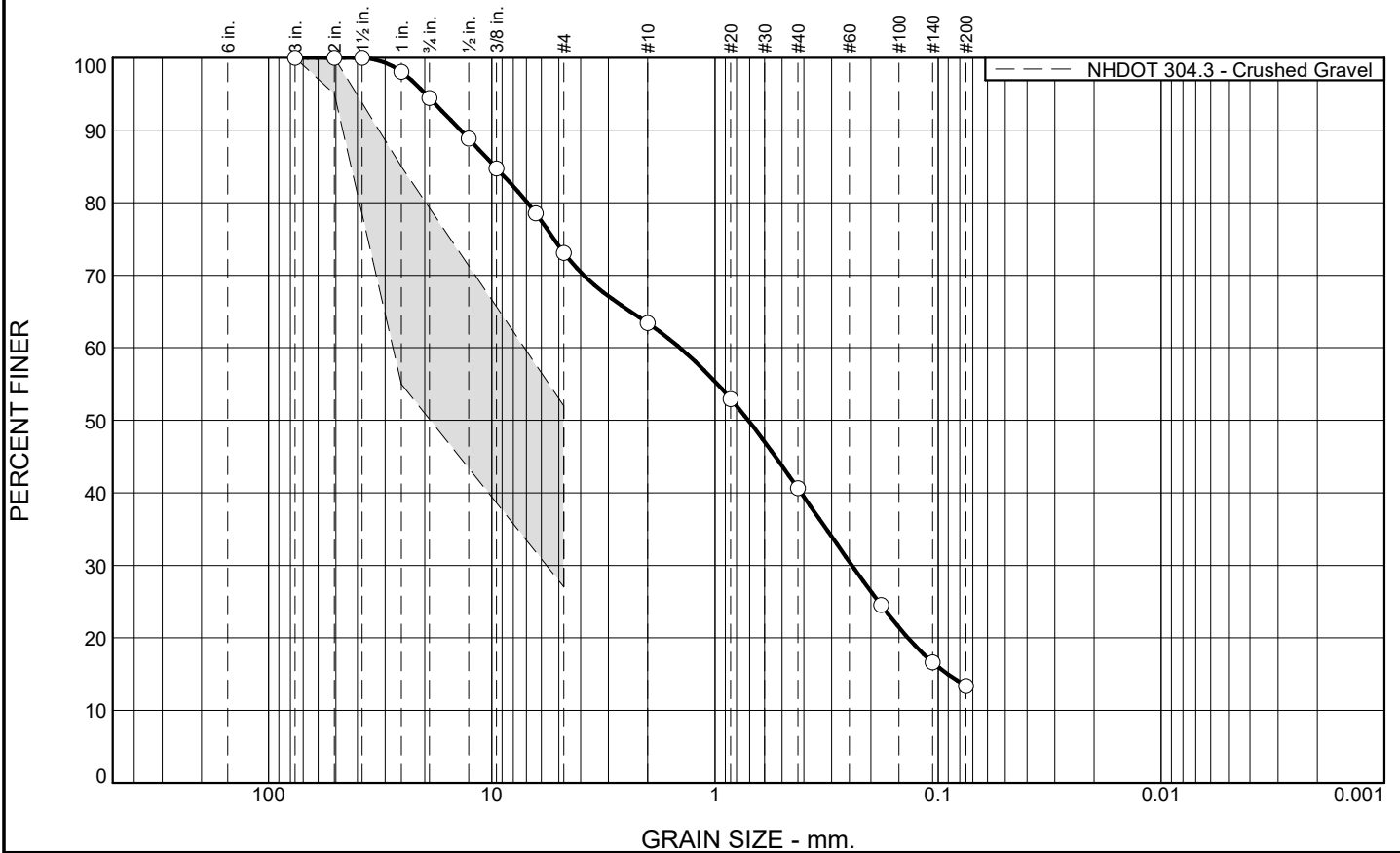
Tested By: NRP/CAG

Checked By: MTG

MTG

This page intentionally left blank

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.6	21.3	9.7	22.8	27.2	13.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0	100.0	
2"	100.0	95.0 - 100.0	
1 1/2"	100.0		
1"	98.1	55.0 - 85.0	X
3/4"	94.4		
1/2"	88.9		
3/8"	84.7		
1/4"	78.5		
#4	73.1	27.0 - 52.0	X
#10	63.4		
#20	52.9		
#40	40.6		
#80	24.5		
#140	16.6		
#200	13.4		

