BOSTON UNIVERSITY
College of Business Administration
THESIS
Aggregate Production in New Hampshire
by
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(A.B. Brown University 1951)
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the requirements for the degree of
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Introduction

We all tend to take many of the basic things in life for granted. The roads we ride to work on and the buildings we work in are two such items. Even if we do realize that their construction was a major undertaking for someone, we never ask where the materials came from, or how. Basic to all construction of a heavy nature since earliest civilization, the production of sand and gravel has become a major industry in the world. In the United States it has its own association, a magazine, and thousands of plants throughout the nation. National production of aggregates (sand, gravel, and crushed rock) is currently 375,000,000 tons per year with an average value of one dollar a ton and costing up to a dollar a ton more to deliver, a not inconsiderable total.*

The production of aggregates is considerably changed from a half-century ago. The Romans graded gravel for their roads, but since their time men were content to merely smooth out a roadbed and possibly add a little ungraded sand. Experience taught cement users that the concrete would be better if graded and cleaned aggregates were used, and that they would more than repay the expense of doing so.

Aggregates come from trap rock which has to be crushed, and more often from glacial deposits of sand and

*20, pg. 136
gravel. As will be noted in Chapter III, not all deposits can pass tests of usefulness. There are a number of ways to separate these deposits, which will also be discussed. An entire chapter will be devoted to a discussion of present and future uses for aggregates, and to the marketing of them.

The industry, although a basic one as already noted, has not been recognized as fully as it merits. I hope in this paper to probe into its history, operation, problems, and future. There is no one place of literature telling where it came from, where it is (unless editorials can do this), or where it is headed. The country as a whole has many plants, so I have chosen one very small state as the basis of my discussion. New Hampshire is not the smallest state in the Union, nor does it have any great number of aggregate producers, but since it has no peculiar problems it seems to be a choice both representative and limited enough to give the coverage the topic deserves.

Little prior study of this field has been done. There is, therefore, an opportunity to do a survey. In 1940 a Masters Thesis on the construction of a portable aggregate plant was presented at Massachusetts Institute of Technology; that was an engineering thesis and not concerned with management. At the present time the United States Bureau of Mines is completing a report to the President's Council of Economic Advisors on the state of the industry in New England and other selected parts of the country. This
was, unfortunately, not public nor could it be perused. The sources for this thesis are industry publications, Federal and State governmental bulletins, and interviews with State and company personnel. It was at first deemed advisable to visit every producer in New Hampshire, but this was not necessary, for, as pointed out by industry leaders a representative cross section would do the job. Officials of the two largest producers and two smaller ones provide most of the direct company material, and State Highway Department officials filled in the gaps (or, more often, provided the leads).

The method of approach is to review the background of the business, especially the economic aspects. Since it is largely dependant upon the volume of construction, the nature of the industry is cyclical. Moreover, in areas such as New Hampshire where winter weather is severe, the operations are curtailed to the point of a shutdown for three to six months a year. I shall look at sales, product and uses, production methods, and administrative concerns of management before drawing the conclusions which, it is to be hoped, a comprehensive report on the industry will enable.

The purpose of the paper will be to develope trends in the aggregate industry in New Hampshire and draw conclusions as to their future.

The following is a list of the companies operating
in New Hampshire and their addresses; they are listed in order of size, and a map on page 17 shows their location and the population each serves.

1. Manchester Sand, Gravel, & Cement Company, Inc. Hooksett

2. Iafolla Crushed Stone Company, Inc. Beverly Hill Road, Portsmouth

3. Arthur Whitcomb (a) Keene (b) Tilton

4. William J. Vickers & Son, Inc. Farmington

5. Twin States Sand & Gravel Company Elm Street, West Lebanon

6. Lessard Sand & Gravel Company (a) Berlin (b) Gorham

7. Littleton Sand & Gravel Company Littleton

8. Kenneth Allen, Rochester (Produces mostly for his own concrete block plant and sell little aggregate as such)
CHAPTER I

HISTORY AND BACKGROUND

The aggregate industry as such dates only from the turn of the century, when "Rock Products" magazine included in its original issue some aggregate information. The oldest aggregate company in continuous existence, however, dates from 1854.* The earliest evidence that washing was being considered came in 1898 from the comment of the nation's leading cement man, Mr. S. B. Newberry, that "in some cases, washing the aggregate may be necessary (to the making of good cement)." It was the need for good concrete that led to a realization that considerable care should be taken to get strong, clean aggregates. Mr. Nathan C. Rockwood, Editorial Consultant of "Rock Products" magazine, tells of testing to find out how much cement was needed in a given batch of concrete; he did this by filling a pail with sample aggregate and adding water to measure the amount of void to be filled. Toward 1910, the concrete men favored coarse aggregates, later shifted to see the value of some fines. Only recently, however, have they devoted their efforts to testing the soundness of the aggregates. The first tests were prepared in 1905 by the American Society for Testing Materials, but were never carried out.**

The big block to large plants has always been the expense of transportation. Thus it is no surprise that a large number of small companies exist in the field. The

*7, pg. 106
** ibid, pg. 107
business of producing aggregates, furthermore, has been over­
looked in the past; plants tended to either spring up on good
deposits with senseless disregard of location, or to rise
wherever a need for their products existed. Many of the New
Hampshire plants began this way. For instance, Mr. John
Morton, now Chief Engineer of the State of New Hampshire, set
up a plant in Gorham to sell to the Public Service Company
for a $50,000,000 dam. When this job was completed, the plant
remained to service the area.*

A basic factor in the production of aggregates is
that, being an extractive business, it is subject to wasting
away of assets. In large metropolitan areas, this is espec­
ially important, as once the limited deposits are exhausted
no more may be available. The problem in New Hampshire has
not been depletion of total deposits, but rather a lowering
of standards. As one grade of material is consumed, lower
grades must be accepted.** With the tremendous expansion of
use of aggregates, this can pose quite a problem. Unless new
sources are found, the trend toward looser specifications will
continue. Essentially, this might be called obsolescence,
since changing specifications and rising transportation costs
often render useless previously good deposits. One last point
under the subject of depletion is the need to plan large gov­
ernment projects so as not to overdeplete any given area's
aggregate supplies. This applies most notably to airports.***

* 36
** 20
*** 5 pg. 67
The foremost problem of the business is its close tie with the business cycle. The chart on the following page shows the Gross National Product, that is, relative prosperity, and construction, the market for aggregates, as well as aggregate production between the two world wars. A. H. Hansen, in the third chapter of his text "Business Cycles and National Income," points out that construction, and building construction in particular, moves in cyclical waves. The latter has a regular seventeen year cycle (approximately). Building construction is affected by supply and demand, in normal (non-war) times, independent of prosperity. There is a certain lag that Hansen points out is due to a lack of trained workers. But what of construction in general - factories, roads, dams, etc.? These projects are closely tied to national production needs, expanding rapidly in good times, leading the boom in many instances as new production facilities are required. In either case - building or general construction - there is a noticeably cyclical tendency. Since aggregates are sold for construction, their production follows the cycle, too.

In the light of the cyclical nature of construction the aggregate producer would do well to keep informed as to the possibility of any changes in the business cycle. With heavy fixed commitments in plant and equipment, a sudden fall in markets could ruin the improvident producer. A warning of sorts was uttered in 1952 by a large New England producer who said, "We need only a slight shrinkage in volume to re-
CHART I -
COMPARISON BY YEARS (1919 - 1941)
OF
NATIONAL SAND & GRAVEL PRODUCTION*
GROSS NATIONAL PRODUCT**
CONSTRUCTION OUTLAYS (NEW)***

** * pgs. 81, 94, 85
*** Courtesy of U.S. Bureau of Mines
sult in a 'dog-eat-dog' situation."* As if to refute this, he goes on to say that he still plans to expand his existing facilities.

The long-run cyclical aspect of aggregate production is matched, at least in Northern climates, such as in New Hampshire, by enforced seasonality. From mid-November through February or even until April, all construction is frozen to a standstill; furthermore, washing operations in sand and gravel pits are effectively stopped by the weather conditions. The concrete products companies operate, using steam to keep the aggregates from freezing, and this necessitates some stockpiling of inventory. Moreover, the highways are sanded in icy weather, using some of the sand. For the most part, however, the plants cease to function during the winter months.

This winter shutdown, however, does not reduce the costs. Depreciation goes on, taxes must be paid, and a number of key personnel usually remain on the payroll. John Iafola, for instance, has a crew of about fifty working the crushed rock plant in the summer, and keeps twenty to twenty-five employed throughout the winter.** Even with maintenance jobs, and state highway snow-plow and sanding contracts, these permanent employees work less than two full days per week. A glance at the following chart shows how a typical company's profits, good in November, have shrunk by the end of March.***

*13, pg. 103
** 28
*** 23
The possibility of stockpiling has been discussed by the aggregate producers, and some enlightening conclusions reached. An article in the June, 1950, edition of "Rock Products" magazine pointed out that aggregates stored for six months or more lose strength and have their size reduced due to scaling, flaking off of edges, etc., resulting in a loss of their value as bonding agents in concrete.* It has been the experience of New Hampshire State engineers that rainfall washes any contaminating dirt that may remain in the aggre-

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* 6

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<td>First</td>
<td>18.1</td>
<td>43.8</td>
<td>58.7</td>
<td>96.0</td>
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<td>44.3</td>
<td>47.1</td>
<td>39.9</td>
<td>49.0</td>
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<td>Third</td>
<td></td>
<td>74.2</td>
<td>25.3</td>
<td>21.8</td>
<td>14.7</td>
<td>11.0</td>
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<td>Fourth</td>
<td>39.3</td>
<td>36.2</td>
<td>91.6</td>
<td>28.9</td>
<td>65.9</td>
<td>65.0*</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>9.4</td>
<td>22.6</td>
<td>73.9</td>
<td>65.2</td>
<td>65.0*</td>
</tr>
<tr>
<td>Profits/Sales</td>
<td>0.4%</td>
<td>7.3%</td>
<td>22.7%</td>
<td>4%</td>
<td>2%</td>
<td>3.6%</td>
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Quarterly Profits of Manchester Sand, Gravel & Cement Co., Inc., for Years Ending March 31 - 1947-1953
in thousands of dollars

* Through June 31
gate stockpile to the lower portion of the pile, thus rendering that portion of the aggregate unacceptable. This is particularly true at the crushed rock plant in Portsmouth, since the rock aggregate is not washed and some fines remain on the stone. To use such rock aggregate, it has been found necessary to re-screen it or wash it with a kerosene or fuel oil spray. Needless to say, this can substantially reduce or even wipe out the profits of the operation.

Another bar to any extensive stockpiling in New Hampshire is the state's "stock-in-trade" tax. This is an inventory tax that puts a premium on rapid turnover, since it can result in one item being taxed in succeeding years. Mr. Iafolla is said to have practically given one huge pile of stone away to escape this tax. A movement is now underway to repeal this tax and if this is successful, more stockpiling should be an immediate result.

Sooner or later, every aggregate producer will try to expand into related fields. Every plant in the state has a ready-mix concrete company attached to it or nearby; most of them have asphalt hot-mix plants. Concrete blocks are a further sideline. But, by far and away, the biggest attraction is in the contracting field. One contractor, John Iafolla, reversed the usual procedure by entering the aggregate field with a crushed trap-rock plant. Contracting is a challenging field, with a chance for the accumulation of excellent profit. However, as is always the case, where large profits are pos-
sible, the businessman must take greater risks of offsetting losses. The state of New Hampshire - a very small state, as our nation goes - has some twelve contractors in the state, including some four or more nominally Massachusetts corporations, and two each from Connecticut and Rhode Island who do work in New Hampshire.* Three of the aggregate producers are engaged in contracting (The Manchester Sand, Gravel, & Cement Company, Lafolla Industries, and Arthur Whitcomb). All these companies are competing for some $12,000,000.00 in state road contracts and perhaps half as much private construction. The large investment that each company has in its equipment means that each wants to - in fact, must - keep busy or go broke. Therefore, the various concerns fight bitterly for every contract opened for bidding. One job let by the state December 29, 1952, had eight bids ranging from $331,000 to $365,000, only $34,000 separating the high and low bid!* Many of the companies will take 'loss' jobs in the winter just to keep busy, for certain work is non-seasonal, such as clearing. The commissioner, General Merrill, knows this and advertises and lets his bids accordingly. One may easily see, therefore, that expansion, especially into contracting, may be hazardous.

