PB 161620

NBS

Technical Note 119

# COMPUTER SIMULATION OF STREET TRAFFIC

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

# THE NATIONAL BUREAU OF STANDARDS

## Functions and Activities

The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to government agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. Research projects are also performed for other government agencies when the work relates to and supplements the basic program of the Bureau or when the Bureau's unique competence is required. The scope of activities is suggested by the listing of divisions and sections on the inside of the back cover.

## Publications

The results of the Bureau's research are published either in the Bureau's own series of publications or in the journals of professional and scientific societies. The Bureau itself publishes three periodicals available from the Government Printing Office: The Journal of Research, published in four separate sections, presents complete scientific and technical papers; the Technical News Bulletin presents summary and preliminary reports on work in progress; and Basic Radio Propagation Predictions provides data for determining the best frequencies to use for radio communications throughout the world. There are also five series of nonperiodical publications: Monographs, Applied Mathematics Series, Handbooks, Miscellaneous Publications, and Technical Notes.

A complete listing of the Bureau's publications can be found in National Bureau of Standards Circular 460, Publications of the National Bureau of Standards, 1901 to June 1947 ($1.25), and the Supplement to National Bureau of Standards Circular 460, July 1947 to June 1957 ($1.50), and Miscellaneous Publication 240, July 1957 to June 1960 (Includes Titles of Papers Published in Outside Journals 1950 to 1959) ($2.25); available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

NATIONAL BUREAU OF STANDARDS
*Technical Note*

119

NOVEMBER 1961

# COMPUTER SIMULATION OF STREET TRAFFIC

M. C. Stark



DISTRIBUTED BY
UNITED STATES DEPARTMENT OF COMMERCE
OFFICE OF TECHNICAL SERVICES
WASHINGTON 25, D. C.

Price $2.25

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)



LIST OF TABLES

## LIST OF FIGURES

## LIST OF APPENDICES

# COMPUTER SIMULATION OF STREET TRAFFIC

Martin C. Stark

## ABSTRACT

This Technical Note describes a digital computer simulation of vehicular traffic on a section of city street. The study was made for the Bureau of Public Roads by the Data Processing Systems Division, National Bureau of Standards, over a period of three years, from July 1958 to June 1961. The narrative of the report is presented first, followed in order by the three summary Tables, the Figures, and the Appendices. The latter contain text which goes into greater detail and which, in many instances, also refers to the Figures.

An element-by-element computer simulation of the volume and movement of traffic on a nine-block section of 13th Street N. W., in Washington, D. C. is described. A stochastic process is used, in which the input parameters defining the operating and physical characteristics of the cars are controllable within narrow ranges. The computer reviews each simulated car every quarter second and moves it according to rules for movement which are applied by 37 main routines and subroutines of the computer program.

The simulation run on the computer produces two outputs: The quarter-second car positions are plotted on an oscilloscope and photographed, which result in a moving picture like an animated cartoon, so they can be seen in real time. The effect is comparable to viewing the traffic flow from a helicopter. The other output is a series of tables issued by the computer. These tables catalog all vehicles as they enter the model, clock and count them as they pass a key intermediate point, and finally, check them out at the end of the course, counting them again and noting their individual running times. Other information is also furnished, such as type of vehicle, speed, and lane use. The tables thus furnish an abundance of quantitative data for measuring and evaluating the performance of the model.

Arbitrarily changing the input parameters in the simulation model will permit predictions of the resultant running times and capacities if the proposed changes were really made on the street.

With the completion of this initial, specialized, working model a solid groundwork has been laid for further research effort through refinements, extensions and generalizations of the ideas and methods presented.

## 1. PURPOSE OF THE STUDY

The purpose of the work reported here was to simulate the volume and movement of cars with a digital computer, using as the test site a real location where abundant field data were available for control and checking purposes. The test course selected was a nine-block section of 13th Street, N. W., Washington, D. C., from Euclid Street to Monroe Street.

A standard computer-simulation technique involving the use of random numbers "generates" cars at each entering lane in such a manner that the total number entering at each point over a period of time has an assigned expected value. Each car is moved every quarter second according to detailed "rules of the road" built into the computer program.

Successive car positions have been plotted on an oscilloscope and photographs taken so that the simulated operation can be viewed from moving pictures. The effect is comparable to the observation of traffic over a stretch of several blocks as if by helicopter. Printout tables furnish detailed quantitative data about the volumes, running times and characteristics of the cars involved.

To the extent that the simulation model can be made to resemble the known real conditions, we may infer that if the volumes and characteristics of traffic and the operating rules were changed in the model, the results of a run would represent a prediction of what would happen on the street if the indicated changes were really made. The quantitative operational values to be sought relate to delays, running times, and capacities which can be handled within prescribed levels of delay.

It should be borne in mind that a single run represents only a sample of results derived from the situation being simulated. If the run is for four minutes, the reliability of the results would have the same limitations as taking only a 4-minute count on the street. The strength of the results can be improved by lengthening the run or by having multiple runs and consolidating the output data.

The immediate area of application of this simulation device relates to the use and timing of traffic signals. Simulation runs can be made to study the sensitivity of the traffic flow to altered signal settings, to measure the effect of changed offsets, cycle length and splits with a view to arriving at optimal timing and to explore the capacity of the signal system to handle different patterns or increased volumes of traffic.

The use of a generalized model can be extended to many other traffic engineering situations such as use of one-way streets, banning of left turns, location of bus stops, and restriction of parking.

## 2. HISTORY OF THE PROJECT

The late Professor H. H. Goode of the University of Michigan was one of the first persons to stress the possibilities of digital computer simulation as an aid to engineers in solving traffic engineering problems(1). A simple model constructed under his direction was based on the crossing of a pair of north-south streets by a pair of east-west streets. Each street carried a single lane of traffic in each direction.

When cars moved they all moved at the same speed. When moving, a constant minimum space was required between them. When stopped, the cars could be close together. The four intersections were signalized. In the moving picture display, a symbol adjacent to each intersection indicated the signal message (a bar in a straight position for Go, in a cross position for Stop, at a 45° angle for Amber).

Cars would turn right, left or go straight by reference to a random number comparison at the moment the car entered the intersection. A left turner would wait in the intersection if necessary, blocking its followers, until opposing traffic offered a certain gap.

In the computer model each of these cars was represented by a single bit. Thus all cars were regarded as alike and were processed uniformly.

### Concept of More Sophisticated Model

It was Goode's idea that instead of describing each car by only one bit it would be possible to represent each car by a whole computer word. In this way the car could be assigned individual characteristics as to speed, type and destination.

The Bureau of Public Roads entered into an initial agreement with the National Bureau of Standards in July 1958 under which NBS would develop a considerably more advanced simulation model, utilizing several of Goode's concepts. For control and checking purposes it was desired that a real location be selected for which abundant field data were already available.

### Selection of 13th Street Site

The test site selected was a section of 13th Street, N. W., Washington, D. C., from Euclid Street to Monroe Street. The length of the course is 3,240 feet, including nine blocks. Seven of the intersections are controlled by traffic lights, three by stop signs.

---

(1) Goode, H. H., and Pollmar, C. H., and Wright, J. B., "The Use of a Digital Computer to Model a Signalized Intersection," Proceedings of Highway Research Board, vol. 35, 1956, pp 548-557.

(See Fig. 1.) The operation relates to the peak hour of the afternoon rush, when the four lanes of 13th Street are operated one-way northbound.

By early 1960, the NBS effort had produced a first model, complete with a movie but lacking printout tables for quantitative evaluation. This model, which we refer to as NBS Simulation I, carried out most of the original objectives. It was, however, incomplete in various respects. Principally, it generated no cross traffic. (Traffic turning onto cross streets however was carried away.) A flaw in the program permitted cars at one location to be swallowed up by other cars. Some cars trapped behind slow moving leaders fluttered wildly from one lane to another attempting vainly to overtake. Other correctible defects were observed.