Soil Description
silty sand with gravel

Atterberg Limits
 PL= LL= PI=

Coefficients
 D₉₀= 13.7789 D₈₅= 9.7008 D₆₀= 1.4381
 D₅₀= 0.7098 D₃₀= 0.2435 D₁₅= 0.0906
 D₁₀= C_u= C_c=

Classification
 USCS= SM AASHTO= A-1-b

Remarks
 Natural Moisture Content: 7.8%
 18.3% passing the #200 sieve based on the portion the #4 sieve.
 Specification requires 0-12%.

* NHDOT 304.3 - Crushed Gravel

Location: TP-7
 Sample Number: Bulk

Date: 03/30/2023

R.W. Gillespie & Associates, Inc. Biddeford, Maine	Client: Gale Associates, Inc. Project: Doctor True Road Sanborton, NH Project No: 0851-059 Lab No. 17446-07
---	---

Tested By: NRP/MES Checked By: MTG

MTG

This page intentionally left blank

Land Use: 210

Single-Family Detached Housing

Description

A single-family detached housing site includes any single-family detached home on an individual lot. A typical site surveyed is a suburban subdivision.

Specialized Land Use

Data have been submitted for several single-family detached housing developments with homes that are commonly referred to as patio homes. A patio home is a detached housing unit that is located on a small lot with little (or no) front or back yard. In some subdivisions, communal maintenance of outside grounds is provided for the patio homes. The three patio home sites total 299 dwelling units with overall weighted average trip generation rates of 5.35 vehicle trips per dwelling unit for weekday, 0.26 for the AM adjacent street peak hour, and 0.47 for the PM adjacent street peak hour. These patio home rates based on a small sample of sites are lower than those for single-family detached housing (Land Use 210), lower than those for single-family attached housing (Land Use 251), and higher than those for senior adult housing -- single-family (Land Use 251). Further analysis of this housing type will be conducted in a future edition of *Trip Generation Manual*.

Additional Data

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip generation resource page on the ITE website (<https://www.ite.org/technical-resources/topics/trip-and-parking-generation/>).

For 30 of the study sites, data on the number of residents and number of household vehicles are available. The overall averages for the 30 sites are 3.6 residents per dwelling unit and 1.5 vehicles per dwelling unit.

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in Arizona, California, Connecticut, Delaware, Illinois, Indiana, Kentucky, Maryland, Massachusetts, Minnesota, Montana, New Jersey, North Carolina, Ohio, Ontario (CAN), Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Vermont, Virginia, and West Virginia.

Source Numbers

100, 105, 114, 126, 157, 167, 177, 197, 207, 211, 217, 267, 275, 293, 300, 319, 320, 356, 357, 367, 384, 387, 407, 435, 522, 550, 552, 579, 598, 601, 603, 614, 637, 711, 716, 720, 728, 735, 868, 869, 903, 925, 936, 1005, 1007, 1008, 1010, 1033, 1066, 1077, 1078, 1079

Single-Family Detached Housing (210)

Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Setting/Location: General Urban/Suburban