The construction business has often been criticized as a political mess. To a certain extent the criticism has been deserved; in some areas, especially one state south of New Hampshire, the abuses of public building funds have been scandalous enough to turn the tide of an election. Honest,
competitive bidding can do much to avoid this, and an able and alert administrator can move to block possible collusion. With few reservations, New Hampshire has just such an able, alert, and honest Highway Department. Occasionally, a poor loser will cry 'fraud' when someone else gets a bid; at other times, one party or another may seek political favors. On the whole, however, road contracts are honestly and fairly let in New Hampshire.

There are, in retrospect, several noticeable trends in the field of past aggregate production. Most noteworthy is the continued dominance of small companies. The initial investment of $75,000 to $100,000 is large for starting a small business, but opportunities still remain. The growing acceptance of portable plants may result in an unforseen need to expand for the established producers. In sparsely populated states such as New Hampshire this is especially true; more will be said of this later.#

The trend in size of aggregates has been smaller and smaller.* It remains to be seen if this continues. Markets have shifted, and a vast number of new ones arose as World War II showed us that concrete has a myriad of uses. Transportation, especially in New Hampshire, has always been a problem; aggregate producers estimate the cost of moving aggregate at five cents per ton-mile. However, with improved roads, new areas are becoming available as markets. The need for these roads has at long last been recognized.

# Chapter II on Markets
* 29
and their construction should provide a steady market. Every spring, pursuant to his policy of pre-planning, General Merrill holds an informal meeting with all the New Hampshire aggregate producers which gives each producer an idea of the state's needs from his particular plant. Federal defense spending boosted sales from particular plants in 1942, and may do so again if the proposed Newington (Jet) Air Force Base is indeed constructed.

Costs have been rising in the past few years, due to increases in labor wage rates and the more expensive machinery needed for plant operation. Aggregate prices for the country as a whole, as seen on the chart on the next page, have been rising, but are not yet as high as in 1920. As is seen in the chart, and as would be expected, the price of aggregates runs roughly parallel to the cost of construction. It would be well to note, however, that these past ten or more years have seen aggregate producers operating in sellers' markets.

Labor unions have made some inroads on aggregate production workers throughout the country, but as yet have not succeeded very well in organizing New Hampshire Labor. This problem will be noted in greater detail in a later chapter.

Industry opinion underestimated the length and intensity of the boom period since the war. Mr. Bror Nordberg's editorial comments in "Rock Products" magazine were cautious.
In 1946, and even in 1949 viewed the boom as within two to five years of ending. Not only has construction proceeded at a record pace, but the emergence of so many new uses for aggregates has given the industry a larger market. Financing the inevitable expansion to handle the boom has been a problem. Some companies have sought new capital. In New Hampshire, bank loans have been resorted to in large amounts. It may be well to ask how sound some of these loans—essentially nothing more than mortgages—will prove when the inevitable recession comes.

This, then, is the background of the industry. Trends have been developed, or continued, and the producer searches hard to find out where they lead. Prosperity is the keynote today, and may be for some time to come. Let us now, however, look at the mechanics of the business with regard to sales, production, and administration.
CHAPTER II
MARKETS

All construction makes use of some type of commercial aggregate. The market for aggregates depending upon this definite factor, and construction in turn depending primarily on the needs of the people and industry, one soon observes the location of markets to be a matter of population density as well as of raw materials. The chart on the following page shows the location of the eight major aggregate plants in the state of New Hampshire and the population included in their effective range of operations (twenty mile radius).

The southern half of the state contains the bulk of the inhabitants, and therefore offers the best market for aggregates. A factor of some importance in the oversize areas served by the Manchester and Iafolla companies is the lack of other suitable deposits in the area. Iafolla can, actually, offer only crushed stone, so that for practical purposes of sand sales, both the Vickers Company and the Manchester company share in the Portsmouth market, adding 45,000 to the total persons served by each. The Manchester company enjoys a further advantage in that the heavily populated Nashua region, south of Manchester to the Massachusetts border, contains no deposits of any size which can meet the necessary specifications.* Therefore, of the state's half-million persons, almost 300,000 live in the area to which the Manchester Sand, Gravel and Cement Company sells aggregates.

* 3.
CHART IV
MAP SHOWING SEVEN COMPANIES AND EIGHT MAJOR PLANTS WITH THE POPULATION SERVICED IN A 20 MILE RADIUS IN N.H.*
The northern plants were started to service dams being constructed by the Public Service Company and the Federal Department of the Interior as flood control measures.* Although the areas in which they operate are sparsely populated, they have survived due to the increasing needs for clean, graded aggregate. In recent years, more and more uses have been made of concrete, and modern roadbeds, especially in New England, take large amounts of base material. The variety of markets in New Hampshire differs markedly from the rest of the country. One reason is that the state is still a major agricultural area, and another is that such industry as is in New Hampshire does not need or build facilities requiring heavy construction. Nevertheless, some considerable construction has taken place recently. Public Service Company plants, and some buildings such as the new Merchants National Bank and the New Hampshire Fire Insurance Company building have gone up. Most of the construction, however, is public; mostly roads, but also some airports, with a multi-million dollar airbase being started near Portsmouth by the United States Air Force this year. More concrete is used in buildings today, as prestressed beams are saving money over steel beams and concrete building blocks are being used more extensively in private home construction and small business establishments.**

Interviews with the major aggregate producers in New Hampshire showed that most their sales are to public

* 36
** 27
projects, most notably roads. Mr. Lawrence Fuller of the Iafolla Crushed Stone Company stated that their sales were about 60% public, and Mr. Parker Rice of the Manchester Sand, Gravel, and Cement Company said that sales were about 50-50. These two concerns are also the largest contractors, and so used much of their own aggregate production.

The state of New Hampshire in 1948 put out a booklet entitled "Highway Needs". It was estimated that the state needed approximately $190,000,000 worth of new road construction, both for entirely new roads and for rebuilt roads, in the next fifteen years.* Very little was accomplished by this booklet, as legislators ignored it because of financial problems. Two years later, in 1950, the new Highway Commissioner, Mr. Frank Merrill, of wartime fame as commander of the famous 'Merrill's Marauders', presented a definite proposal to the legislature. He asked for a fifteen year program to modernize New Hampshire's roads, calling for maintenance expenditures of about $12,000,000 annually and as much again for new roads. He presented a detailed outline of the first two years of the program - the plans were to be formulated two years at a time - and a workable method of financing it. The legislature authorized General Merrill's overall plan and passed the measures to effect the first two-year plan. The plans are drawn up in detail at least two years in advance, an example being the actual 1953-1955 report seen appended in Exhibit A. In the first year of the

*4.pg.43
plan, only one change was made, and that a total of 0.6 miles, due to the shortage of steel for bridge construction.*

The long range roadbuilding plan is a boon to New Hampshire aggregate producers. As this will be their largest single market, they are naturally anxious to be able to forecast it. Now they are able to fairly accurately predict probable sales in this market from two to four years in advance of the actual demand. Each producer has his own area of best production, and seldom is it necessary for the contractor to go beyond his own sphere of activity to obtain the necessary aggregates to fulfill his contracts. An exception to this general rule occurred last year when the Manchester Sand, Gravel & Cement Company used its own product at a job north of Tilton, although Arthur Whitcomb, Inc., was close by.* The reason for this was to spread overhead at the Manchester plant, although the sale was without profit. Most of the time, however, the aggregate producer can plan his sales to the state jobs well in advance.

Aggregate use in roads is only partly for the surface structure. In an average asphalt road the asphalt cover is only 6% of the total road mass.** This is due not only to the increasing need to support larger vehicle loads but also to the need for insulation against frost action. Frost heaves have caused many of us to receive some hard jars when riding along in our automobiles, and this is but a part of the frost danger. Freezing water exerts a tremendous pressure – enough

* 35
** 31
to crack the strongest concrete. Only since the war has this fact become universally accepted in designing roads, although New Hampshire state engineers have long noted it and planned accordingly. Mr. F. H. Jackson and Mr. Harold Allen of the United States National Public Roads Administration, after an inspection tour of the famed Autobahns in Germany in 1946, reported that they were far better roads than ours in spite of the inferior cement used in their construction. Specifically, their comments were as follows:*  

1. Placing the concrete slab a sufficient height above the ground water (level) to avoid saturation by capillary action, or lowering of the ground water table by drainage;  

2. Replacement of soils susceptible to frost damage with soils not susceptible to such damage;  

3. Use of coarse granular material or of an impervious strata such as bituminous concrete (hot asphalt) slabs to prevent the capillary rise of ground water.  

At the present time, all major New Hampshire road construction is done according to the above-stated principles.  

The state roads are made in three different types: surface treated gravel, road mix, and hot asphalt mix, the latter being used only in congested areas. These three types of road cost per mile, respectively, and for typical sections, $13,620, $31,200, and $42,750#, and use not quite as much of an increase in gravel.** Concrete roads are no longer built in New Hampshire. The turnpikes, one completed, the other starting this year, cost considerably more per mile, and consume much more aggregate. For the producer, however, the sales

# Exhibit B Shows the Actual Figures, Unadjusted, As taken from State Files.  

*15, pg. 51  

** 32
for turnpike construction can safely be viewed as very lucrative, since few plants are equipped to produce the necessary amounts of aggregate.

Hot asphalt, or bituminous concrete, mixed at a plant and shipped to the job, often called plant-mix, is another good market for aggregates. Hardly an aggregate plant exists that does not have an asphalt plant on its property. Unlike other aggregates, the materials for the asphalt plant need not be washed, although they are at the Manchester plant because no dry-separation is done at the main gravel plant.* The hot-mix is sold mostly to three groups: town, because congested streets must be paved quickly or traffic will be tied up; private individuals for driveways; and industrial concerns for parking lots, graded banks, etc. The demand here is not at all predictable, but since the asphalt plant can use any available aggregate (usually the over abundant sand supply), it is a good market for the producer to have nearby.

The market for aggregates has always had concrete as its number one customer; while roadbeds take a larger physical volume, concrete still takes most of the dollar-volume of sand and gravel. For this the cement companies may thank the phenomenal growth in the extent and variety of uses for concrete. Although the World War I experiment with concrete ships proved a failure, the shortage of wood and steel has seen Europe using some concrete railroad boxcars!**

* 30
**# 12.pg.105
No such drastic step has been necessary here in the United States, but the everyday use of concrete has reached proportions not dreamed of before World War II. The most notable field has been precasting of construction units, including walls, flooring, roofing, beams, pipe lengths, and blocks. The latter have become quite important in New Hampshire in just the last six years.

The DUROCETE Company of Manchester has been the big name in concrete building blocks in New Hampshire. Dante Donati, whose father made decorative concrete masonry, became interested in precast concrete blocks while working on the construction of Grenier Air Force Base during the last war, and he purchased a twenty dollar molding machine which he operated evenings after work. When the war ended, he began to expand as rapidly as he could get the necessary finances to buy more equipment. Today, with several hundred thousands of dollars invested in plant and trucking facilities, DUROCETE serves all three northern New England states plus northern Massachusetts. There are a number of smaller operators, but no one even approaching the size and volume of DUROCETE. This, mind you, is all building block business, including some cinder blocks.

Mr. Donati envisions a vast horizon as yet unexplored in light-weight aggregates. Precast manhole blocks can save the builder $200.00 on a $275.00 job, but concrete does have its limits where support is a necessity.*
stressed concrete also has limits to its use due to the weight involved. Cinders and other light-weight aggregates, on the other hand, offer equal strength with half the weight and at a net saving because no steel will be needed. The hold-up so far has been the lack of enough of the light-weight aggregates, whose production requires equipment costing at least $500,000.* Mr. Donati hopes to start production soon of a flooring useable in skyscrapers if necessary, called "Flexicord", which costs one third as much as steel while giving equal support for weight.

A summary of the principle factors behind the rising use of light-weight aggregates comes from the January, 1952, issue of "Rock Products" magazine as follows: **

1. The stress placed by the building industry on the importance of "built-in" insulation, sound absorption, and high acoustical values;

2. The fact that loadbearing block may be easily attained with expanding shale (or clay) aggregate, and with a higher yield of block per sack of cement;

3. The comparatively light weight of the expanded shale (or clay) unit, resulting in lower labor costs by reason of the increased output per mason. (The 8 x 8 x 16 inch unit in expanded shale or clay weighs approximately 25 pounds compared to 44 pounds for a sand and gravel unit of the same size.);

4. The recent discoveries of additional deposits of shale and clay in various parts of the United States which have the necessary bloating and strength characteristics, assuring satisfactory aggregate;

5. The increasing scarcity of cinder aggregate, due to the fact that many major industries are

* 27
** 19 pg. 242
changing to powdered coal or oil as a source of fuel;

6. The fact that in strength and volumetric changes expanded shale (or clay) equals or approaches that of sand and gravel aggregate;

7. The improvements made in expanded shale (or clay) plant design insure a low cost, uniformly high quality grade of aggregate.