The second work program by NBS was begun in July 1960 and was completed a year later. The effort resulted in the present, greatly improved Simulation II, which is the principal subject matter of this report.

### Phase Completed

The phase of the work now terminated has considered all the items that were formally presented and has successfully carried out nearly all of them. It is believed that for practical purposes we now have a specialized model that is, or can be readily made to be, a solid basis for further research effort.

## 3. DESCRIPTION OF THE METHOD

### Use and Numbering of Unit Blocks

Each lane of each street is divided into 12-foot sections called unit blocks. Computer storage reserves a place for information about each unit block (abbreviated UB). If there is a car in a UB, full information about its exact location and its physical characteristics is stored. Another portion of the storage word furnishes any necessary information about the road at that point. This dual role of the UB is extensively described in Appendix G.

The UBs are numbered consecutively wherever possible. This facilitates a systematic search of successive UBs for cars to be processed as well as an orderly movement of each car from one UB to the next higher numbered UB. Fig. 2 shows the basic numbering plan for UBs. Turns use diagonal UBs superimposed on the basic grid. The turn UB layout is shown in several other figures, especially Figs. 6 & 7 relating to 13th and Girard Streets. (See also Fig. 18.)

Quarter Second Review Cycle

The time cycle for searching all UBs for cars, moving the cars, generating new cars and preparing any outputs is one quarter second of simulated real time.

Traffic inputs are generated (using random numbers) to represent assumed input volumes. Every quarter second, the IBM-704 program moves the cars according to "rules of the road" built into the computer program. The coordinates of the car positions and the traffic signal settings are written onto a magnetic tape output. This tape is later fed into SEAC (a specialized NBS computer), which is equipped with attachments and facilities for projecting the coordinates onto an oscilloscope and actuating the trigger of a camera in order to produce a series of photographs capable of being processed into a real-time moving picture film.

Printout Tables

The 704 program which moves the cars also prints out detailed data which describe the generated cars, count and clock the cars as they pass an intermediate check point along the course and finally check out the cars as they finish the test course. These three tables (Appendices A, B and C) furnish a full "case history" of the cars involved. Cars can be traced through the course; their physical characteristics are noted; their individual running times and performances are recorded.

The moving picture provides an overall view of the general performance of the fleet of cars. The tables provide specific, detailed, quantitative data by which to measure and judge the performance.

## 4. ANALYSIS OF RESULTS

Several simulation runs have been made. (See Appendix P for a list of the runs.) Run No. 3, of four-minute real-time duration (three complete 80-second signal cycles), has been selected as typical and will be described in considerable detail in later sections of this report. A moving picture was made of the oscilloscope display. The computer produced printout sheets furnishing detailed numerical data to permit analysis of the behavior of the simulated cars. From this information three summary tables have been made which are described below.

Table 1 summarizes the count of cars generated during each cycle for each of the generation points. The figures are shown by each cycle, summed for the four minutes and expanded to an hourly volume. It will be noted that the volume of simulated cars entering the model at the Euclid Street entrance to the 13th Street test section is 2,910 cars per hour. This compares with a field volume of 3,050.

(See Fig. 9.) The principal cross streets, Harvard Street, Columbia Road and Park Road, carried 330, 600 and 780 simulated cars per hour compared to the field values of 708, 668 and 670, respectively. The poor correspondence for Harvard Street presumably is due to the smallness of the sample. In the long run the number of simulated cars, by design, should tend to equal the field values. Because of concern about the Harvard Street generated volume, Run No. 4 was scrutinized as an essentially parallel run in the Monte Carlo method. While not otherwise summarized in detail, Run No. 4 showed generated traffic, expanded to an hourly rate, of 780, 720 and 585 cars, respectively, on the three principal cross streets, Harvard Street, Columbia Road, and Park Road.

The field data are traffic counts made over a period of time in 1954-55 by the District of Columbia Department of Highways and the Bureau of Public Roads, and documented in an article entitled "Capacities of One-Way and Two-Way Streets with Signals and with Stop Signs", by Alexander French, February 1956, Vol. 28, No. 12, PUBLIC ROADS.

It is assumed that care was exercised in sampling the traffic at that time and that the results set forth are reasonably representative of the then-existing conditions. Nevertheless, a general note of warning should be sounded to the effect that any deficiency in the representation of a prototype situation being simulated will be carried over into the simulated model and will introduce error into the results of any analytic or predictive simulation runs. Simulation can never be a substitute for sound basic data. In the present study the problem of validation may be even more difficult because of the passage of time. Validation of the model for 1955 traffic conditions may be indicative, but is no guarantee, of validation under present-day traffic conditions.

The significance of Table 1 is that it provides a rough check on the "car generating" procedure. Table 1 represents the traffic "inputs". Tables 2 and 3 (to be described) represent "outputs" and are the means for measuring the performance of the simulation. These tables provide a verification that traffic moves through the model in reasonable correspondence to the known situation in the field.

Table 2 shows the results of a count at Station B which is on 13th Street just north of Lamont Street. (See Fig. 3.) This is the heaviest point of the test course. In the model, the expansion of the four-minute count at Station B produced an hourly volume of 3,330 simulated cars. This is comparable to the field volume of 3,168 cars per hour.

Table 3 relates to cars leaving the end of the 13th Street test course north of Monroe Street. Again, the simulated cars are counted by cycles and by lanes, and are expanded to an hourly rate of 2,400. The field figure at this point is 2,691 cars per hour. Table 3 also records the running times of those cars which have traversed the full length of the test course from Euclid Street. In the first cycle when the model contained somewhat fewer cars, the average running time was 364 quarter seconds. In cycle 2 it was 444 and in cycle 3, 464. The average time over the three cycles was 437 quarter seconds.

Incidentally, the traffic signals on 13th Street, during the P. M. rush hour, are set for a speed of 26.8 miles per hour. The average running time of the simulated cars of 437 quarter seconds reflects an average speed of 20.2 mph. A running time of 330 quarter seconds is required to stay in pace with the signal progression.

Tables 1, 2 and 3 are summaries of full computer printouts which are photographically reduced as Appendices A, B and C, respectively. The basic printout sheets identify individual vehicles, thus making it possible to trace through the movement of any particular vehicle.

## 5. CONCLUSIONS

A working simulation model of a particular, fairly complex traffic location has been constructed. A computer program causes the cars to behave in what seems to be a realistic manner. The cars stop at red lights; they yield the right of way at stop signs; they maneuver into correct positions for turns; they move at different speeds; they accelerate and decelerate; faster cars shift lanes to overtake slower cars; they form queues; and they do most of the definable things that cars can be expected to do in city traffic.

The results in no sense indicate a rigorous validation of the model. Up to the present point, reasonableness is the only criterion for judging the performance. Approximately the correct number of cars are accounted for at key points; their characteristics as to speed category, type of vehicle and intended turns correspond with known input data; their average running times are expectedly somewhat slower than that required to keep up with the progressively timed traffic lights.

It may be significant that the speeds and running times become slower as the simulation progresses from cycle 1 to cycle 2 to cycle 3. Although the model was "filled" with cars before the beginning of the run, it had been filled just prior. The lengthening of the running times may be caused by the fact that the full effect of congestion takes a little while to set in.

To get more information bearing on the validity of the model, two steps may still be taken. One is to study the movie display carefully to see whether a "helicopter" view of the cars verifies that they are performing correctly. The other is to compare the simulation running times with actual running times from the field, perhaps by a field check of license numbers of cars traversing the course or by a series of runs through the course using the "floating car" method.

(In the latter method, a test car is driven through the course a number of times with the driver trying to drive neither faster nor slower than the average car in the traffic stream.)

A point worth bearing in mind is that even though the simulated running times may not be entirely valid in total, a difference in running time to reflect a changed parameter may be highly significant. The reverse is also true. A particular detail of the simulation may not check completely with reality and yet the total result can still furnish a useful measure. Ideally the simulation would correspond with reality both in detail and in total, but it has value even if one of these objectives is not immediately accomplished.