Number of Studies: 174

Avg. Num. of Dwelling Units: 246

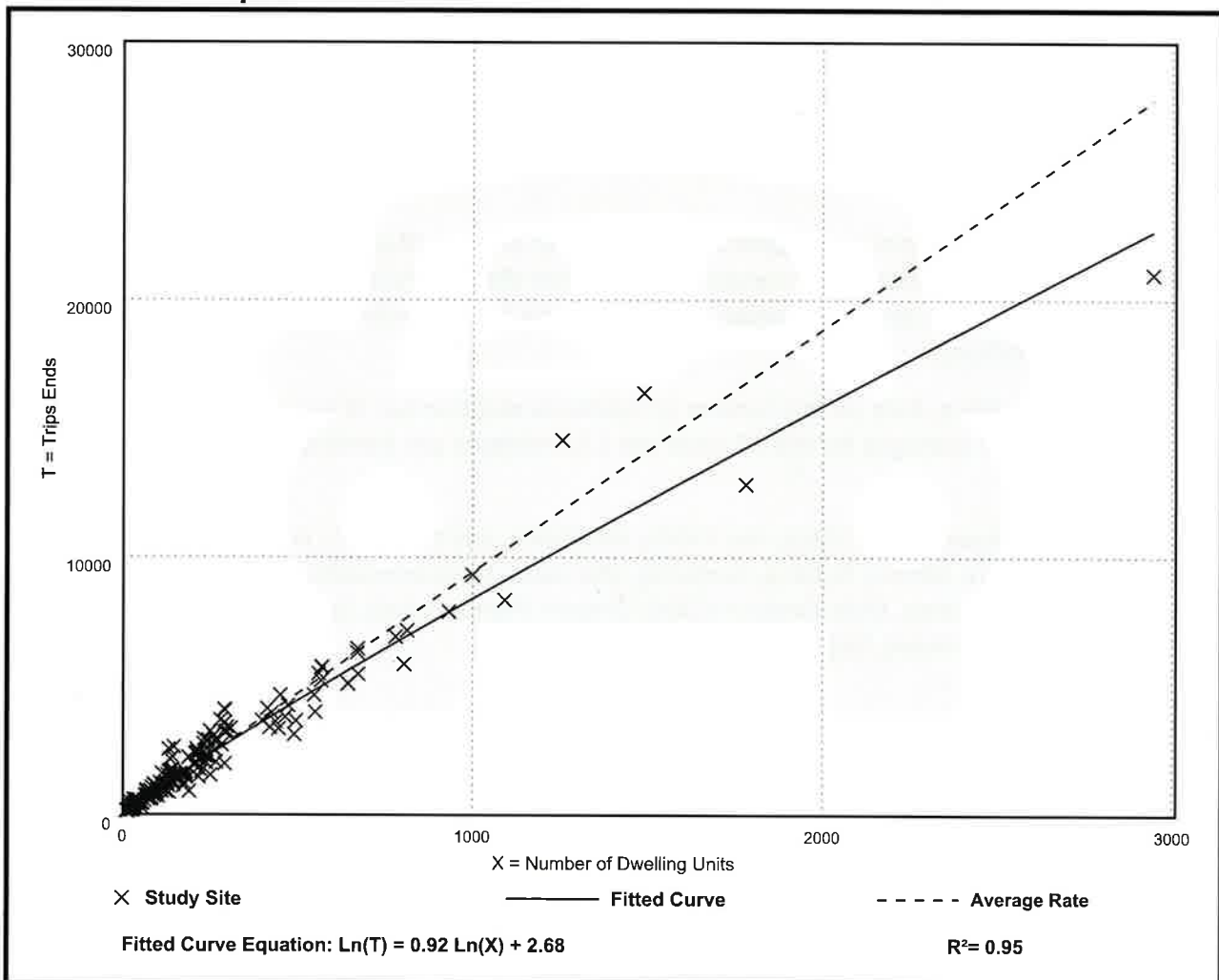
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.43	4.45 - 22.61	2.13

Data Plot and Equation

70 PARCELS x 9.43 = 660





6 Bedford Farms Drive, Suite 101 | Bedford, NH 03110
 P | 603.471.1887 F | 603.471.1809
 www.galeassociates.com

Project: Sanbornton, NH Dr. True Road (Study Phase)