A point which present aggregate producers would do well to note was made by Mr. Donati when he said "use of light-weight aggregates could cut into present aggregate business as much as 40%". In several parts of the country, large established aggregate producers have gone into the light-weight aggregate field as a protection of their interests. An almost certain development affecting New Hampshire producers is a proposed plant near Worcester, Massachusetts, to produce this light-weight material. The initial investment of such a plant is the only block to its existence — and the need grows daily because of the rapidly diminishing supply of cinders used in cinder block construction.

Almost every aggregate plant has nearby a ready-mixed or transit-mixed concrete company. As a market, this has ranked with the concrete block manufacturers, although the latter is fast becoming more than just a market. One small block producer, Kenneth Allen of Rochester, set up his own sand and gravel plant to meet his aggregate needs. Thus far, no ready-mix company has done this; the possibility remains, however, as a point to be considered by aggregate producers whenever they compute their prices to ready-mix operators.
This discussion of markets may have tended to create the impression that the aggregate business is mere order-taking; nothing could be farther from the truth. The aggregates produced by any given plant are varied in makeup and the demand for them also varies. Every plant has some sizes which are practically unsaleable, even at gift prices. The Manchester Sand, Gravel & Cement Company has at times sold excellent sand at reduced prices just as a merchant marks slow goods down in order to move them. In other cases, a market may exist unbeknowns to the vendor. Mr. John Morton, chief engineer for the state of New Hampshire, and formerly the owner of a sand and gravel company, states that he once had on hand a large amount of 'useless' tailings. During a slack period, he went around to various farms, homes, small industries, etc., and found that he was able to sell all the so-called waste and obtain some fine grading jobs as well. Another time, he went into the loam business and sold, in effect, lawn. Among his customers were the Public Service Company, cemeteries, and private homeowners. In essence, the key man in any aggregate producing company is the salesman, competing with a number of other men, often seeing an advantage disappear.

The recently completed New Hampshire State Turnpike used a large amount of crushed rock. A lesser, but still considerable, amount of sand was needed. The Iafolla Crushed Rock Company was expected to supply all of the crushed rock, and the sand was to come from the Manchester Sand, Gravel & Cement Company. However, to get the necessary sand, the Con-
tractor was forced to buy some of his gravel in Manchester, also.

Another problem is the constant shifting of markets, either due to construction needs or to new methods replacing old. The latter includes the abandonment of concrete road construction by the state of New Hampshire in favor of the bituminous concrete. The result of this change had been a change in the type of aggregate desired. Then, too, the rise of the concrete products industries has opened up new fields, just as the arrival of light-weight aggregates may threaten their markets. A good selling job by the present producers may halt the advance of competitive aggregates; a poor selling job will leave some aggregate producers without markets.
CHAPTER III

THE PRODUCT AND ITS SOURCE

Sources of aggregates are found throughout New Hampshire in various forms. Rock deposits and sand and gravel deposits are present everywhere, the latter as a result of glacial action. The glaciers, as they moved down from the North, carried loose material along with them and this material worked as an abrasive to grind more material loose from the solid mountains of rock. The drift, as this material is called, consists of clay, sand, and gravel—the latter including boulders. Melting water inside the glaciers carried some drift and when the ice melted this was deposited as kames. Internal streams carried other till with a greater gravel content, and deposits of these streams, called eskers, provides us with some of our best gravel today.* The illustration on the next page shows the disposition of soil when glaciers receded in a typical case.

There is an abundance of aggregate material in New Hampshire; however, only a few of the deposits are of any use commercially. The sand on the seacoast, in a belt reaching 10-15 miles inland, tests as very weak and is unuseable.** Many other deposits are weak, or are dirty, or are unworkable for any of a number of other reasons. The State Highway Department's laboratory is constantly testing different deposits, finding some old ones are now good due to lowered specifica-

* 3 pgs. 14-22, 35-40,
** 33, 37
tions, or newly found ones, or that such new ones are no good at all. For example, only a few years ago sand was required to pass a 35% wear test, but now the limit is 40% because the old specification is no longer available in economical quantities.* An area of the state with ample supplies and a good market without any acceptable deposits is Nashua; in a few years, perhaps, lowered standards may make some of the Nashua deposits workable. The state is not the only testing agency, as any project will have its own specifications, such as the Public Service Company dams or the Army Engineers in regard to airforce bases. As the state is the main customer, however, its tests are the most common.

CHART V

THE MOST COMMON DEPTHS OF VARIOUS SURFACE SOILS

GRANELLY "HANNE" NUMMULARs ON LOWER HILL SLOPES RUN @ 42' DEEP
TILL PROVED THICKEST 28' ON THE AVG. HILL TOP
TILL IS OFTEN RATHER THIN 14' ON SLOPES
SANDY "OUTWASH" PLAINS IN VALLEYS AVERAGE 34' THICK
TILL IN VALLEYS RUNS RATHER THIN 14' IN VALLEYS
BED ROCK

COURTESY: "THE GEOLOGY OF NH" PART II - SURFICIAL GEOLOGY
BY J.W. GOLDSHWATE, J. GOLDSHWATE, RP GOLDSHWATE.

* 33,37
The State Laboratory aggregate tests are primarily of three kinds, described as follows:

1. Wear Test, called the Los Angeles Rattler Test, in which the sample is put into a rotating barrel with steel balls and tested for the percentage of breakage.

2. Soundness Test, in which the sample, usually made up into concrete, is soaked and dried alternately in a salt solution to measure its resistance to freezing and thawing.

3. Cleanliness Test, in which the sample is immersed in a Sodium Hydroxide solution to test for the presence of organic matter, and put through a No. 200 sieve to test for dirt.

Tests may establish a deposit as acceptable for use, but there are a number of other factors which will enter into the workability of any deposit. As was pointed out in chapter two, markets are of prime importance; beyond this obvious observation, the potential operator must consider the surface topography, type of deposit, and so forth. The size of the deposit must be enough to support continued operations over a period of time which will enable the operator to make a profit; unless, of course, he uses a portable outfit, and even then the deposit must last until the job is finished. The shape of the deposit, and the topography, will affect the kind and variety of equipment needed. For instance, a
large amount of overburden will force the operator to use heavy bulldozers to strip the gravel bank. This is an expensive procedure, and it cuts the potential profits down. Furthermore, if the bank run is packed hard it will be difficult to remove. Then, if the deposit has any ground water in it further complications may set in. On the other hand, a lack of water in the vicinity will prohibit the effective washing of aggregates.* In many cases the overburden will be saleable, sometimes highly so, such as good loam, and this should be stored in an easily accessible place. Again, the opposite may be true; the overburden may be complete wast, so often the actual case, and this must be removed out of the way of not only present but also of future operations.

The overburden deserves consideration from another point of view than as wast: the attitude of the public. The American Aggregate Company, the worlds largest producers of commercial aggregates, has pioneered the reclamation of worked-over gravel pits. They have spent considerable amounts, of money to turn their exhausted pits into useable property. In one case, a housing development and a public park were built from what had threatened to be an eyesore.** Many localities where aggregates are scarce have been zoned against the working of the few good deposits. At this time no such problem is found in New Hampshire, but there may come a time when public opinion will demand the removal of eyesores like old gravel pits.

* 2 pg. 11
** 17 pg. 102-107
Aggregates come from four distinct types of deposits, only two of which are found in New Hampshire. The first two of the following are worked in New Hampshire:

1. Dry pit or bank deposits, the former being excavation wholly below the level of the surrounding land surfaces, and the latter being excavation at a level with the ground.

2. Trap rock quarry operation with a crusher, done only at John Iafolla Crushed Rock Company in Portsmouth.

3. Wet pit operation where the deposit is below both the surrounding land and also the water table.

4. Marine deposits under lake, river, or ocean water. *

The most desirable deposits are those with the greatest percentage of coarse (½ inch) gravel. Deposits in the state run from 50-50 in the Northern areas to about 25-75 in the Manchester area, sand to coarse aggregate. ** The plant of Kenneth Allen in Rochester has about the ideal ratio of 30-70, which is the average concrete requirement. *** The nature of the deposit dictates the size crusher that is needed to reduce the oversize, and it may also lead to a deficiency in supplying market needs. The Iafolla plant, for instance, does not have the sand needed for many operations and often must bring it 40 miles from Manchester; Manchester Sand,

* 2 pg. 15

** This refers only to workable deposits; seacoast areas have 70-30 distribution, but are no good

*** 26
Gravel, & Cement Company production has an abundance of sand but sometimes runs short of gravel.

The many uses of aggregates require, ideally, a number of different sizes. An example of the extent to which this is carried can be seen at the Manchester Sand, Gravel, & Cement Company where 18 distinct sizes are produced, including nine crushed rock, five concrete, and four miscellaneous sizes.* Seven of these are washed. In any particular case the nature of the plant, and even more so the market requirements, will determine the number of sizes produced. No other plant in the state can make as wide a variety as the one referred to above.

Whenever concrete is an important market for the aggregates, it is necessary to have washing facilities because only washed sand and gravel are used in concrete. Therefore, the mere presence of good markets and deposits does not insure success. Water is needed, and in large amounts. The Manchester Sand, Gravel, & Cement Company uses three artesian wells which produce a total of 1000 gallons/minute into a storage pond which must feed 1200 gallons/minute to keep the plant operating at its 200 t.p.h. normal capacity.** The pumps go overtime to keep up with the demand. Other plants have dammed up streams, or use pond or river water. A second, entirely new plant of the Manchester company, which is about three-quarters of a mile from the main plant, will use water from a dammed-up brook, with the danger that an especially dry

* 31
** ibid
summer may lead to water shortages.

The Iafolla Crushed Rock Company plant is entirely dry. This is a factor which limits the usefulness of their product, and which leaves the Portsmouth area without proper concrete aggregates nearby. The next chapter will discuss in greater detail the differences between the Iafolla plant and others in the state.
CHAPTER IV

PRODUCTION

The basic requirements of any sand and gravel plant are proper material, an adequate supply of water, and sufficient power at a price satisfactory to the user. There are very few uses for material which is ungraded. For cement, the large user of aggregates, washed material is required at all times. There are several types of plants. Most common of these are fixed plants; semiportable plants, which are in reality only fixed plants which can be moved, and portable plants, which can easily be moved from one place to another, are the other two types. Another influence on production is transportation, not only from the plant to market, but also from the bank to the plant itself. Labor, as everywhere else, is a prime concern of the business.

Material must be suited to the market as was seen in Chapter II. This will vary from place to place and depends on whether the market is private or public. Thus the Iafolla Company serves railroad ballast needs, road construction, particularly road beds, hot-mix plants, and the like, but cannot serve concrete users. Water is the key problem for a sand and gravel pit, as cleanliness is the big factor in most of the production. Manchester Sand, Gravel, & Cement Company, for instance, uses 1,200 gallons per minute of water when the plant is operating at full capacity of 200 tons per
per hour of finished aggregates. This water comes from three artesian wells with a total capacity between them of 1,000 gallons per minute, necessitating the running of the three wells before and after the day's work.* The cost of sinking artesian wells is quite large, and wherever possible the company will avoid using this source of water. Other companies will use river water, ponds, or will make their own source by damming up a brook. An example of the damming of a brook will be seen in the new Manchester Sand, Gravel, & Cement Company plant, in which a small brook has been measured and is believed capable of delivering, on the average, enough water to satisfy the plant. The risk with this source of water is that a stream may dry up. The water table may drop too, and in the case of artesian wells the latter can cause large and unexpected expense. Power is normally electric. Wherever the market for aggregates exists in large enough quantity as regards population, the key factor for most markets, electricity is available in plentiful supply for industrial users. When it is not available, such as in out-of-the-way jobs—roads, for instance, or dams—diesel power may be used, or in extreme cases, gasoline-driven motors.

Labor, for the most part, is unskilled. Nevertheless, there are problems, particularly in New Hampshire, of recruiting labor. Any source will normally do, but the type of work is, unfortunately, seasonal. The winter layover of three months or more is not conducive to attracting people

* 31
interested in year-round work. Consequently, a large source of labor will be college students on their summer vacations, or generally low-caliber people who will work in the summer and sit around and collect unemployment compensation in the winter time. Some of the more ambitious people will work for the sand-and-gravel companies in the summer and then will work in the mills in the winter. This floating labor force constitutes about two thirds or more of the labor needed for operation of the plant.* The remainder are a core of employees who must be kept on the payroll the year round. With the Manchester company between ten and fifteen are permanent employees. The total labor force in the summer time can consist of as many as a hundred. The Iafolla Company has twenty to twenty-five permanent employees and will hire fifty more for summer work in and around the plant. For these men there is very little work in the winter time. Maintenance of equipment, snow removal, and so forth will occupy at the most two days a week. Snow removal offers another problem. Since the snow will not begin at nine in the morning or end at five at night, the men who are on call for it must be willing to rise at odd hours of the day or evening, and whoever is in charge of getting them out will often have to get up himself and go rouse them, since a number of the men do not have telephones.