## 6. AREAS FOR FURTHER RESEARCH

The question remains: What constitutes validation of the model? So far the test of reasonableness is the only criterion that has been applied. When the performance of the model is accepted as corresponding reasonably closely with actual field conditions, it will be possible to change the parameters and study the new results. From a practical point of view it is the ability to test untried conditions and to make predictions of likely results that will be the real payoff of simulation as a tool for traffic engineers.

Beyond the immediate objective of getting practical answers for 13th Street are several broader objectives. Study should be made of how to generalize the model in various ways. A model should be made where the main street is two-way rather than one-way. Additional features should be added such as random delay factors, standing vehicles, bus stops, wider range of speeds and acceleration rates, pedestrians and additional count stations.

Study should be made of what is required to make the model applicable to other locations by plugging in different basic data at key points in the program.

An output editing routine is an important future requirement. A computer is capable of putting out a vast amount of paper. The present program is no exception. In order to facilitate an expeditious use of the model to develop useful results, a routine should be written that will summarize the output data at several levels of detail. In the present study the important answers center around running times, delays, and street capacities.

Another area of study is the question of how fine the model needs to be in order to furnish good answers. The present model is very fine. The basic time unit is one quarter second and the basic distance unit is one-hundredth part of 12 feet (1.44 inches). These small units lead to an enormous number of computations even for a high-speed digital computer. To what extent, if at all, would the usefulness of the results be jeopardized if the model used larger time and distance units? In order to answer this important research question, it is necessary to use a model which is capable of a fine breakdown. To seek an answer to this question using a coarse model would be impossible. The usual technique in solving this kind of problem is first to try a gross unit, then try a unit half as large, and then halve it again. This method will fairly quickly locate the general area where the optimal value lies.

In looking ahead to further applications, proposed tasks may be considered in three categories: Those that can be done practically immediately, those that will require some changes and rewriting of the computer program and those of longer-range nature that may require fairly extensive changes in the program.

Representative tasks for future research effort are listed below arranged in the three categories of required time and effort:

A. Immediate Results

1. Change volumes, turn ratios, lane distributions, traffic signal settings, desired speeds, percent of trucks, acceleration rates, for the specific 13th Street course.

2. Modify certain rules of behavior (such as those involving clearances, lane preferences, acceptable gaps, response to amber signal, overtaking).

3. Plant cars to depict a study condition such as the following:

    a. Plant a stalled car and see what happens.

    b. Set up a solid line of cars to study the wave action.

    c. Set up a conflicting turn situation.

B. Intermediate Results

1. Prepare an editing routine that will summarize the computer output data at several levels of detail.

2. Substitute signalized control for stop sign control (or vice versa) at any intersection, and study the results.

3. Change any cross street from one-way to two-way (or vice versa).

4. Substitute a yield sign for a stop sign.

5. Put in additional count stations to measure volumes and delays at more points.

6. Provide for buses which would stop at prescribed bus stops.

7. Interject random delay factors into the performance of the cars.

C. Longer-Range Tasks

1. Make 13th Street two-way (as it is in non-rush hours).

2. Study problem of generalizing the computer model so that, by merely "plugging in" proper data regarding physical layout, it can be made applicable to another set of streets.

3. Study the effect of making the model less fine (by using larger space and time units).

In addition to the representative specific tasks listed above, further effort should be accompanied by a broadening of the scope of the work with the purpose of promoting an interchange of information, acquainting traffic engineers and administrators with what has been done to date, learning what additional problem areas lend themselves to treatment by simulation techniques, and creating a wider interest and challenge for further research.

## 7. THE COMPUTER PROGRAM

The basic working program for the IBM-704, including the working constants and the input parameters, contains about 6000 words. In addition, the "A" layout (two words for each of about 1800 UBs) uses about 3600 words and the "B" layout another 3600. (The "A" and "B" layouts are defined in Chapter 8.) A table look-up of the coordinates of each UB and traffic signal for presentation by SEAC on the oscilloscope uses about 3700 words. The total requirement thus is about 16, 900 words. The 704 installation at NBS has 32, 768 words of primary core storage so that no effort to conserve space was necessary. The computer program was assembled using the SAP assembly program.

The final production run representing four minutes of real time required 60 minutes of 704 time. Thus the ratio of computer time to real time was 15 to 1.

In order to display all of the 13th Street test course simultaneously in as much detail as possible on the oscilloscope it was found desirable to break 13th Street into two pieces. The first piece, from Euclid Street to Irving Street, appears in the left half of the display and the second piece, from Irving Street to Monroe Street, in the right half. (See Fig. 4.)

## 8. DETAILS OF THE PROGRAM

### Search Routine

The program searches methodically for cars to be processed. Starting at UB0, the first UB in lane 1, the search continues through lanes 1, 2, 3 and 4 of 13th Street, then the lanes of all the cross streets and finally the diagonal UBs (for turns).

### "A" Layout and "B" Layout

The cars are found on what has been called the "A" layout. To keep matters straight, because it is impossible to process all the cars simultaneously, each car as it is processed is moved to its new position on the "B" layout. For the remainder of the review cycle the car continues to appear on the "A" layout in its old position.

When all the cars found in the "A" layout have been moved to new positions in the "B" layout, the scanning is completed. Then the "A" layout is erased and the "B" layout becomes the starting point for the next scan.

### Generation

At the end of each cycle the car generation routine is performed. If a car is generated, its characteristics are also determined including its destination or "exit". (See Fig. 3 for key to exit numbers.) A newly generated car will be launched if this can be done safely. Otherwise it will be retained on a backlog list for the particular generation point in question until it can be safely launched. (See Fig. 2 for map of generation points.)

### SEAC Display

The edit routine notes the positions of the cars and the settings of the traffic signals, looks up the coordinates and writes the information on the output tape to be used later for the SEAC display. Finally the clocks are advanced one quarter second and the program is ready to repeat the cycle.

### Permissible Speed

When a car is found for processing, virtually the first task of the program is to consider the car's desired speed in relation to its present speed (last quarter second jump) and its allowable acceleration rate. Each car carries with it an information package describing various physical characteristics and details. The word format is pictured in Fig. 5 and described in detail in Appendix G.

## Sight Distance

When the permissible speed has been determined (in terms of unit point jump per quarter second), the equivalent of required sight distance is determined by a table look-up, Fig. 15. The program then probes ahead attempting to achieve the "goal points" necessary to satisfy the sight distance requirement.

Two prime considerations are whether there is a car ahead and whether there is any irregularity about the roadway (such as a traffic signal or a turn). In every case the key to the information appears in the UB word format (Fig. 5) and can be found by systematic checking of every UB involved (ahead, behind, right or left as required).

The considerations to this point are described in more detail in a later section, Appendix E, entitled the Basic Forward Move which utilizes Fig. 10.

If the goal points can finally be verified, the stated jump can be made (onto the "B" layout). If the goal points are not adequate, then a table (Fig. 15) is consulted to determine what reduced jump can be made safely.

## Irregular Unit Blocks

During the processing, the program is constantly on the alert to comply with the requirements of any of the roadway "irregularities". If a UB is responsive to a traffic signal, the program must check the signal indication. If there is a turn ahead, the program must test whether our car is intending to turn. If our car passes a count station, it must be properly tallied and clocked. If our car reaches the end of a lane, it must be checked out. A number of other special situations may occur, singly or together. In general, each situation has one or more sub-routines which can be called upon to determine the proper move. Some of the routines are specific to traffic on the main street, some relate to cross traffic only, some handle cars in the diagonal unit blocks (on turns), some are generalized. The scope of the routines can be realized by reference to Appendix F which lists and defines briefly 37 main routines, sub-routines and table look-up routines. The use of many of these routines is illustrated by later references.