Calculated By: SMB

Date: 3/30/2023

Checked By: NIA

Date: 04/03/2023

NOTE: In providing opinions of probable construction costs, the Client understands that Gale Associates, Inc. has no control over the cost or availability of labor, equipment or materials, or over market conditions or the Contractor's methods of pricing, and that our Opinion of Probable Construction Costs are made on the basis of our professional judgment and experience. Gale Associates, Inc. makes no warranty, expressed or implied, that the bids or the negotiated costs of the Work will not vary from the Opinion of Probable Construction Cost provided herein.

OPINION OF PROBABLE CONSTRUCTION COST - Reconstruction Gravel Surface

UNIT NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE*	AMOUNT
203.1	Common Excavation	CY	5,840	\$20.00	\$ 116,800.00
214	Fine Grading	U	1	\$2,500.00	\$ 2,500.00
304.3	Crushed Gravel	CY	5,840	\$30.00	\$ 175,200.00
593.222	Geotextile, Separation, Class II, Monofilament, Woven	SY	11,670	\$4.00	\$ 46,680.00
605.151	6" Perforated Corrugated Polyethylene Underdrain Pipe	LF	1,750	\$25.00	\$ 43,750.00
618.7	Flaggers	HR	400	\$40.00	\$ 16,000.00
619.1	Maintenance of Traffic	U	1	\$1,500.00	\$ 1,500.00
619.253	Portable Changeable Message Sign	U	2	\$2,600.00	\$ 5,200.00
692	Mobilization	U	1	\$0.00	\$ -
Sub-Total					\$ 407,630.00
15% Contingency					\$ 61,144.50
Sub-Total					\$ 468,774.50

ESTIMATE

\$

470,000.00

This page intentionally left blank



6 Bedford Farms Drive, Suite 101 | Bedford, NH 03110
 P | 603.471.1887 F | 603.471.1809
 www.galeassociates.com

Project: Sanbornton, NH Dr. True Road (Study Phase)

Calculated By: SMB

Date: 3/30/2023

Checked By: NIA

Date: 04/03/2023

NOTE: In providing opinions of probable construction costs, the Client understands that Gale Associates, Inc. has no control over the cost or availability of labor, equipment or materials, or over market conditions or the Contractor's methods of pricing, and that our Opinion of Probable Construction Costs are made on the basis of our professional judgment and experience. Gale Associates, Inc. makes no warranty, expressed or implied, that the bids or the negotiated costs of the Work will not vary from the Opinion of Probable Construction Cost provided herein.

OPINION OF PROBABLE CONSTRUCTION COST - FDR Gravel Surface

UNIT NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE*	AMOUNT
214	Fine Grading	U	1	\$2,500.00	\$ 2,500.00
306.112	Reclaim Stabilized Base Processed in Place, 12" Deep	SY	9,340	\$5.00	\$ 46,700.00
306.36	Stone for Reclaimed Stabilized Base	TON	2,730	\$50.00	\$ 136,500.00
618.7	Flaggers	HR	400	\$25.00	\$ 10,000.00
619.1	Maintenance of Traffic	U	1	\$1,500.00	\$ 1,500.00
619.253	Portable Changeable Message Sign	U	2	\$2,600.00	\$ 5,200.00
692	Mobilization	U	1	\$0.00	\$ -
Sub-Total					\$ 202,400.00
15% Contingency					\$ 30,360.00
Sub-Total					\$ 232,760.00

ESTIMATE

\$

235,000.00

This page intentionally left blank



6 Bedford Farms Drive, Suite 101 | Bedford, NH 03110
 P | 603.471.1887 F | 603.471.1809
 www.galeassociates.com

Project: Sanbornton, NH Dr. True Road (Study Phase)

Calculated By: SMB

Date: 3/30/2023

Checked By: NIA

Date: 04/03/2023

NOTE: In providing opinions of probable construction costs, the Client understands that Gale Associates, Inc. has no control over the cost or availability of labor, equipment or materials, or over market conditions or the Contractor's methods of pricing, and that our Opinion of Probable Construction Costs are made on the basis of our professional judgment and experience. Gale Associates, Inc. makes no warranty, expressed or implied, that the bids or the negotiated costs of the Work will not vary from the Opinion of Probable Construction Cost provided herein.