The problem of labor unions in aggregate plants has become greater since the war. Throughout the country most construction jobs of any size involved unionization of the workers.

* 8, 27, 29, 31, 26
To this time that has not been the case in New Hampshire. Certain particular jobs are unionized, notably Public Service Company construction. The aggregate companies have met this by hiring union truck drivers to service those jobs and only those jobs. One of the officials of the state of New Hampshire began a small sand-and-gravel pit in northern New Hampshire to service the Public Service Company dam. The job called for quite a bit of aggregate since the dam was to cost $50,000,000. When he made his bid this gentleman did not contemplate having to pay union wages to any of his men. He soon discovered, however, that the job was unionized and that there was considerable opposition to the use of non-union truck drivers in bringing aggregates. Several of his trucks were run off the road, and he was told in no uncertain terms to unionize the truck drivers working on this job. His objections were founded in the fact that the union normally expected a man to do one job and one job only. Since most truck drivers will have to help at times with the loading of their trucks and almost always with the unloading, this was an unreasonable demand on the employer. Fortunately for this gentleman, the Public Service Company recognized his dilemma and agreed to give him an adjustment in the rates they were paying him for his product to compensate for having to pay union wages and put up with union conditions. The rest of his company was not unionized.

In any aggregate plant a few men will be organized.
These are specialized men, notably shovel operators, bulldozer operators, and the like. Truck drivers are almost never unionized and in no case in New Hampshire are any of the plant employees themselves unionized. There was one strike a few years ago at the Iafolla Crushed Rock Plant. The strike lasted three months and was quite bitter. However, when Mr. Iafolla thought the time had come to do something definite, he loaded all his trucks and drove right through the picket line without an incident, which effectively broke the strike. At another time all the companies in New Hampshire were paralyzed when bulldozer and shovel operators, almost all of whom are unionized, struck. When it was settled, work began again but the strike was harmful for those workers in the plant who had nothing to do with these specialized operators. On the whole, New Hampshire can safely be said to be free of any major labor strife in the aggregate plants, since the incidents mentioned were scattered and solitary cases.

**Chart II: Organization of Manchester Sand, Gravel & Cement Co.*

**Board of Directors**

| Parker H. Rice, Maurice Devine, Winthrop Wadleigh * |

**President**  
P.H. Rice

**Sales**  
P.H. Rice

**Engineer**  

**Foreman**  
12 Men (Plant)

**Scaleman**  
Hired Trucks

**Bookkeeper**  
Clerks

* Mr. Wadleigh represents a large creditor interest

* 31
The typical organization of the plant can be seen from the Manchester Sand, Gravel & Cement Company, in which Mr. Rice serves as the head of the plant in every way imaginable from sales to production to finance. Below him, in charge of the plant itself, is a foreman, and under him, six truck drivers, two shovel operators, a Huff loader operator, a bulldozer operator when needed, and three plant men. Ranking equally with the foreman is the scaleman, whose job is of prime importance because he records the loads, parcels out the work to hired trucks, and decides pay rates.

Delivery in most of the aggregate companies is by hired trucks. A few plant trucks are owned, mostly for intra-plant transportation, both bringing of the bank-run gravel to the plant and distributing the finished aggregates to the storage piles. Iafolla, for instance, uses two double-body dump trucks to haul his crushed stone to the plant. Unlike many of the other companies, however, he has a fleet of some thirty trucks to deliver his finished product. The risk here is great, as the initial cost of trucks is high and upkeep usually great. The other companies, almost every other as a matter of fact, hire their delivery trucks. The Manchester Sand, Gravel, & Cement Company owns six to eight dump trucks, evenly divided between small Fords and large Sterling's. Used mainly for intra-plant work, these trucks are sometimes used for deliveries. They can handle only a small portion of the business, naturally, and so some thirty to
fifty trucks are hired from independent operators. The customary way to pay these men is on a five-cent-per-ton-mile basis.* A few of the companies have attempted to hire on an hourly basis, but this is unwise as it may give rise to abuses such as stopping for a cup of coffee or making repairs on company time. The Manchester Sand, Gravel, & Cement Company pays its truckdrivers a set fee per ton for delivery to given places throughout the state, which averages approximately five cents per ton mile. On state construction jobs the state allows ten cents per ton mile for delivery from the nearest pit if over a two-mile distance away from the job.** The assignment of work to these trucks is normally done on a seniority basis. Those men who have been with the company the longest get the first and best jobs and consequently make the most money. One family in Manchester has five brothers working for the same concern, and during the summer these men average in excess of $200 per week apiece. Of course, in the winter time they have no work. The payroll for the Manchester Sand, Gravel, & Cement Company is $200-250,000 per year for hired trucks and drivers.*** Another reason for hiring trucks is to speed delivery, since the more speed with which a man executes his job, the more jobs he can get. Since this speeding often involves traffic violations, it is definitely advisable to have the men take the risks on their own part and not on behalf of the company.

The operation of the plant itself can be best illustrated by using a series of examples. The first of these is

* 31
** 34
*** 31
CHART VII - CRUSHING PLANT

IAFOLLA CRUSHED ROCK CO.

Portsmouth, N.H.
the Iafolla Crushed Rock Company of Portsmouth, New Hampshire, whose plant is the most expensive, largest, and most efficient in the state. The investment in the plant itself is well over half a million dollars, more than double that of the next largest plant. Its production, one might add, is not double the next largest plant. When this plant was constructed some seven years ago, it was considered the latest thing in crushed rock plants. Rock Products Magazine devoted a complete major lead article to the construction of this plant, its operation, and the results expected from it.* The initial capacity was to be 250 tons per hour with a maximum - and some extra equipment needed for this - of 450 tons per hour. Situated next to a trap rock quarry, the plant receives blast rock from the quarry face. The equipment necessary for this is a drilling crew consisting of ten men, eight pieces of equipment, and countless drills. Also, a drill shop must be kept in operation at all times to insure proper supply of drills. Blasted rock is loaded with a one-and-a-half-yard shovel. Two quarry trucks, each of which is a two-part trailer truck of eleven-ton capacity in each part, haul the rock some 220 yards to the plant itself. As seen in the diagram, the flow of the material is the essence of simplicity. A large gyratory crusher does the primary breaking and sends the material into the secondary building, where it is screened. Larger material goes through a secondary crushing; middle size material goes directly to the final building where it is sorted into

* 8 pg. 122-124
several different sizes by three screens. The reduced material from the three secondary crushers is again run through the first screen and, assuming it is all right, goes on up to the final screening. This operation is the same as the closed-circuit sand-and-gravel plant, only the equipment is far more expensive both in its original cost and its upkeep, and there is no washing process. To the present time Mr. Fuller, superintendent of the plant, says there has been little maintenance cost, but it is to be doubted that this will last for any length of time. One reason for not having too much maintenance cost is the fact that the equipment, which was all installed by Allis-Chalmers, was installed under a rated capacity and guaranteed. Before they were finished, Allis-Chalmers had spent more than $70,000 replacing the crushers so that they had the right ones there.* It was an expensive experiment. The conveyor belts from building to building are semi-enclosed so that the plant may operate in any weather. It does not wash any of its production, since crushed rock generally is considered clean enough if the fines have been screened out. However, since excess material is stored out of doors, it is frequently necessary to clean it before using it if it has been sitting for any length of time, due to the fact that rain and weathering in general will wash dirt to the bottom ten feet of the pile.**

The state of New Hampshire has found it necessary to refuse some of Mr. Iafolla's aggregates on the ground that they were

* 28
** 36,6 pg.126
too dirty. Only after expensive reprocessing through the plant by spraying with fuel oil or kerosene has this material been acceptable. This is one reason that the Iafolla Company has not done as well as was expected originally.

The standard sand-and-gravel plant, of which the Manchester Sand, Gravel, & Cement Company is the largest and best in the state, operates somewhat differently from a crushed-rock plant in that the aggregates are washed. The Manchester plant is a double closed circuit, in effect four sections.* The middle two sections contain crushers. Going in one direction is a crusher which handles only oversized material and turns out unwashed crushed rock and stone dust. The main plant, going in the other direction from the same base of operations, consists of the normal closed circuit. The material is reduced, screened, and goes through secondary crushing if necessary, all material going to the top of the plant where a rotary scrubber washes the aggregates and a rotary screen sizes them. This plant, like so many plants in the field, particularly older companies, has grown as the need arose and without any set plan. It originally consisted of only a crusher and a washer. From time to time, notably since the war, equipment was replaced or added so that the total investment now is approximately $250,000. Norman peak capacity is 200 tons per hour. The plant has running from the various chutes conveyors which will pile sand and some of the smaller gravel aggregates in individual piles apart
from the plant and save the expense of trucking them to the surge piles. By changing the screens when necessary on either plant, a total of eighteen different sizes, from fines up to one-and-one-half-inch rock can be made. These were discussed in the chapter on the product.

A third type of plant is the semi-fixed plant, which can be moved if necessary, but the movement of which is a major undertaking. The Manchester Sand, Gravel, & Cement Company is building just such a plant at the present time. Since it is not completed, the example chosen is the semi-portable plant of Cooke & Company in Scarborough, Maine. The diagram, Chart IX, shows the floor of the plant, the necessary equipment, and lists the cost piece of equipment by piece of equipment. The total cost of this plant, whose capacity is approximately seventy tons per hour, would be $44,600, and it would require upkeep of roughly $2,500 a year. This plant, as one can see, is a closed-circuit operation with material feeding in at one end and coming out at the other end with all the necessary crushing and grading taken care of. Many companies will not use the settlement tank, No. 13, which is expensive; but, like the Manchester Sand, Gravel, & Cement Company in their main plant, will recover the fines during the winter time when business is slack. This new plant of Cooke & Company is expected to be a considerable improvement over the old plant. Mr. A. C. Stanley, president of the company, says: "The new plant actually has a capacity of 150 tons per hour, which is more than we can utilize at present. Compared with
our previous washing and screening operation, this plan saves us two trucks — — at $30 a day each — — and four men — — at $8 a day each. So we save a total of $92 daily or almost $14,00 per year since we work six months out of each year and twenty-five days out of each month. At this rate the plant will pay for itself in less than five years.

"We are actually producing three times as much at less than half the cost. Our maintenance cost on this equipment has been extremely small."

The last type of aggregate plant is the portable plant. It is also the latest type. Growing in use, particularly in states with scattered deposits and scattered jobs such as the state of Maine, this plant may be a coming thing in the aggregate field. Chart X shows and gives the cost of a Cedarapids Junior Tandem Straight-line plant with washer attached.** This plant can produce fifty to a hundred tons per hour and will last approximately ten years. The cost is very substantial, $65,210. The plant itself is easily movable, capable of being knocked down and set up again in the same day. The washing attachment would take at least two days to knock down and re-erect and maybe longer. The two plants can be used separately. The intricacies of the crusher can be observed from the figure. If one were to look at it, one would see bank run being fed in at one end and aggregate of a given grade coming out the other end. Sand comes out independently on a separate conveyor. Inside the plant

* 18 pg. 82
** 24
CHART X - PORTABLE PLANT
CEDARAPIDS JUNIOR TANDEM
itself are two crushers and a grader as well as an elevating wheel to take the crushed aggregate back onto the belt for grading.