## Turns

An intersection is basically the crossing (usually at right angles) of two sets of consecutively numbered UBs. The various possible turns are represented conceptually by the superposition of appropriate diagonal unit blocks to connect the lanes involved in each turn. In the model, turns from 13th Street are always made from the nearest lane. Thus turns from northbound to eastbound are made from lane 1 of 13th Street and turns from northbound to westbound are made from lane 4.

Turns from cross streets into 13th Street, however, may be made into either lane 1 or lane 4. The rules, built into the program, are as follows: If a turning car is destined to make a later right turn (odd exit), it will turn into lane 1 without exception. Similarly, if it is destined to turn left later (even non-zero exit), it will always turn into lane 4. This rule applies to both right and left initial turns into 13th Street.

## Lane Preference

For those cars turning into 13th Street which will stay on 13th Street (zero exit), each car carries with it a lane preference (bit No. 34, see word format, Fig. 5) which was randomly determined at the time the car was generated. The car will turn into the lane of its preference except for one situation. If it is trying to turn left into lane 4 and must yield to opposing traffic (assuming the cross street is two-way), it will relinquish its preference and proceed to the position for turning into lane 1. It will of course wait, there, until it can turn safely. These points are illustrated in Appendix I entitled "Left Turn Exercise", and in Fig. 8.

It is seen that at an intersection where the cross street is two-way, six turns are possible, two from 13th Street and four into 13th Street. The diagonal unit blocks are conceptually superimposed. For clarity, they are shown separately in Figs. 6 and 7. See also Fig. 14.

## Simple Turn

Appendix H illustrates a simple turn at 13th & Harvard Streets. The numbering of the UBs at the turn is shown. The information package for the specific turn is reproduced. The general approach to the task is outlined.

## Turn Bias and Last Chance

Cars are coaxed to get into the correct lane for an approaching turn by the "turn bias" routine (XL) which causes a car to keep trying to shift when within 1200 feet of the turn. If, because of continued congestion, the car cannot shift, it finally reaches a last chance block beyond which it cannot proceed without shifting lanes. The pattern of last chance blocks is illustrated in Fig. 12.

## Traffic Signals

Appendix J describes the traffic signal information package and outlines how the program reads the signal indication and makes a decision. The traffic signal subroutine (LL2) is generalized. Main street traffic reads the signal directly; cross street traffic, in effect, reads the same data but draws the opposite conclusion. The signal timing diagram for the real situation and for the model is shown in Fig. 11. Page 1 of Fig. 11 is the diagram itself, page 2 gives the timing data on which the diagram is based, page 3 explains the diagram and defines special terms.

Stop Signs

The minor cross streets, Fairmont, Girard and Lamont, are controlled by stop signs. A car approaching 13th Street from one of these streets will be subject to control by the stop sign routine. A flow chart for this routine is shown in Appendix M, page 1. First, our car will be required to come to a complete stop. (When stop is completed, a "1" will be inserted in bit 18.) Before our car can proceed across the intersection, a check is made of the 20 approaching UBs on 13th Street for each of the four lanes. If an opposing car is present or moving at all in the nearest UBs our car cannot proceed. If the opposing car is found in UBs farther away, the critical speed is higher. Page 2 of Appendix M shows a table of progressively higher critical speeds corresponding to the 20 UBs located correspondingly farther from the intersection. If the speed is exceeded, our car cannot proceed. The critical speeds have been computed on the basis of an "acceptable gap" of four seconds.

Move Routine

In general the penciled flow charts for the 37 routines have not been reproduced because they are voluminous and would require vast detailed explanation to be of even dubious value. Reference has already been made to the stop sign routine (SG2) which, for illustrative purposes, has been reproduced and is explained in Appendix M.

One further example of a flow chart is the move routine (M1). (See Appendix N.) This routine makes the actual move after many other routines have determined the effective clear distance ahead. If the full clear distance sought has been achieved, the move routine is entered at M2 which accepts and performs the previously determined, tentative quarter second jump. (Refer again to paragraphs on Permissible Speed and Sight Distance on pages 11 and 12.) If the clear distance has been compromised, the move routine is entered at M1 which uses the limited clear distance to determine a reduced jump. In the extreme case, the jump may be zero.

The move routine moves the car onto the "B" layout and makes any appropriate entry in either the Station B or Vehicle Retirement printout tables (Appendices B and C). If the car is a "marked car", the routine also prints out its quarter second position on a chronological list. (Refer to Appendix L.)

Additional Details

Appendix K outlines the conditions that must be met when a car makes a turn in the face of opposing traffic. Considerable additional details are available in the appendices, particularly Appendix G on the "Two-Word Format", Appendix F listing the routines, and Appendix O defining terms.

## 9. IMPROVEMENTS IN NBS SIMULATION II OVER SIMULATION I

Work on NBS Simulation I was stopped in February 1960. Some features were not completed, others were omitted or found defective. The current Simulation II has been completed, improved and expanded in a number of respects. Below are listed noteworthy items of improvement:

1. Simulation I generated no cross traffic (although cars turning onto cross streets from 13th Street were carried away). Simulation II is complete with full handling of both 13th Street and cross street traffic.

2. On the film display of Simulation I, the Irving Street intersection was duplicated in the hope of facilitating observation. It proved to have the opposite effect. Simulation II eliminates this confusing overlap.

3. In Simulation I cars reaching Monroe Street disappeared immediately after reaching the center line of Monroe Street. The new model carries these cars a short distance beyond the intersection.

4. When the project was started, Irving and Kenyon Streets were two-way streets. Now they are one-way streets. The revised model incorporates this change.

5. Observation of the Simulation I film indicated a couple of undesirable performance characteristics. At one location, when cars were stopped at a traffic light succeeding cars disappeared into them. This flaw in the program has been corrected.

   Some cars trapped behind slower leaders bobbed around excessively trying in vain first one lane and then another in an attempt to overtake. In the revised model, an attempt has been made to promote greater stability in this situation by not allowing a lane shift unless significant gain in net clear distance ahead can be achieved. This differential was set at 18 feet whereas formerly a car would shift if it could gain any advantage at all.

6. The earlier program would search ahead no farther when finding a leader. The movement of our car would then be governed solely by the performance of the leader. This approach was subject to the criticism that a car could "ride on the coat tails" of its leader and thereby go through an

amber light or approach an intended turn without slowing down. The new program makes an independent check ahead of a leader to assure proper consideration of road factors that may not be applicable to the leader. This improvement should improve the realism of the model.

7. In Model I, a car desiring to overtake would always try the left side first. In Model II, a "coin is tossed" to determine which side is tried first. The second procedure is thought to be more realistic since 13th Street is operated one-way with each lane tending to move independently.

8. In Model I, the moving picture was thought to be virtually the sole end product. It is realized now that means of analyzing the results quantitatively are required. In Model II, the movie is still a valuable, visual guide for judging the performance but the real output is the series of tables that record volumes and running times. These are discussed elsewhere.

9. In Simulation I, a single word was used to identify a UB. In Simulation II two words are used. The principal addition is the launch time which requires 11 bits. In the first model, putting all the information into one word was a tight squeeze. In the revised model there is room for expansion if desired (additional categories and additional characteristics).

10. Simulation I starts with an empty layout. After three minutes the formal run stops, at just about the time the layout is filled with cars. Simulation II is prefaced by an earlier "unofficial" run which has filled the model. The entire 4-minute run of Simulation II displayed in the moving pictures and analyzed in the output tables is based on a full-of-cars model.

11. Simulation I permitted a constant clearance distance between successive cars. Simulation II provides for an increasing clearance as speed increases. (See Fig. 15.)

## 10. ASSUMPTIONS AND PARAMETERS

In many instances, in the absence of specific answers from field data, it was necessary to make certain assumptions or to assign arbitrary values or distributions to parameters. In most cases these can be readily changed if desired. These assumptions in general relate to one of two areas: the characteristics of the car or the rules governing the movements. Figure 16 relating to characteristics of vehicles shows a number of these judgment values. Other arbitrary values and rules have been used as listed below:

1. Cars generated on 13th Street have been originally distributed 20, 30, 30, 20 per cent across lanes 1, 2, 3 and 4 respectively.