OPINION OF PROBABLE CONSTRUCTION COST - Pavement Surface (add option)

UNIT NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE*	AMOUNT
304.33	Crushed Aggregate for Shoulders	CY	10	\$45.00	\$ 450.00
403.11023	HBP-3/4" Binder Mix, Machine Method	TON	1,310	\$80.00	\$ 104,800.00
403.11053	HBP-3/8" Surface Mix, Machine Method	TON	790	\$80.00	\$ 63,200.00
410.22	Asphalt Emulsion for Tack Coat	GAL	380	\$10.00	\$ 3,800.00
417	Cold Planing Bituminous Surfaces	SY	5	\$150.00	\$ 750.00
Sub-Total					\$ 173,000.00
15% Contingency					\$ 25,950.00
Sub-Total					\$ 198,950.00

ESTIMATE	\$	200,000.00
-----------------	-----------	-------------------

This page intentionally left blank



6 Bedford Farms Drive, Suite 101 | Bedford, NH 03110
 P | 603.471.1887 F | 603.471.1809
 www.galeassociates.com

Project: Sanbornton, NH Dr. True Road (Study Phase)

Calculated By: SMB

Date: 3/30/2023

Checked By: NIA

Date: 04/03/2023

NOTE: In providing opinions of probable construction costs, the Client understands that Gale Associates, Inc. has no control over the cost or availability of labor, equipment or materials, or over market conditions or the Contractor's methods of pricing, and that our Opinion of Probable Construction Costs are made on the basis of our professional judgment and experience. Gale Associates, Inc. makes no warranty, expressed or implied, that the bids or the negotiated costs of the Work will not vary from the Opinion of Probable Construction Cost provided herein.

OPINION OF PROBABLE CONSTRUCTION COST - Drainage (add option)

UNIT NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE*	AMOUNT
202.41	Removal of Existing Pipe 0-24" Diameter	LF	80	\$100.00	\$ 8,000.00
203.11	Common Excavation, Drainage Swale	CY	1,850	\$20.00	\$ 37,000.00
203.12	Common Excavation, Sedimentation Pool	CY	15	\$20.00	\$ 300.00
206.1	Common Structure Excavation	CY	20	\$75.00	\$ 1,500.00
570.4015	Mortar Rubble Masonry 15" Headwall for Drives	CY	30	\$625.00	\$ 18,750.00
570.4018	Mortar Rubble Masonry 18" Headwall	CY	40	\$750.00	\$ 30,000.00
583.3	Riprap, Class III for Sedimentation Pool	CY	20	\$50.00	\$ 1,000.00
603.33215	15" Polyethylene Flared-End Section for Drives	EA	14	\$370.00	\$ 5,180.00
603.82215	15" Corrugated Polyethylene Pipe for Drives	LF	480	\$55.00	\$ 26,400.00
603.82218	18" Corrugated HDPE Pipe for Slope Drainage	LF	280	\$90.00	\$ 25,200.00
641	Loam	CY	790	\$40.00	\$ 31,600.00
643.12	Ferterlizer for Initial Application	TON	1	\$985.00	\$ 985.00
644.15	Park Seed Type 15	LBS	180	\$30.00	\$ 5,400.00
Sub-Total					\$ 191,315.00
15% Contingency					\$ 28,697.25
Sub-Total					\$ 220,012.25

ESTIMATE	\$	225,000.00
-----------------	-----------	-------------------

This page intentionally left blank