The type of plant which any given operator will have depends on the size of his deposit, the nearness to the market, the power, and the water. If the deposit is large, the market close, a fixed plant is indicated, especially if the market is a large one. If the market should be somewhat limited, for instance, power company dam or a road in a rural area, which requires a large amount of aggregate, a movable plant would be indicated. The limited deposit and steady market favors semi-fixed plants, with a single job for which no other use to any plant would be indicated favoring a portable plant. For instance, one state in the Pacific Northwest certifies deposits throughout the state, and the successful bidder for any contracting job takes his portable and sets up right on the job at the nearest pit, moving on to the next job when that is done.* The semi-portable plant of the Manchester company is semi-portable for the reason that its present location has a deposit with a large percentage of sand. It may at a later time be deemed advisable to move this to a location with more gravel content. Less than ten years ago portable plants were a novelty. In 1940 a student at M.I.T. wrote a Master's thesis on the possibility of setting up a portable separator for bank-run aggregate.** The market permanence, the length of the job, and particularly the trans-

* 12 pg. 103
** 2
portation from the nearest pit are factors which will lead
the contractor to bring in a portable rather than try to use
available aggregate supplies from established producers.
Furthermore, if he is held up for an abnormally high price,
the contractor can often get lower price merely by threat­
ening use of a portable.* The outstanding contribution to
the use of portable plants was the J. Perini Company construc­
tion of the Maine Turnpike six years ago, as all the aggregates
for this job came from portable plants. There were four port­
able s used, one of which was owned by the state of Maine, and
is still operated by the state of Maine, and three of which
were owned or leased by the Perini Company. One of these
plants was brought all the way from Nevada. Speaking of the
use of these plants in Maine, Mr. W. D. Lenhardt, editor of
of the Rock Products Magazine, said: "The point --- is ---
the producer must go to the job and not the job to the prod­
cuer, and if the producer won't do it, the contractor will."**
Often, as was the case with at least one of the plants on the
Maine Turnpike job, the company stays. Even in the most re­
move region there may be a definite need for aggregates. For
the most part, the operators of these portables move around
very much as the huge combines do in the grain belt. They are
migratory; the workers sleep in tents or whatever housing is
available, and they may work in one section of the country at
one time and in another section the next month. Perini used
one of his plants in a job in northern Maine a year after the

* 29
** 10 pg. 88
Maine Turnpike was finished.*

Two contractors have used portable plants on particular jobs in New Hampshire, but so far that is the only use that has been made of such plants. R. G. Watkins of Amesbury, Massachusetts contracts a number of jobs in New Hampshire, and it is said that he plans to buy a portable plant and operate it there in the coming year. It is worthy of note that the operation of the portables may well be a coming trend, if not by the contractors on the job, then by the established producers, who find it more economical to move a portable plant to the scene of a job than to truck the material thirty or forty miles. The trouble here, at least as far as New Hampshire is concerned, is that the number of good deposits available seem to be concentrated in a few areas, and the control of these deposits has been established by the companies already there.

There is one other type of aggregate plant. As yet there is none in New Hampshire, and it is unlikely that there ever will be, since New Hampshire offers a small market. However, these plants, for the production of lightweight aggregates, are being built, and it is quite likely that one will be built in or around Worcester, Massachusetts.** Aggregates from this plant would serve people in New Hampshire who use the lightweight aggregates. They could, therefore, cut into the business of the established producers. The cost of one of these lightweight plants is estimated at a minimum of half a million dollars. They resemble cement plants; the product

* 29
** 27
that they make is the result of heating at very high temperatures almost any inferior aggregate and then cooling it suddenly, producing a puffed up and very strong material. The uses of these materials, as was pointed out earlier, are just now becoming known,¹ and it remains to be seen whether New Hampshire would provide a large enough market to warrant such a large investment or whether a Massachusetts plant can take care of any needs which its northern neighbors may have.

¹ Chapter II
CHAPTER V
ADMINISTRATION

The administrative concerns of management are finance, credit, and overall policy. The top personnel usually consists of an office manager, and frequently the only office manager is the president, who also serves as sales manager, production manager, and anything else you might wish to give him. In a large company, there may also be a credit manager who would also deal with financing. Furthermore, the company should have a good lawyer on call at all times. Other personnel would be an engineer if much contracting work was done, definitely a bookkeeper, who in effect might really be the office manager, and one or more clerks. Nepotism is noticeable because this is a small business, and it is only natural that a man wishes to have his son or son-in-law follow him.

The financial problems of an aggregate producer are many and varied. As would be expected, the large capital investment for the plant is only a starter.* Normally this money would be the proprietor's own. His sources of additional capital, banks, insurance companies, and finance companies, would want some equity behind any loans they might make to the company. These loans are definitely necessary, since working capital normally exceeds the plant equipment investment. The need for working capital is caused by the nature of construction work, in which the job is frequently not paid

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for until it is finished; all the suppliers have to wait until the money is paid to the contractor. Accounts payable, of course, can be juggled; in fact, that is one of the main functions of the office. At least one major company in New Hampshire runs from thirty to ninety days behind on all bills. Working capital can sometimes be obtained through a revolving loan with a bank. The need for money is greatest during the summer, and almost vanishes in the winter time.

The New Hampshire State Engineer who began a plant in the north of the state started with little money. He had a small plant, a few trucks, a shovel, and many debts. Through hard work over a period of a few years he built up a good plant and found that he owned everything free and clear, but that he had no money in the bank. He needed working capital and so had to mortgage his equipment. This is a common occurrence in the field. He eventually sold out and discovered that he had made quite a profit, but admitted freely that he could not have continued himself because he had no way of financing the necessary expansion. Money for expansion is hard come by for any small business. Friends, relatives, or interested people may become backers, but it is definitely a speculation, and as such the money comes at a dear price. Therefore, most companies will seek to expand through reinvestment of earnings wherever possible. This has been true in New Hampshire, as seen by the Iafolla Company, which used mostly its own money, and money borrowed from a bank with the plant as security, to finance
construction of its plant.

The credit problem for any of these aggregate plants, and in New Hampshire they are all small ones, is that receivables take so long to collect. The large jobs particularly require a wait, since even the contractor is not paid, frequently, until the job has been tested in operation. Small people, the individual contractor for instance, building a house or a factory, operate on very close financial backing and involve considerable risk. The operator of the sand-and-gravel company must weigh these risks, and in most cases he would accept risks which other people would consider quite doubtful. In short, he must know his customers very well.

One other big problem financially for the sand-and-gravel company is the problem of taxes. The stock-in-trade tax of New Hampshire a considerable problem, not only for these companies, but for every small business. Whenever an inventory is to be kept any length of time, the owner runs the risk of multiple taxation. This does not encourage large inventories nor does it help business. Depletion allowances are also inadequate, a fact which is deplored in the editorials and articles of almost every issue of the industry's magazines. The New Hampshire companies, located for the most part on inexpensive property, have not had very much depletion trouble. For instance, the Manchester Sand, Gravel, & Cement Company owns or leases property with an estimated $500,000 worth of gravel in it, yet property cost only $15,000. The problem

* 31
of Federal income taxes has bothered business throughout the country as well as individuals. Maintenance expenses can be charged quite logically toward income. Since this is the case under the present tax structure, any maintenance charges might be said to be half paid for by the Federal Government.* This has led to over-maintenance of all equipment, and in the case of any large company means that the plant and equipment is undervalued. Maintenance costs money just as cash expenses for taxes do, and just as much as taxes can drain the bank account, so can maintenance. Almost every aggregate producer is always short of cash. The financial officer, therefore, is constantly on the lookout for ways to either conserve cash or to obtain more of it. In fact, most of them seek to obtain as much money as is possible. Even so, they still run short, for no sooner do they get the money than they have it spent.

* 13 pg. 96
CHAPTER VI

OTHER MANAGEMENT PROBLEMS

The management of any business is concerned with the extent of its operations, its overall policies, and, in the case of small business, with the problem of succession. The aggregate producers have the same concerns as any other business. As to their extent of operations, sooner or later every company desires to expand. When business is good, they seek more business in order to get higher profits. When business is poor, they seek to expand by diversifying in order to get some profits. In any case, after a certain length of time, everyone wants to expand.

Sand-and-gravel producers, especially since the war, have sought to expand to related industries. Almost every plant has an asphalt or hot-mix plant connected with it. An example of this is seen in Manchester, where Mr. Lindsay Rice, formerly assistant to his brother, Mr. Parker Rice, severed his connections from the sand-and-gravel company to set up an asphalt company. His plant is located on Manchester Sand, Gravel & Cement Company property and uses Manchester Sand, Gravel, & Cement Company aggregates. The market is different, consisting primarily of cities and private individuals rather than the state, but, nevertheless, is a very profitable one. Mr. Lindsay Rice has had quite a bit of success with his company. Another nearby company

* 30
is a ready-mixed concrete company, and still another is the Duracrete Company, makers of concrete building blocks. Duracrete was discussed in the chapter on uses, and one should note that Mr. Donati feels that there is a great future in his business, but that lightweight aggregates may well replace the standard sand and gravel used at present.

There is no denying that there is a good future in all these related fields, but one would do well to ask where the money will come from. This lack of money is all that prevented Mr. Parker Rice from establishing the sidelines near his company himself. The only way to do this normally is to borrow or to take in a partner, and, in Mr. Rice's company's condition, neither could be done. The example of Mr. Iafolla is a case where conditions were reversed, for he was originally a contractor, and he decided to go into the aggregate producing field. His investment of a million dollars in plant and equipment for his crushed-rock plant is subject to close scrutiny by the student of aggregate production. He is located in a large-population area, but has a limited market due to the problem of cleanliness in his products and the fact that he has no sand to offer. He might do well to consider getting a portable plant for the production of sand, since there are deposits not too far away from his plant which are acceptable for any use which might be contemplated.

Contracting is the normal other field for a sand-and-gravel producer. The usual beginning is like the gentle-
man in the north of New Hampshire had. I have referred to him before. His original investment was very small. In slack periods he used his shovel for small excavation and ditch jobs. Before long he had one or two extra, specialized, pieces of equipment. At first, an operator like this will rent his equipment. Later, however, he will try to buy it. The danger here is that the growth may be too rapid. Rapid growth if consolidated can be good, but if not consolidated can lead to the tumbling down of his business.

The Manchester Sand, Gravel, & Cement Company is the best example of a company which has expanded rapidly. In 1940 the company got its first major contract, a $135,000 job in Boscawen, New Hampshire, and showed its first really substantial profit in several years, $9,700. Of course, for many years, Mr. Rice had taken his profits in salary, since he owned ninety-eight per cent of his stock. With the advent of the war and the preparedness buildup, a number of airbases were built. One such base was Grenier Field in Manchester, New Hampshire, on which the Manchester Sand, Gravel, & Cement Company was low bidder for as much work as was to be civilian performed. Mr. Rice attempted to cut the specifications to close, and expanded his company rapidly to get the equipment necessary to do the job. When he discovered that his material would not be acceptable, and he had to use more expensive aggregate brought from a greater distance away, the company lost a considerable amount of money. The contract loss am-

# Chapter V, pg. 55
ounted to nearly a hundred thousand dollars. Even today, Mr. Rice has not been able to relieve himself of the burden that this loss created. With the addition of this new equipment, the company's fixed liabilities rose and the overhead rose even more on a percentage basis. The contracting business is a risky one. In order for equipment to be used and to pay its way, it must be used as often as possible and for this reason many companies will take loss jobs rather than see their equipment lay idle.

For a few years after the war, Mr. Rice increased his equipment very little as he stuck primarily to the sand-and-gravel business. However, in 1950, he foresaw the need for much contracting in the state of New Hampshire, particularly from the newly adopted fifteen-year program of rebuilding the state roads. He re-entered the contracting field, and he invested over $300,000 in new equipment. Since he wished to enter the contracting business on a large scale, he did as most contractors do, and used another corporation to buy most of his equipment, renting it in turn from that corporation. This is a common means of operating. It often results in the contracting company losing money and the equipment company making money. In this particular case, such an arrangement would be detrimental to the creditors of the parent company and has been frowned upon.

Final analysis of any decision to expand a company rests in the profitability of that decision. Admittedly,
two years is a short time in which to judge results of such an operation. However, from the results of those two years, the successfulness may be doubted. They have been so poor, in fact, as to make the casual observer wonder if the move was wise. The earnings of the company for the period before 1950 averaged over five per cent after taxes of the total investment. Since 1950, however, sales have risen as contracting has become a major portion of the company's business. Earnings have risen in total amount, but have declined as a percentage of the total assets to roughly three per cent. Earnings on the new equipment, to look at these earnings from a different point of view, have been only 3.7 per cent; bank loans to finance this new equipment cost 4½ per cent. Of course, in all fairness to the company, one might point out that the bank interest is before taxes, and the profits are after taxes. Still and all, this is not a favorable trend.

The decision of any aggregate producer to enter the contracting field is always at the time a good one. However, many factors which should be considered are overlooked. The heavy investment and consequent high cost of carrying it appears negligible next to the possible profits. These profits, however, are only possible and may well result in losses instead. The need to get business at any price, particularly true if there are large numbers of contractors competing for what business there is, will drive the individual to make a bid which is figured very close. As pointed out earlier, one

# See profits trend Chart II
recent bid in the state of New Hampshire contained eight bids within $34,000 of each other on a $331,000 job. To the individual entrepreneur a gamble is the essence of business life. However, no gamble should be taken without first fairly weighing all aspects and eliminating any great optimism with which the original prospect may have been viewed.