2. Cars are launched on 13th Street only if they can be launched safely at their full desired speed. Generated cars which cannot be launched immediately are saved until they can be launched.

3. Cars are launched on cross streets if they can be launched safely at speeds greater than 15 miles per hour.

4. When a car is considering shifting lanes because of a slow leader, the car will not abandon its own lane unless it can gain an advantage of at least 18 feet in net effective sight distance.

5. Figure 9 shows the volumes assumed at each generation point. For the principal streets authentic volumes had been furnished from field data. For the remainder arbitrary figures were used. Certain minor movements were given a token value of 10 cars per hour.

6. Car speeds are reduced to 15 miles per hour for turns. A moderate deceleration rate of 5 unit points per 1/4 second per 1/4 second is used, beginning as soon as the car driver "sees" the turn in looking ahead for adequate sight distance.

7. The correct probability distribution that should govern generation of cars is not known. The available field data give (in effect) only the mean or "expected value" of this distribution, which is not enough to determine other important parameters of the distribution (e.g., its variance). Although the (binomial) distribution used in the simulation was chosen to have the correct mean value, it may nevertheless distort some aspects of the real situation. If field data to describe completely the distribution were available or were to be gathered, the significant parameters could be incorporated into the generating mechanism.

## 11. ACKNOWLEDGMENTS

While the final results were due principally to the sustained effort of the project leader, Martin C. Stark, supporting credit should go to L. Garrett, who wrote the auxiliary program for the oscilloscope display; L. Cahn, who engineered and operated the special camera attachment for making the moving pictures; and L. Riches, who assisted in an important phase of writing the main program. Credit should also go to John Warme for drawing the figures, Helen Grantham for typing the manuscript for the final report and Anna K. Smilow for her careful processing of the final copy for publication.

## SUMMARY OF CARS GENERATED

### By Street and by Hourly Rate

| | Cycle 1 | Cycle 2 | Cycle 3 | Total Period |
|---|---|---|---|---|
| 13th Street | 3060 | 3105 | 2565 | 2910 |
| Fairmont Street | 90 | 90 | 45 | 75 |
| Girard Street | 45 | 90 | 90 | 75 |
| Harvard Street | 270 | 630 | 90 | 330 |
| Columbia Road | 540 | 630 | 630 | 600 |
| Irving Street | 360 | 360 | 180 | 300 |
| Kenyon Street | 450 | 180 | 90 | 240 |
| Lamont Street | 0 | 90 | 0 | 30 |
| Park Road | 1035 | 630 | 675 | 780 |
| Monroe Street | 135 | 315 | 45 | 165 |

Note: The signal cycle length is 80 seconds. Cycle 1 represents 320 quarter seconds from simulation-run time 1036 to 1355; cycle 2, from time 1356 to 1675; and cycle 3, from time 1676 to 1995.

## SUMMARY OF CARS GENERATED
### By Generation Point and by Cycle

| | | | Generation Point | Cycle 1 | Cycle 2 | Cycle 3 | Total |
|---|---|---|---|---|---|---|---|
| 13th Street | Lane 1 | Green | 1 | 17 | 15 | 9 | 41 |
| | | Red | 2 | 2 | | | 2 |
| | Lane 2 | Green | 3 | 19 | 23 | 15 | 57 |
| | | Red | 4 | 1 | | 2 | 3 |
| | Lane 3 | Green | 5 | 19 | 18 | 16 | 53 |
| | | Red | 6 | | | | |
| | Lane 4 | Green | 7 | 10 | 13 | 15 | 38 |
| | | Red | 8 | | | | |
| Fairmont | Lane 1 | | 9 | 1 | 2 | 1 | 4 |
| | Lane 2 | | 10 | 1 | | | 1 |
| Girard | Lane 1 | | 11 | | | 1 | 1 |
| | Lane 2 | | 12 | 1 | 2 | 1 | 4 |
| Harvard | Lane 1 | | 13 | 3 | 8 | 1 | 12 |
| | Lane 2 | | 14 | 3 | 6 | 1 | 10 |
| Columbia | Lane 1 | | 15 | 4 | 7 | 8 | 19 |
| | Lane 2 | | 16 | 8 | 7 | 6 | 21 |
| Irving | Lane 1 | | 17 | 3 | 5 | 1 | 9 |
| | Lane 2 | | 18 | 5 | 3 | 3 | 11 |
| Kenyon | Lane 1 | | 19 | 6 | 1 | 2 | 9 |
| | Lane 2 | | 20 | 4 | 3 | | 7 |
| Lamont | Lane 2 | | 21 | | 2 | | 2 |
| Park | Lane 1 | | 22 | 13 | 8 | 11 | 32 |
| | Lane 2 | | 23 | 10 | 6 | 4 | 20 |
| Monroe | Lane 1 | | 24 | 1 | 3 | | 4 |
| | Lane 2 | | 25 | 2 | 4 | 1 | 7 |

Table 2

## SUMMARY OF STATION B COUNTS

| | Cars Passing Station B | | | |
|---|---|---|---|---|
| | Cycle 1 | Cycle 2 | Cycle 3 | Total |
| Lane 1 | 20 | 22 | 23 | 65 |
| Lane 2 | 13 | 18 | 24 | 55 |
| Lane 3 | 11 | 15 | 21 | 47 |
| Lane 4 | 18 | 17 | 20 | 55 |
| | 62 | 72 | 88 | 222 |
| Hourly rate | 2790 | 3240 | 3960 | 3330 |

Notes: Station B is located on 13th Street just north of Lamont Street.
Cycle 1 is from simulation-run time 1036 to 1355; cycle 2, from time 1356 to 1675; and cycle 3, from time 1676 to 1995.

Table 3

## SUMMARY OF VEHICLE RETIREMENT DATA

### (Volumes and Running Times)

| | Cars Retiring at End of 13th Street | | | |
|---|---|---|---|---|
| | Cycle 1 | Cycle 2 | Cycle 3 | Total |
| Lane 1 | 4 | 20 | 11 | 35 |
| Lane 2 | 6 | 16 | 13 | 35 |
| Lane 3 | 11 | 17 | 17 | 45 |
| Lane 4 | 11 | 17 | 17 | 45 |
| | 32 | 70 | 58 | 160 |
| Hourly rate | 1440 | 3150 | 2610 | 2400 |

### Distribution of Running Times

### (Of Cars Traversing Entire 13th Street Course)

| Running Times (in 1/4 sec.) | Cycle 1 | Cycle 2 | Cycle 3 | Total |
|---|---|---|---|---|
| 200-249 | | | | |
| 250-299 | 4 | | | 4 |
| 300-349 | 3 | 3 | 2 | 8 |
| 350-399 | 12 | 12 | 15 | 39 |
| 400-449 | 2 | 23 | 9 | 34 |
| 450-499 | 3 | 9 | 7 | 19 |
| 500-549 | | 7 | 5 | 12 |
| 550-599 | | 4 | 11 | 15 |
| 600-649 | | 2 | 2 | 4 |
| 650-699 | | | | |
| Total cars | 24 | 60 | 51 | 135 |
| Average running time | 365 | 444 | 464 | 437 |

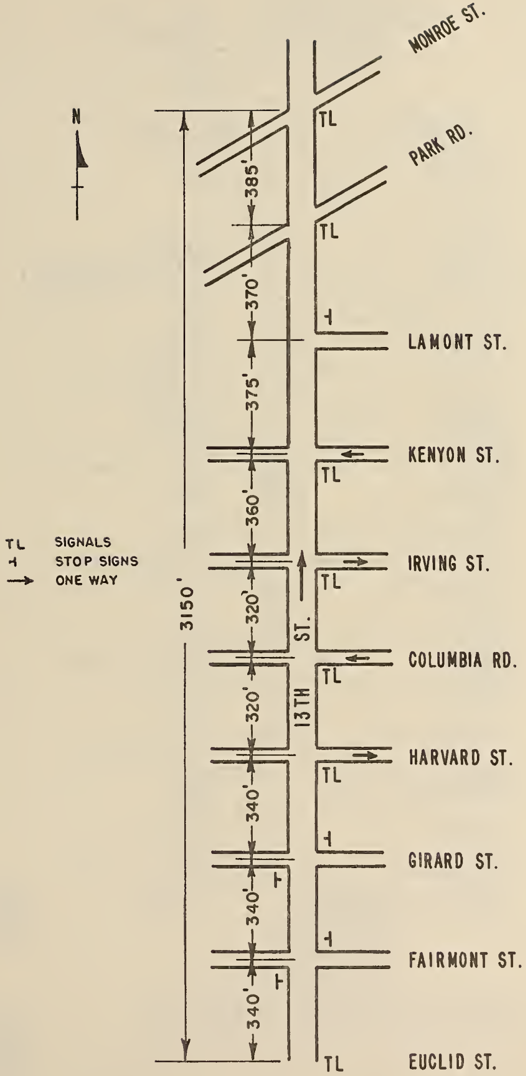



FIGURE I. 13TH STREET LAYOUT

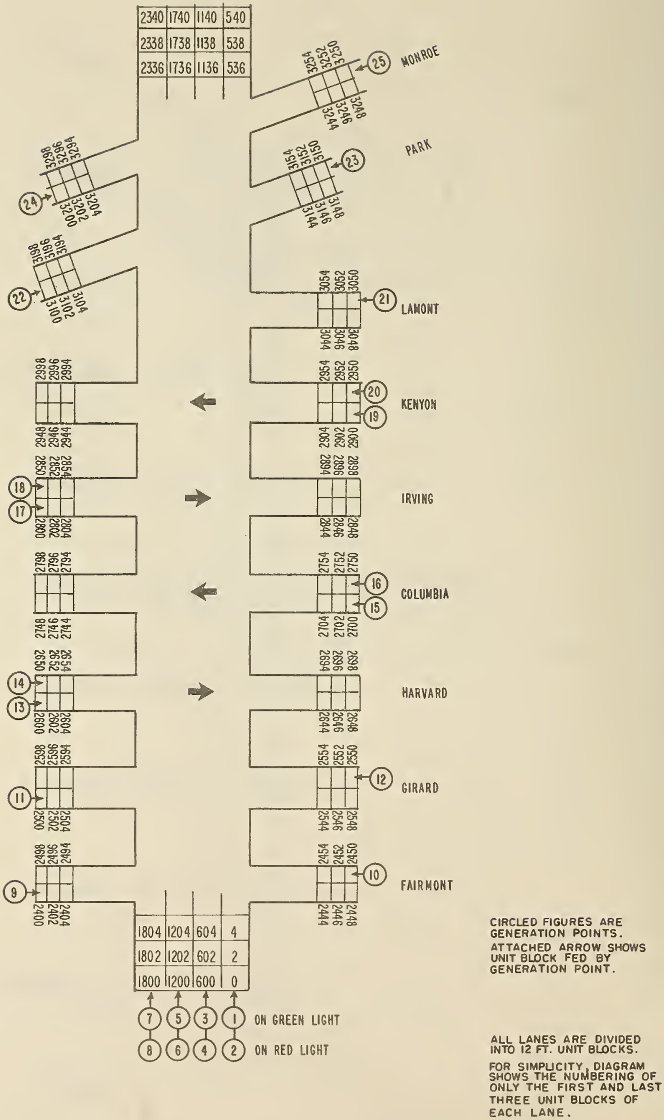



FIGURE 2. GENERATION POINTS AND UNIT BLOCK NUMBERING

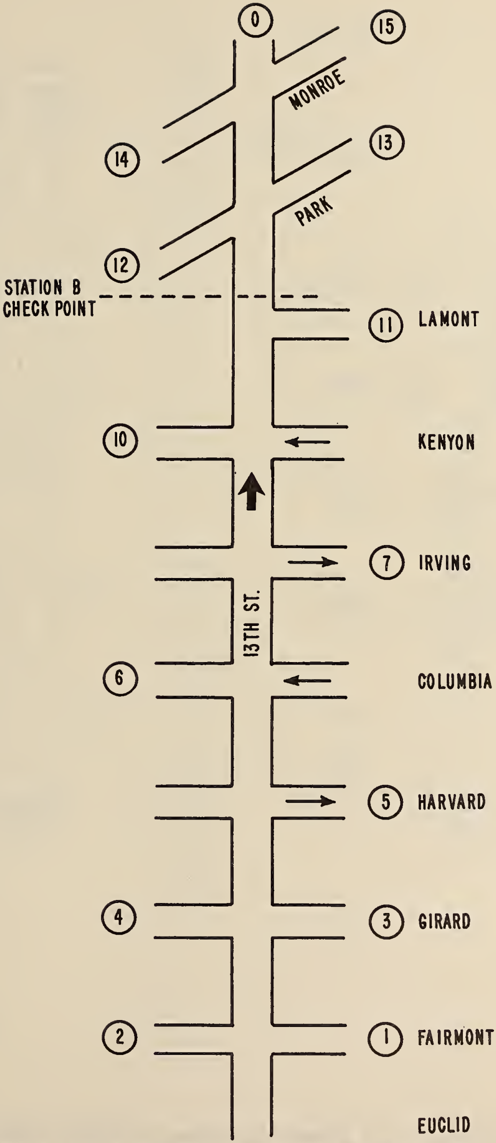



FIGURE 3. EXIT NUMBERS AND STATION B CHECK POINT

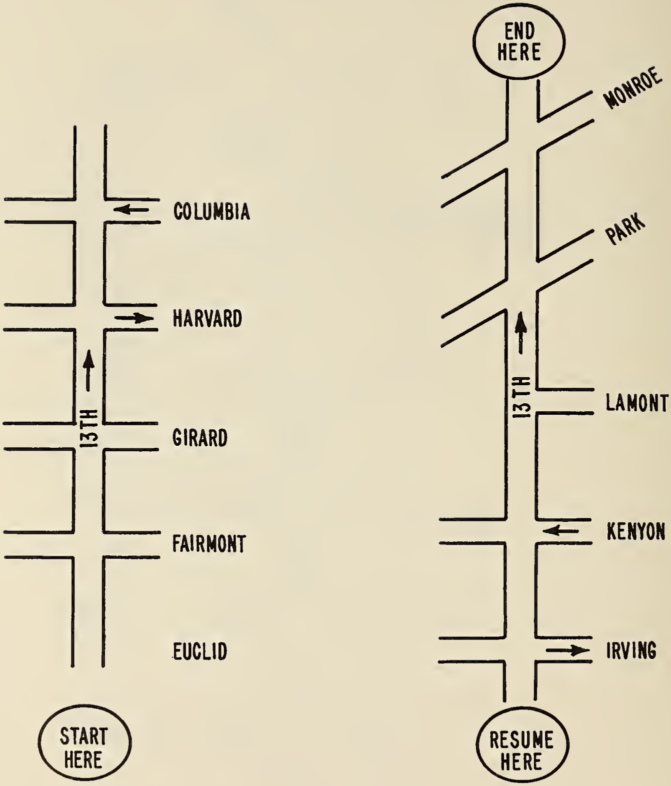



FIGURE 4. 13TH STREET AS SHOWN ON OSCILLOSCOPE

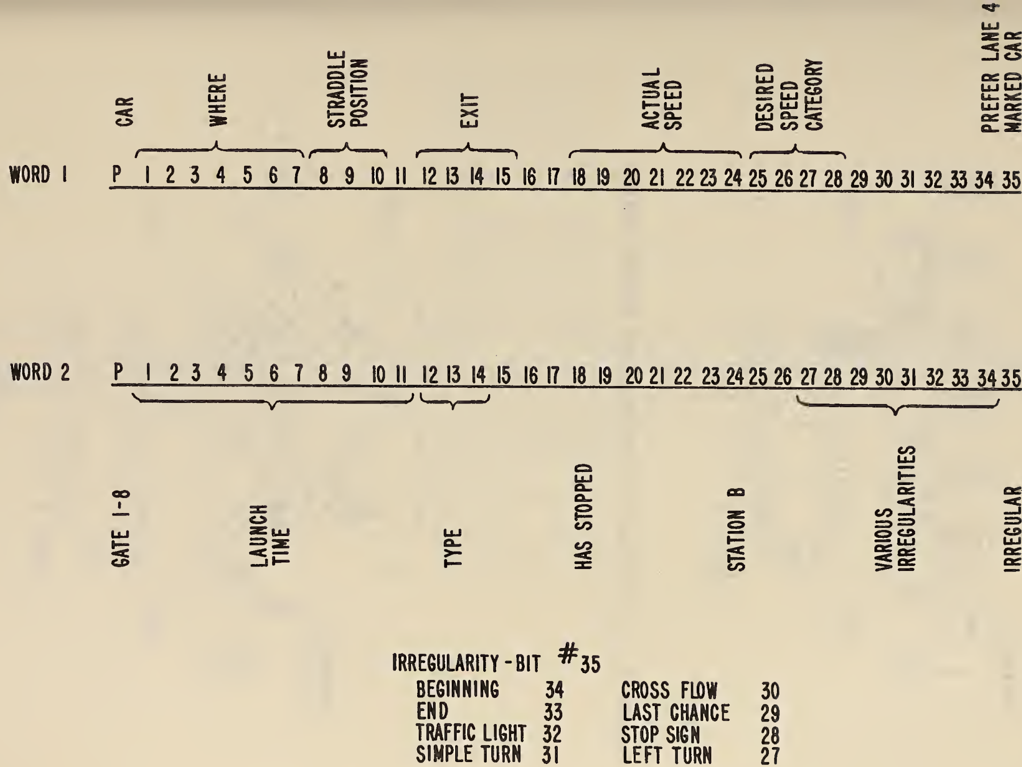



FIGURE 5. THE TWO-WORD FORMAT

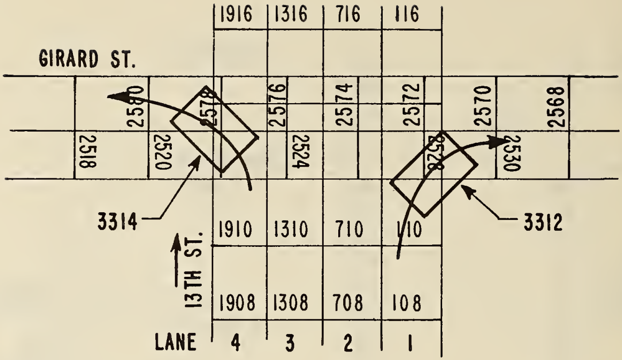



FIGURE 6. TURNS FROM 13TH STREET INTO GIRARD STREET

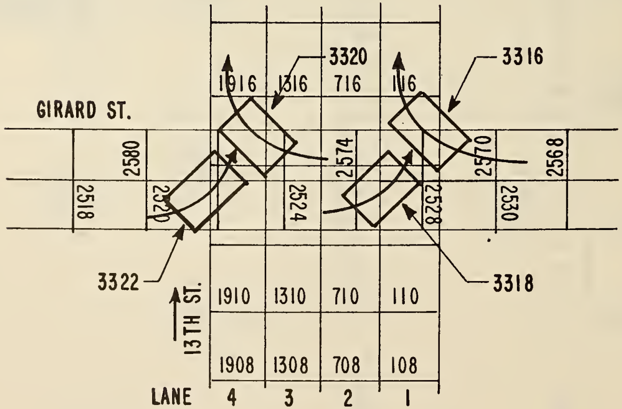



FIGURE 7. TURNS FROM GIRARD STREET INTO 13TH STREET

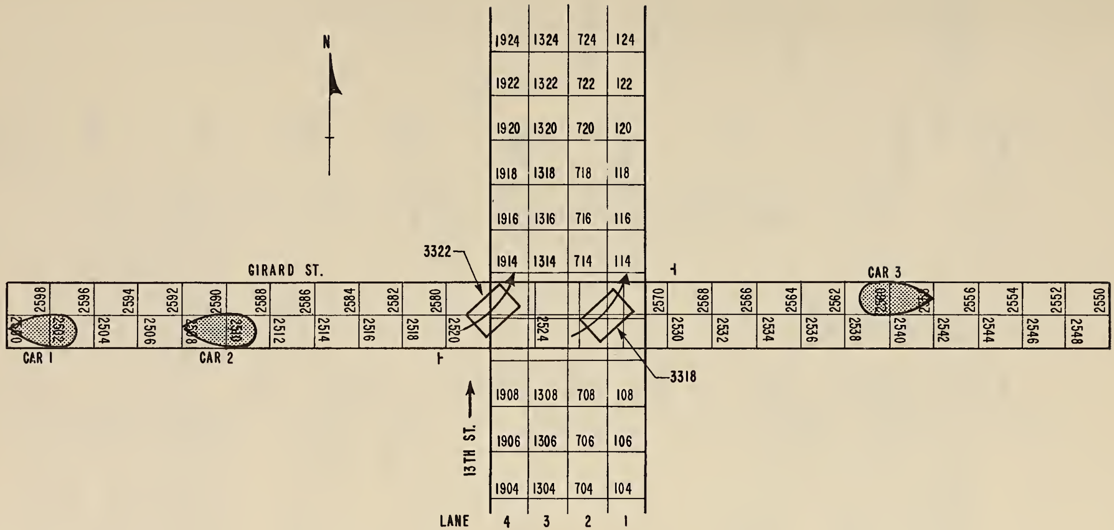



FIGURE 8. LEFT TURN EXERCISE AT 13th AND GIRARD STREETS

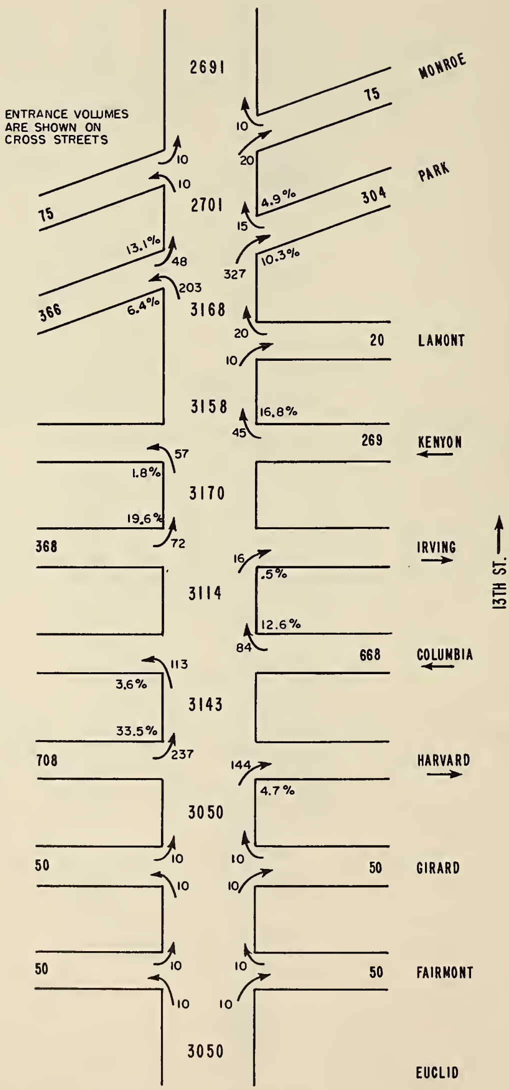



FIGURE 9. DESIGN VOLUMES

| Entrance Street and Lane | | Hourly Rate | Probability Value (A) |
|---|---|---|---|
| 13th | Lane 1 | 610 | 4.24 |
| | 2 | 915 | 6.36 |
| | 3 | 915 | 6.36 |
| | 4 | 610 | 4.24 |
| Fairmont | E/B | 50 | .35 |
| | W/B | 50 | .35 |
| Girard | E/B | 50 | .35 |
| | W/B | 50 | .35 |
| Harvard | E/B (So.) | 354 | 2.46 |
| | E/B (No.) | 354 | 2.46 |
| Columbia | W/B (So.) | 334 | 2.32 |
| | W/B (No.) | 334 | 2.32 |
| Irving | E/B (So.) | 184 | 1.28 |
| | E/B (No.) | 184 | 1.28 |