Throughout history construction companies and related industries have always been closely associated, usually unfavorably, with politics. The past record has been decidedly shaky. Specifications, for instance, could be tailor-made to suit a particular company who sold at a high price where another company's lower-priced materials would have done the job just as well. There are some people who believe at the present time that this is the case with the reactive-aggregates theory, in which aggregates having certain chemical properties are barred from use in concrete. Another example of a similar thing is seen in Massachusetts, where addition of fifty cents or a dollar's worth of rubber to asphalt mix entitles the vendor to sell it for nine dollars a ton more, and yet the state encourages the use of it on these so-called "rubber roads." Still another political hookup is seen in the collusion of contractors and politicians to put special features into a given road, the most notable occurrence of which was the Merritt Parkway in Connecticut. Another example closer to this time was the case in Massachusetts of numerous signs which were made and which would appear to have had some
outcome on a state election. A case in New Hampshire just last year was the charge made by the state that Mr. Rice and Mr. Rotundi, of a Melrose contracting firm, conspired to fix the price of a stretch of highway in New Hampshire. Mr. Rotundi's company won the bid by less than a thousand dollars over Mr. Rice's bid, and immediately subcontracted the job to Mr. Rice. The newspapers in the state had a field day, claiming everything from collusion between the contractors and the state officials to the fact merely that the two contractors were crooked. Nothing was ever proved on either, nor am I attempting to draw any conclusions. Nevertheless, the resulting bad publicity was good for none of the people concerned, not for the industry, nor for the New Hampshire roadbuilding program. Furthermore, certain principals attempted to make a political issue of this case, which further aroused public resentment of contractors.

Contracting as such can often result in particularly dishonest actions on the job. In some cases the inspector for the state or government is not above reproach. There have been occasions where very poor aggregates were used on a job and passed for that job, and where later on it was found possible to prove that the inspector had been bribed. In other cases, less easy to prove, the inspector has refused to pass perfectly good work until he was given certain concessions. It is fortunate, indeed, that these are exceptions and not the rule, for on the whole most con-
tracting is much more honest than people assume due to the fact that bids are public and competitive, and trick specifications are no longer common.

The last and least discussed problem of management is the succession to the control of the company. Since most aggregate companies are small companies, not only in New Hampshire, but throughout the country, they are one-man businesses. When this owner dies or retires, what is to happen to the business? Most of the time a son or nephew will enter the business and eventually take it over. However, there is no guarantee that he will do a good job. Furthermore, should the owner die without leaving an heir who can manage the company, a forced sale will frequently be necessary and forced sales are usually at a discount. In fact, one might note that there are always a number of good bargains in the line of small businesses of all kinds available for some one who has the money to buy. The problem of succession cannot be easily handled, but is one with which management should be concerned.
CONCLUSION

The production of aggregates has had a growth so typical of the whole country, as from almost nothing the industry has become of major importance in a very few years. Let no one think that this growth is ended; not only will the industry continue to grow, but it would appear that it might well undergo changes as great as any in the past. The stabilization offered in New Hampshire by the long-range State roadbuilding program assures the producers of at least some constancy of market. The increased uses of concrete, both of the conventional kinds and of the new lightweight ones, indicate that markets will expand. However, if the lightweight aggregates become available in larger quantities, the established producers may lose some markets; furthermore, the addition of portable plants to the standard lines of contracting equipment could cut into present sales. As more efficient plants are built, older ones become money losers. The overly large percentage of the market served by the Manchester Sand, Gravel, & Cement Company is bound to entice competition for this firm; it may be that a little competition would be good for the company. The cyclical and seasonal nature of the business in New Hampshire is not going to change, and in their effort to expand, more of the aggregate producers may enter related fields. These are the points which warrant conclusions.

The companies in New Hampshire all grew up to meet
definite needs. As this has been the case in the past, it will hold true in the future. A look at the population map on page 17 shows that there is little need for any new companies in the northern part of the state. However, the Federal government has for some time had plans afoot to build four flood-control dams in the northern wilderness.* There is no real supply of aggregates in that area, and if the dams were constructed a source would have to be developed. Perhaps someone might set up a portable unit to handle the job. The established companies would do well to consider this.

The use of portables has been proved the best way to operate in sparsely populated areas. The division of the aggregate plant into several units rather than one large and unwieldy one has made the plants extremely mobile. The only restriction would seem to be the legal load limits of the roads traveled. Writing his annual review in the January 1952 issue of "Rock Products," Walter B. Lenhardt said

"--it is our belief that a portable plant can be as much a part of an established producer's plant set-up as his portable shovel and other mounted items."**

The success of this type of operation in western states has proved the validity of Mr. Lenhardt's observation. In New Hampshire all major jobs are not located in any one area; in fact, they are few and far apart as a rule. At the present time portable plants are indeed an expensive proposition, but with transportation costs so high and looking like they

*36
**11, pg. 161
will continue to rise, the prospect of "moving Mohammed to the mountain" is appealing to the producer.

The decreasing sources of good aggregate in New Hampshire is another point in favor of the adoption of mobility in the scheme of operations of the producer. Perhaps if a portable unit were used the large market in the Nashua vicinity which now has no plant to serve it would be able to have a supply. The impending construction of a $25,000,000 toll road from the Massachusetts line at Tyngsborough to Concord, the "Central New Hampshire Expressway", will require a lot on material. Since some of this will have to be trucked 30 miles or more from Manchester, at a cost to the state of as much as $2.80 a ton extra, the price of a portable plant seems small. However, the one drawback at this time is the lack of suitable known deposits in the vicinity.

The Newington Airbase offers another fine opening for a portable set-up. The nearest large supply of sand is, again, 35 miles away in Manchester. There are some usable deposits in the vicinity, however, and the Air Force can hardly be expected to pay the large transportation fee to get the sand from Manchester. Politics could become a factor here, as the local companies may try to assure that they hold this vast potential market. Mr. Lenhardt made a statement applicable to such jobs as the Newington one in his observations of 1949, saying
"Everyone seems to be yelling for a reduction in the spending of the Federal government but, at the same time, all are trying to get their feet in the public hog trough though insisting that their particular project is essential to the nation's welfare." *

A number of people have raised the objection that with a perfectly good airfield at Manchester, why do they need a new one only 40 miles away? With the present wave of economy in the government it is entirely possible that the whole project will be sidetracked.

Another trend in production of aggregates is the rise of semi-automatic plants. The plant of the D. D. Ruxton Company, Inc., of Ludlow, Massachusetts, is built to be run by four men. One man operates the shovel, another the truck to haul the material from the bank to the plant, a man to handle the bins, and one man to run the plant from a central control panel. ** With labor, even unskilled labor, so dear these days, such a plant is a very low-cost producer.

The present non-union status of sand and gravel plants will probably continue in New Hampshire. The nature of the work, and the fact that it is impossible to stabilize the work-year make a fixed, strong labor force unlikely. Only a strong group can successfully organize. Management must be constantly on the lookout to avoid unions, however, for if they once become entrenched the job of running an aggregate plant as now constituted will be impossible. The continued use of hired trucks is a factor in favor of the producers, since every truckdriver is an individual entre-

* 9, pg. 104
** 14
preneur, and as such will resist collective organization.

The increasing number of uses for concrete will most certainly lead to an expansion of the range of operations for producers. They can hardly be expected to be content to let others make the new products and merely sell aggregates to them; rather, it seems as if the producers themselves will enter the new fields and do so in a big way. This trend is already noticeable in the addition of asphalt plants to every aggregate plant and the nearby ready-mixed concrete companies. There also remains the possibility that the concrete men may do as Kenneth Allen did and build their own sand and gravel plants.

This new market will in time use more and more lightweight aggregates. At this time there is no ready source of such material, but when and if it becomes available in a substantial amount, the established producers will have to face the loss of some of their markets. It could well be that one of them will beat the change by joining it and building a lightweight plant. That will not be likely in New Hampshire, but could be the case in some nearby section of Massachusetts. It is likely in this case that a serious political hassle will develop as aggregate producers seek to prevent liberalization of building codes to keep the lightweight materials out. Again, this is mere conjecture.

Taxes are another worry of the aggregate producer.
which are due for a change. As more liberal depreciation and depletion allowances are given, profits should rise.

The stock-in-trade tax, too, may be repealed and this would be a boon to New Hampshire business. All of such reforms, however, are hard come by and can be won only after strong and aggressive battles with the government.

The cyclical nature of the construction field is hardly likely to change. It therefore behooves those businessmen who work in related fields to guard against over-extending themselves. This is particularly true of the aggregate producers who seek to enter the construction business itself. When they are merely suppliers, they take little risk. Entering a competitive and dangerous foreign field, however, they leave themselves open to severe setbacks. Loss of two or three key contracts can make a contractor so desperate that in his haste to get some business he will make his bids too close. The losses mount up rapidly on a poorly figured job, and there is no way to get a readjustment or to cut them short. When the Manchester Sand, Gravel & Cement Company was engaged in its big losing contract during the war, every truck that went out of the plant to the airbase represented a loss of ten cents. It does no good to cry, either, as that was a calculated risk which was figured much too closely.

Machinery to build roads costs so much that to pay for it the operator must keep it in use as much of the year
as is workable. By assuming the extra burden of this debt, as well as trying to figure bids on a strange job, the producer may well tackle too much. Since losses can mount up so fast, he can lose everything quickly. With the competition as close as it is, he does not stand to make the correspondingly big profit which would compensate him for the risk. Unless his position is strong, one can hardly conclude otherwise than that the businessman should leave the extra risks alone. This is particularly true in a heavily cyclical business.
STATE OF NEW HAMPSHIRE
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CONCORD, N.H.

CONSTRUCTION AND ASPHALT-
PESTONE PROGRAM

This program starts July 1, 1953 or on completion
of the present program and is scheduled for completion
June 30, 1955.
<table>
<thead>
<tr>
<th>TOWN</th>
<th>ROUTE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lancaster</td>
<td>US 3</td>
<td>Starting 0.1 of a mile south of the Lancaster-Northumberland town line, this project runs south about 2 miles eliminating several dangerous curves and relieving extremely hazardous conditions at railroad crossings.</td>
</tr>
<tr>
<td>Stratford</td>
<td>US 3</td>
<td>This project is in two sections. One begins 0.9 miles south of North Stratford Village and runs south 1.1 miles — the other starts just north of the village and runs north 1.5 miles — a total of 2.6 miles in the two sections.</td>
</tr>
<tr>
<td>Carroll</td>
<td>US 3</td>
<td>Correction of dangerous curves and excessive grades is accomplished by this project which starts at the Whitefield-Carroll town line and runs south for approximately 2.2 miles.</td>
</tr>
<tr>
<td>Littleton</td>
<td>NH 18</td>
<td>Starting near the east junction with route 135, this project runs westerly for about 6 miles on new location. The relocation is to be around the Upper Fifteen Mile Falls development and will be essential to maintain highway service in the area as the present highway will eventually be inundated.</td>
</tr>
<tr>
<td>Lincoln</td>
<td>US 3</td>
<td>A deficient section of route 3, one of the state's main north-south routes, will be corrected in this two-section project totaling 3 miles. The first section starts at the flume and runs south over extremely rough and narrow highway for two miles. The second section is a miles of highway between Harvard Bridge and the Woodstock line.</td>
</tr>
<tr>
<td>Campton</td>
<td>US 3</td>
<td>Dangerous curves and an extremely expensive section of highway to maintain is the basis of this project. The piece to be corrected begins at the Plymouth town line and runs north for 2.7 miles, is an Interstate System project.</td>
</tr>
<tr>
<td>Rumney</td>
<td>NH 25</td>
<td>Poor drainage, bad alignment and almost impossible to maintain in the winter describes this 2 mile section of highway starting at the Plymouth town line and running northwesterly.</td>
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<tr>
<td>TOWN</td>
<td>ROUTE</td>
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<tr>
<td>Manchester to Mass. Line</td>
<td>US 3</td>
<td>This project will continue the four lane construction started under the present program. The 1952-53 fiscal program calls for two projects between Manchester and Nashua. Since the exact amount of work which can be accomplished under the present program has not been determined the exact location of the no-project cannot be specified, but approximately $2,000,000 is reserved for work on this highway.</td>
</tr>
<tr>
<td>Milford-Imherst</td>
<td>NH 101</td>
<td>From the Milford Compact this project runs easterly for about 1.9 miles correcting a seriously deficient highway.</td>
</tr>
<tr>
<td>Wilton</td>
<td>NH 101</td>
<td>This continues the 1952-53 program work on route 101 and corrects a hazardous and unsatisfactory highway condition at West Wilton. Starting at the Temple town line, the project runs easterly about 1.9 miles to a junction with 101-A.</td>
</tr>
<tr>
<td>Intrin-Bennington</td>
<td>US 202</td>
<td>Part of a long range program for the complete rehabilitation of Route 202, this project runs from recent construction just south of Intrin-Village southerly about 2 miles, partly on new location to eliminate several bridges and a narrow railroad underpass.</td>
</tr>
<tr>
<td>Meredith-Center Harbor-Moultonboro (partly in Carroll County)</td>
<td>NH 25</td>
<td>This rehabilitation of two seriously deficient sections of route 25 will make a long stretch of this major highway an entirely modern road. The two sections total about 2.55 miles. The first starts at U.S. 3 in Meredith village and runs northeasterly for ( \frac{3}{4} ) of a mile. The second begins near the Meredith-Center Harbor town line and runs northerly for 2.3 miles.</td>
</tr>
<tr>
<td>Alton</td>
<td>NH 28-11</td>
<td>Beginning at the junction of routes 28 and 11, south of Alton, this project runs north 4.2 miles along the old railroad bed a secondary and town road to a new junction with route 28 north of Alton Bay. This is designed to alleviate serious deficiencies in width, curvature, drainage and congestion of traffic on the present route 28 and to enhance the value and scenic attraction of Lake Winnipesaukee by diversion of heavy traffic away from Leefront cottages and developments, as well as to facilitate motor</td>
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<tr>
<td>TO'H</td>
<td>ROUTE</td>
<td>DESCRIPTION</td>
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<tr>
<td>Durham</td>
<td>US 4 NH 108</td>
<td>A bridge and approaches over Beard's Creek just east of Durham village to correct a serious hazard now presented by poor alignment and deficient width of stream crossing.</td>
</tr>
<tr>
<td>Conway</td>
<td>US 302</td>
<td>Starting at the Maine state line and running westerly about 2.2 miles. This project will not only correct a serious road deficiency but furnish an adequate route from east central New Hampshire to Maine.</td>
</tr>
<tr>
<td>Wakefield</td>
<td>NH 16</td>
<td>Part of a program for the complete rehabilitation of route 16, this project starts at the Ossipee town line and runs southerly about 3 miles, correcting highly unsatisfactory conditions.</td>
</tr>
<tr>
<td>Sunapee</td>
<td>NH 103</td>
<td>One section of this project fills the gap west of the 1951 project along Lake Sunapee. The other section runs south from the junction of route 11. Total length for both sections - 1.7 miles.</td>
</tr>
<tr>
<td>Sunapee</td>
<td>NH 11</td>
<td>Beginning at the junction of routes 11 and 103 this project runs easterly for about 2.4 miles correcting serious deficiencies.</td>
</tr>
<tr>
<td>Hopkinton</td>
<td>US 202 NH 9 NH 103</td>
<td>About 3 miles of construction. Part of the route 9 rehabilitation program. Corrects dangerous curves at both end of Hopkinton village one of which has an extremely high accident rate. At the same time it is hoped to solve the traffic congestion and excessive grades on Diamond Hill.</td>
</tr>
<tr>
<td>Pembroke-Epsom</td>
<td>NH 28</td>
<td>Beginning at the 1952 Pembroke-Epsom project, one mile south of the Epsom line, this job runs southerly about 4 miles to US 3. Corrects a very poor stretch of road and will make a convenient and adequate junction with US 3.</td>
</tr>
<tr>
<td>TOWN</td>
<td>ROUTE</td>
<td>DESCRIPTION</td>
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<tr>
<td>Warner</td>
<td>NH 103</td>
<td>Starting 0.4 miles east of the Warner-Sutton town line and running easterly 2.1 miles, this job corrects dangerous curves, poor alignment and inadequate width.</td>
</tr>
<tr>
<td>Cheshire County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keene</td>
<td>NH 9-10</td>
<td>This job includes about 0.6 miles of construction to improve the junction of routes 9 and 10 north of Keene and relieves an extremely hazardous condition which has caused numerous accidents. Will also solve problems currently caused by excessive grades.</td>
</tr>
<tr>
<td>Keene</td>
<td>NH 12</td>
<td>Starting 1.3 miles south of the Surry-Keene town line and running one mile southwesterly. Corrects a section of inadequate width which has generated accidents. Part of programmed rehabilitation of route 12.</td>
</tr>
<tr>
<td>Westmoreland</td>
<td>NH 12</td>
<td>Beginning just north of the junction with route 63 and running northerly about 3 miles. Continues road finished in 1950 northerly to correct inadequate width and dangerous curves and pitches.</td>
</tr>
<tr>
<td>Rockingham County</td>
<td></td>
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</tr>
<tr>
<td>Candia</td>
<td>NH 101</td>
<td>While the exact length of this project is presently unknown, it will start at the Auburn-Candia line and run northeast to correct deficiencies in 101- part of the general rehabilitation of this major east-west highway- and will provide better highway service to Manchester.</td>
</tr>
<tr>
<td>Hampton</td>
<td>NH 1-A</td>
<td>This project depends entirely upon legislative approval of a seawall item in the capital budget. Four lanes of highway 1.6 miles in length to go along new seawalls.</td>
</tr>
<tr>
<td>Hampton</td>
<td>NH 1-A and Marsh Ave.</td>
<td>1.2 mile resurfacing project on Marsh Ave. and Ocean Boulevard at the same time changing over to one way traffic. This job also depends on capital budget fund improvements (not for actual highway work). These two projects (see above) are designed to solve congestion and traffic hazards.</td>
</tr>
<tr>
<td>Exeter-Stratham</td>
<td>NH 101-108</td>
<td>Widening and resurfacing from the Exeter compact easterly 4.5 miles including improvement of the intersection of routes 101 and 108. Part of the long range plan to renovate route 101 and relieve a situation causing numberous accidents - mainly a deficiency in width.</td>
</tr>
<tr>
<td>TOWN</td>
<td>ROUTE</td>
<td>DESCRIPTION</td>
</tr>
<tr>
<td>-----------------</td>
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<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Errol</td>
<td>NH 26</td>
<td>Bridge and approaches at Corser Brook about 1.3 miles east of the Millsfield-Errol town line, to replace a narrow, weak bridge with undermined abutments.</td>
</tr>
<tr>
<td>Stark</td>
<td>NH 110</td>
<td>Starting about one mile west of the Dummer-Stark town line and running westerly 2.7 miles.</td>
</tr>
<tr>
<td>Whitfield</td>
<td>NH 116</td>
<td>This project runs from Whitefield village southerly about 2 miles on new location to improve the steep grades on the present road. This project is part of long range program for Routes 116 and 3 in Whitefield designed to alleviate steep hills and hazardous railroad crossings and to facilitate and improve vehicular movements in to Whitefield and further north.</td>
</tr>
<tr>
<td>New Hampton</td>
<td>NH 104</td>
<td>Starting at the Pemigewasset River Bridge and running easterly 2 miles to a junction with Route 3B, this is part of long term plan to provide a direct modern highway from west central N.H. to the Lakes Region.</td>
</tr>
<tr>
<td>Laconia-Belmont</td>
<td>NH 106</td>
<td>Beginning at the Laconia compact and running southerly about 2 miles to improve the line and grades. This project is a part of the plan for complete rehabilitation of Route 106. It will provide a modern and adequate entry into Laconia from the southeast. Present road is substandard in all respects. It has excessive grades, two dangerous curves and is impossible to maintain in safe condition.</td>
</tr>
<tr>
<td>Springfield</td>
<td>4th NH Turnpike</td>
<td>Beginning at the Wilmot-Springfield town line and running westerly 1.5 miles, to complete the unsurfaced section of completed State Aid. This will open up a large section of the state not now served by an all weather road.</td>
</tr>
<tr>
<td>Rochester</td>
<td>NH 125</td>
<td>This 1.5 mile job is designed to eliminate highly unsatisfactory conditions in Gonic. Part of the old railroad bed west of present Route 125 will probably be utilized. The major increases in traffic on Route 125 require a correction of existing unsatisfactory conditions.</td>
</tr>
</tbody>
</table>
conditions of the Rochester area is to obtain the benefits of work on the same route to the south.

MERRIMACK COUNTY

Loudon
NH 106
Starting at the end of 1951 construction, about 5.8 miles north of the Concord town line, and running northerly about 2 miles. Part of the overall program for rehabilitation of dangerous and substandard conditions currently existing on routes.

CHESHIRE COUNTY

Alstead
NH 12A, 123
Starting at the junction with Route 123A and running southeasterly about 0.9 of a mile to the junction of 12 A and 123. To eliminate substandard and hazardous deficiencies particularly in width and drainage.

Hinsdale
NH 119
Widen and resurface with road mix pavement, starting at the Brattleboro Bridge and running southerly. Current road is substandard and dangerous for heavy traffic loads carried.

Richmond
NH 119
Starting 0.3 of a mile east of the Winchester-Richmond town line and running easterly 1.5 miles, also a box culvert at Fully Brook about 0.8 of a mile west of the Fitzwilliam Town line. This will correct substandard conditions currently existing.

HILLSBORO COUNTY

Weare
NH 114
Beginning just northwest of the New Boston-Weare Town line at Flood Bridge and running northwesterly one mile to a recent project. Part of overall plan for rehabilitation of Route 114.

Lyndeboro
NH 31
Starting one mile northwest of the Wilton Town line and running 0.6 of a mile on new location to eliminate a narrow, weak railroad structure and a grade crossing.

Milford
NH 13
This project starts at the Milford compact and runs 2.7 miles south to the end of 1948 construction. Part of overall plan for rehabilitation of Route 13.

Greenville
NH 31
Starting at the end of 1953 construction, 2.5 miles north of the Mass. Line, and running northerly 2.3 miles. Present road is dangerously deficient and area is now not served by an adequate modern highway to safely carry the heavy traffic now using this route.
<table>
<thead>
<tr>
<th>TOWN</th>
<th>ROUTE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hollis-Nashua</td>
<td>NH 111</td>
<td>Beginning about 0.8 of a mile northeast of the Mass. Line and running toward Nashua 1.8 miles. To correct substandard conditions and to give a modern adequate approach to Nashua from the southwest.</td>
</tr>
<tr>
<td>Pelham</td>
<td>NH 38</td>
<td>In two sections, this project runs from the Mass. Line northerly; also will improve a high accident sharp curve just east of the village, a total length of 2 miles.</td>
</tr>
<tr>
<td>Epping-Brentwood</td>
<td>NH 125</td>
<td>Starting about 0.7 of a mile south of Route 101 at the end of 1951 construction, this project runs southerly about 3 miles.</td>
</tr>
<tr>
<td>Rye</td>
<td>NH 1A</td>
<td>Improve structure at outlet to Eel Pond.</td>
</tr>
<tr>
<td>Rye</td>
<td>NH 1A</td>
<td>Improve ½ mile of alignment at Straw Point.</td>
</tr>
<tr>
<td>North Hampton</td>
<td>NH 1A</td>
<td>Improve drainage to Box culvert at Bass Beach.</td>
</tr>
<tr>
<td>Hampton</td>
<td>NH 101C</td>
<td>Beginning at the Fall Road and running 1.6 miles east to the railroad overpass at US 1.</td>
</tr>
<tr>
<td>Derry</td>
<td>NH 102</td>
<td>Starting at the Derry east compact and running northeasterly about 0.7 of a mile.</td>
</tr>
<tr>
<td>Windham</td>
<td>NH 111</td>
<td>Starting at the Windham Town Hall at Bridge St. and running easterly 2 miles. Part of an over-all program to give the Nashua area an adequate route to the coast.</td>
</tr>
<tr>
<td>Warren</td>
<td>NH 118</td>
<td>This project will replace a narrow, weak timber bridge over Blodgett Brook about 4 mile northeast of Route 25.</td>
</tr>
<tr>
<td>Bartlett</td>
<td>US 302</td>
<td>In four sections, beginning at the railroad crossing east of Bartlett village and running to Glen in sections between bridges, railroad crossing eliminations and betterments. Total length 2.4 miles.</td>
</tr>
</tbody>
</table>
Program for 1952

Asphalt - Stone Resurfacing

<table>
<thead>
<tr>
<th>Description &amp; Location</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>COOS COUNTY</td>
<td></td>
</tr>
<tr>
<td>Lancaster - Route U.S. 2 Beginning at the junction of U.S. Routes 2 and 3 at the Lancaster northerly compact line and running 1.00 miles westerly to the westerly end of the new bridge over the Connecticut River.</td>
<td>1.00</td>
</tr>
<tr>
<td>Northumberland - Route U.S. 3 Beginning at the first B. &amp; M. railroad crossing south of Groveton and running 0.35 miles northerly to and including the bridge over the Ammonoosuc River.</td>
<td>0.35</td>
</tr>
<tr>
<td>Northumberland-Stratford - Route U.S. 3 Beginning at the southerly end of the Canadian National overpass approximately 2.0 miles north of Groveton and running 3.15 miles northerly to telephone pole 901/7.</td>
<td>3.15</td>
</tr>
<tr>
<td>Milan - Route N.H. 16 Beginning at Milan-Dummer town line and running 6.20 miles southerly to the Milan-Berlin town line.</td>
<td>6.20</td>
</tr>
<tr>
<td>Berlin - Route N.H. 16 Beginning at Berlin southerly compact line and running 0.85 miles southerly to the Berlin-Gorham town line.</td>
<td>0.85</td>
</tr>
<tr>
<td>Shelburne - Route U.S. 2 Beginning at the 1951 Asphalt and Stone project and running 1.25 miles westerly to the N.H. - Maine State Line.</td>
<td>1.25</td>
</tr>
<tr>
<td>Gorham - Route U.S. 2 Beginning at the end of the 1951 Asphalt and Stone section which is approximately 1000 east of the B.&amp;M. railroad crossing and running 1.55 miles westerly to the 1951 Asphalt and Stone section at mile post marker 3.</td>
<td>1.55</td>
</tr>
<tr>
<td>Randolph - Route U.S. 2 Beginning approximately 500 west of the Pinkham Road junction at the end of the 1951 Asphalt and Stone section and running 4.50 Miles westerly to the 1951 Asphalt and Stone section.</td>
<td>4.50</td>
</tr>
<tr>
<td>Lancaster - Route U.S. 2 Beginning at the Jefferson-Lancaster town line and running 2.80 miles westerly to the easterly Lancaster compact line.</td>
<td>2.80</td>
</tr>
<tr>
<td>Whitefield - Route U.S. 3 Beginning at the Johns River Bridge in Whitefield and running 3.25 miles southerly to the Carroll-Whitefield town line.</td>
<td>3.25</td>
</tr>
<tr>
<td>Whitefield - Elm Street Beginning at the junction of Elm Street and U.S. Route 3 and running 0.70 miles northwesterly to the Dalton-Whitefield town line.</td>
<td>0.70</td>
</tr>
<tr>
<td>Whitefield - Route N.H. 116 Beginning at the junction of Main Street and U.S. Route 3 and running 0.55 miles easterly to telephone pole #38.</td>
<td>0.55</td>
</tr>
<tr>
<td>GRAFTON COUNTY</td>
<td></td>
</tr>
<tr>
<td>Lisbon-Landaff-Bath-Haverhill - Route U.S. 10 Beginning at the B. &amp; M. railroad crossing north of Lisbon Village and running 12.15 miles southerly to the B. &amp; M. railroad bridge at Haverhill County Farm.</td>
<td>12.15</td>
</tr>
</tbody>
</table>
Grafton continued

Description & Location

Lincoln - Route U.S. 3 Beginning at Bog Brook bridge which is located approximately ½ mile north of U.S. Route 3 and Lincoln road and running 1.05 miles northerly to power pole #104.

Lincoln-Franconia - Route U.S. 3 Beginning at the Flume main building and running 5.40 miles northerly to 1951 Asphalt and Stone section at junction of U.S. Route 3 and N.H. 18.

Orford - Route N.H. 10. Beginning at the junction with River Road and running 3.20 miles northerly to concrete marker right.

Haverhill - Route N.H. 10 Beginning at the Haverhill-Piermont town line and running 4.55 miles northerly to the cattle pass at Clark Brook.

Haverhill - Route N.H. 10. Beginning at the junction with the Blackmount Road and running 1.33 miles northerly.

CARROLL COUNTY

Hart's Location - Route U.S. 302 Beginning at Green's bridge in Crawford Notch and running 6.85 miles southerly to the 1951 Watkins' construction project which ends approximately 1000' north of the railroad crossing at Notchland.

Bartlett - Route U.S. 302 N.H. 16 Beginning approximately 200' east of junction of U.S. Route 302 and N.H. Route 16 at the end of a 1950 Road Mix project and running 1.80 miles southeasterly to the East Branch-bridge; the bridge deck to be included.

Jackson - Route N.H. 16. Beginning approximately 150' north of the Jackson-Bartlett town line at the 1950 Road Mix pavement and running 5.70 miles northwesterly to Dana ..Place bridge in Pinkham Notch.

Wakefield-Milton - Route N.H. 16 Beginning at the concrete pavement at the Milton Town House in Milton and running 8.47 miles northerly to the end of the concrete pavement which is approximately ½ mile south of Sanbronville.

SULLIVAN COUNTY

Lempster-Goshen-Newport - Route N.H. 10. Beginning approximately 200' south of a concrete bridge and directly opposite a large gravel pit right and running 7.05 miles northerly to the southerly compact line of Newport.

Croydon - Route N.H. 10. Beginning at concrete project marker opposite Sugar River Lodge and running 5.55 miles northerly to project marker S-270(3)
Description & Location

MERRIMACK COUNTY

Andover - Route U.S. 4. Beginning at the junction with N.H. Route 11 and running 4.60 miles northeasterly to the Wilmet-Andover town line.  

Concord-Hookinton - Route U.S. 202. Beginning at the concord westerly compact line at the junction with Fisk Road and running 4.45 miles westerly to the end of the concrete pavement at the junction with the Dunbarton Road.

Concord By-Pass - Route U.S. 3. Beginning at the junction with North Main Street at the traffic signals and running 1.75 miles southerly to the junction with U.S. Route 3 south of Concord; exclude rotary.  

Beginning at the bridge over the Merrimack River just east of the rotary and running 0.70 miles easterly to the junction with the Airport Road.  

Beginning at the junction with the Pittsfield road at Beals Corner and running 16.50 miles easterly to the 1950 road mix project in East Northwood; include Epsom rotary and its north and south approaches.

Pittsfield (Village) - Route N.H. 28, So. Main St.  
Beginning at the junction with Chestnut Street and running 0.25 miles northerly to the junction with Broadway Street.  

Pittsfield (Village) - Route N.H. 28, Carroll Street.  
Beginning at the junction with South Main Street and running 0.10 miles northerly to the junction with Depot Street at the blinker light.

Pittsfield-Barnstead - Route N.H. 107. Beginning at the junction with N.H. Route 28 and running 3.30 miles northerly to the Barnstead-Pittsfield town line.  

Pembroke-Concord-Route N.H. 106. Beginning at the junction with U.S. Route 3 and running 3.96 miles northerly to the junction with U.S. Route 4.  

STRAFFORD COUNTY

Barrington-Lee-Epping - Route N.H. 125. Beginning at the junction with N.H. Routes 4 and 9 and running 8.21 miles southerly.  

Rochester-Milton-Route N.H. 16. Beginning at the Rochester north compact line at the intersection with Chestnut Hill road and running 6.55 miles northerly to the south end of the Milton construction project (Sta. 103 / 60). Section ending is subject to change.
<table>
<thead>
<tr>
<th>Description &amp; Location</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmington - Route N.H. 11. Beginning approximately 1.0 miles north of the Rochester-Farmington town line and running 2.12 miles northwesterly toward Farmington.</td>
<td>2.12</td>
</tr>
<tr>
<td>Gilsum - Route N.H. 10. Beginning at the Gilsum-Keene town line and running 5.30 miles northerly to project marker S 271.1(14).</td>
<td>5.30</td>
</tr>
<tr>
<td>Marlow - Route N.H. 10. Beginning approximately 0.2 miles south of the Marlow Mill Pond bridge and approximately 200' south of project marker FAS 271.3(3) and running 1.00 miles northerly.</td>
<td>1.00</td>
</tr>
<tr>
<td>Chesterfield - Route N.H. 9. Beginning approximately 2.5 miles east of the Connecticut River at project marker SN-FAS 11-A (1) and running 3.40 miles easterly to junction of N.H. Routes 9 and 63.</td>
<td>3.40</td>
</tr>
<tr>
<td>Winchester - Route N.H. 10. Beginning approximately 0.2 miles north of junction of N.H. Route 119 and running 1.55 miles southerly to project marker WESO 276-B.</td>
<td>1.55</td>
</tr>
<tr>
<td>Troy-Marlboro-Route N.H. 12. Beginning at the Troy-Fitzwilliam town line and running 3.85 miles northerly to project marker SNAP 203-D(2); also includes 0.20 miles in the Troy Village rotary.</td>
<td>4.05</td>
</tr>
<tr>
<td>Marlow-Swanzey-Keene - Route N.H.-12. Beginning 0.15 miles south of the Swanzey-Marlow town line and running 4.45 miles northerly to the Keene compact.</td>
<td>4.45</td>
</tr>
<tr>
<td>Keene - Route N.H. 9. Beginning approximately 200' west of the Chesterfield-Keene town line and running 1.45 miles easterly to the 1950 asphalt and stone section.</td>
<td>1.45</td>
</tr>
<tr>
<td>Fitzwilliam - Rindge- Route N.H.-119. Beginning 2.30 miles west of the Fitzwilliam-Rindge town line and running 3.30 miles easterly to Pearly Pond bridge.</td>
<td>3.30</td>
</tr>
<tr>
<td>Peterboro - Route N.H. 202. Beginning at the Peterboro south compact line and running 0.90 miles southerly to the B, &amp; M, railroad crossing.</td>
<td>0.90</td>
</tr>
<tr>
<td>Peterboro - Route N.H. 202. Beginning approximately 0.4 miles north of bridge over the Contoocook River and running 1.55 miles southerly to the junction with the Sand Hill road.</td>
<td>1.55</td>
</tr>
<tr>
<td>Peterboro - Route N.H. 101. Beginning at the Peterboro easterly compact line and running 3.85 miles easterly to the Temple-Peterboro town line.</td>
<td>3.85</td>
</tr>
<tr>
<td>Wilton - Route N.H. 101-A - Beginning at the junction of N.H. Routes 101 and 101A and running 1.35 miles easterly.</td>
<td>1.35</td>
</tr>
<tr>
<td>Antrim-Route N.H. 202. Beginning 0.30 miles north of the Bennington-Antrim town line at Prospect Street and running 0.30 miles northerly to the 1948 asphalt and stone section.</td>
<td>0.30</td>
</tr>
</tbody>
</table>
**Hillsboro continued**

**Description & Location**

<table>
<thead>
<tr>
<th>Route</th>
<th>Description</th>
<th>Length</th>
<th>Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milford - Route N.H. 101.</td>
<td>Beginning at the Milford westerly compact line and running 2.42 miles westerly.</td>
<td>2.42</td>
<td></td>
</tr>
<tr>
<td>Londonderry-Litchfield-Hudson-Route N.H. 102.</td>
<td>Beginning approximately 0.52 miles north of the Hudson-Londonderry town line and running 4.38 miles southwesterly.</td>
<td>4.38</td>
<td></td>
</tr>
<tr>
<td>Amherst - Route N.H. 101.</td>
<td>Beginning at the Milford-Amherst town line and running 2.70 miles north-easterly to the new construction.</td>
<td>2.70</td>
<td></td>
</tr>
</tbody>
</table>
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25. Raikback, Neal, of New England Road Machinery
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Data and Cost Material for Sand and Gravel Plant

INTERVIEWS

Mr. Kenneth Allen

27. DUROCRETE, Hockett, N.H., Mr. and Mrs. Dante
Donati

28. Iafolla Crushed Stone Company, Portsmouth, N.H.,
Mr. Berwick
Mr. Burnham
Mr. Fuller
Mr. Iafolla

Mr. Jack Dougherty
30. Lindsay Rice, Hooksett, N.H.
31. Manchester Sand, Gravel, & Cement Company, Inc.,
    Hooksett, N.H.
    Mr. Parker H. Rice

State of New Hampshire Highway Department
32. Mr. F. L. Avery, Engineer
33. Mr. Benning, Testing Engineer
34. Mr. Dare Fosburgh, Planning Engineer
35. General Frank Merrill, Highway Commissioner
36. Mr. John Morrow, Ass't. Highway Commissioner
    and Chief Engineer, formerly of Gorham Sand &
    Gravel Company, Gorham, N.H.
37. Mr. Paul Otis, Testing and Research
38. United States Bureau of Mines, Boston Office,
    261 Franklin St., Boston, Mass.
    Mr. Mitchell