| Kenyon | W/B (So.) | 135 | .94 |
| | W/B (No.) | 134 | .93 |
| Lamont | W/B | 20 | .14 |
| Park | E/B | 366 | 2.54 |
| | W/B | 304 | 2.11 |
| Monroe | E/B | 75 | .52 |
| | W/B | 75 | .52 |

Note A — Percent of time car should be generated per quarter second. Every quarter second, each probability value is compared with a newly generated random number in the range 0.00 to 99.99. If random number is less than probability value, a car is generated at the entrance indicated.

Fig. 9. Summary of Design Volumes for Entrance Into Model

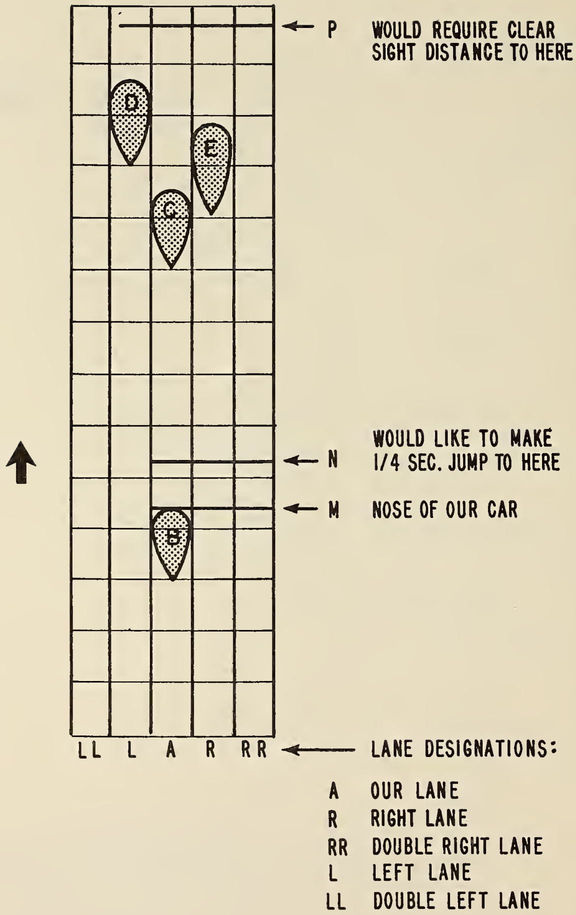



FIGURE 10. THE BASIC FORWARD MOVE

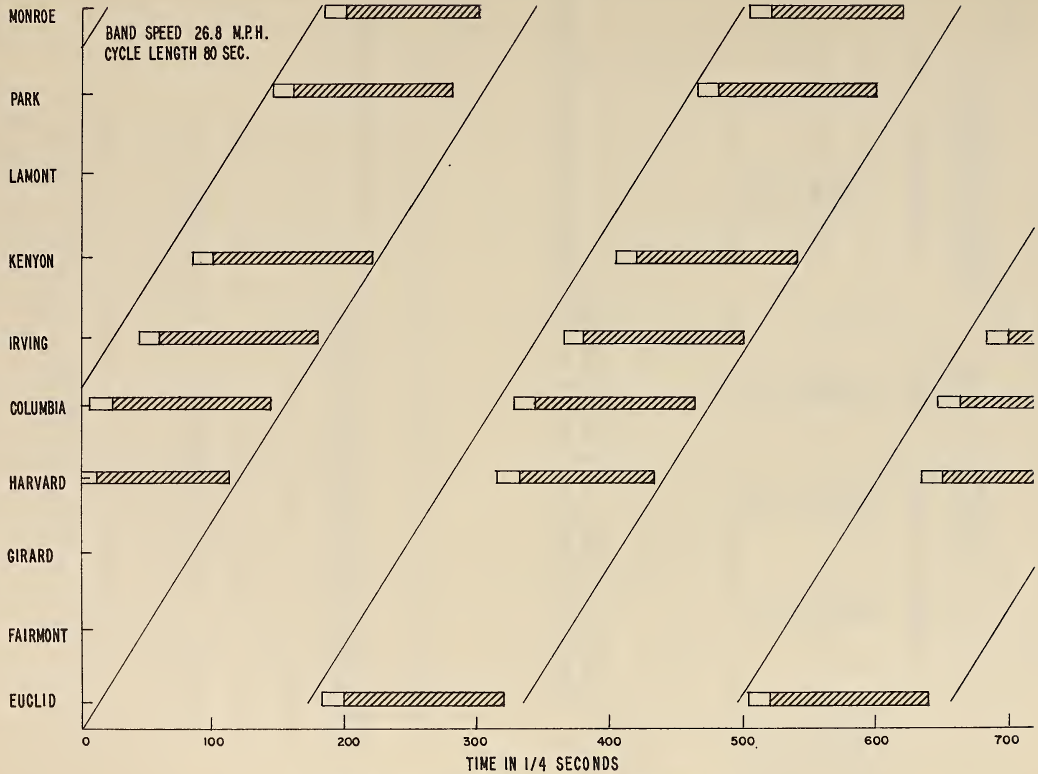



FIGURE 11. 13TH STREET SIGNAL TIMING DIAGRAM

| | Seconds | | | Begin. 13th Green |
|---|---|---|---|---|
| | Offset | 13th Green [A] | 13th Red [A] | Absolute Scale (1/4 sec.) [B] |
| Euclid | 0 | 50 | 30 | 0 |
| Harvard | 28 | 55 | 25 | 112 |
| Columbia | 36 | 50 | 30 | 144 |
| Irving | 45 | 50 | 30 | 180 |
| Kenyon | 55 | 50 | 30 | 220 |
| Park | 70 | 50 | 30 | 280 |
| Monroe | 75 | 55 | 25 | 300 |

Notes:

A - Splits shown include 4-second amber.
B - Simulation clock goes from 0 to 319 quarter seconds and repeats.

Basic data taken from records of District of Columbia Department of Highways and Traffic April 9, 1959.

Fig. 11. Signal Timing Data for 13th Street

Fig. 11. SIGNAL TIMING DATA FOR 13TH STREET

Explanation of diagram on page 1: Green on the main street is indicated by the absence of any marking. Red is indicated by the cross-hatched areas. Amber (at the end of 13th Street green) is indicated by an open outline. The cycle length is 80 seconds (or 320 quarter seconds). The diagram shows several (repeating) cycles.

The broad open bands progressing diagonally up the page represent the bands of traffic which can progress up the street in unison with the (green) timing of the traffic signals. The signals on this section of 13th Street are set for a smooth flow of 26.8 mph in the P. M. rush period.

Definitions:

Split: The apportionment of the total cycle to different signal indications.

Offset: The means of defining the linkage of signal indications at interconnected signalized intersections. The beginning of green on the main street is taken as the point of reference. In the table on page 2, Euclid Street, with a 0 offset, is used as the datum location. The 28-second offset shown for Harvard Street, for example, means that 13th Street green begins at Harvard Street 28 seconds later than it begins at Euclid Street.

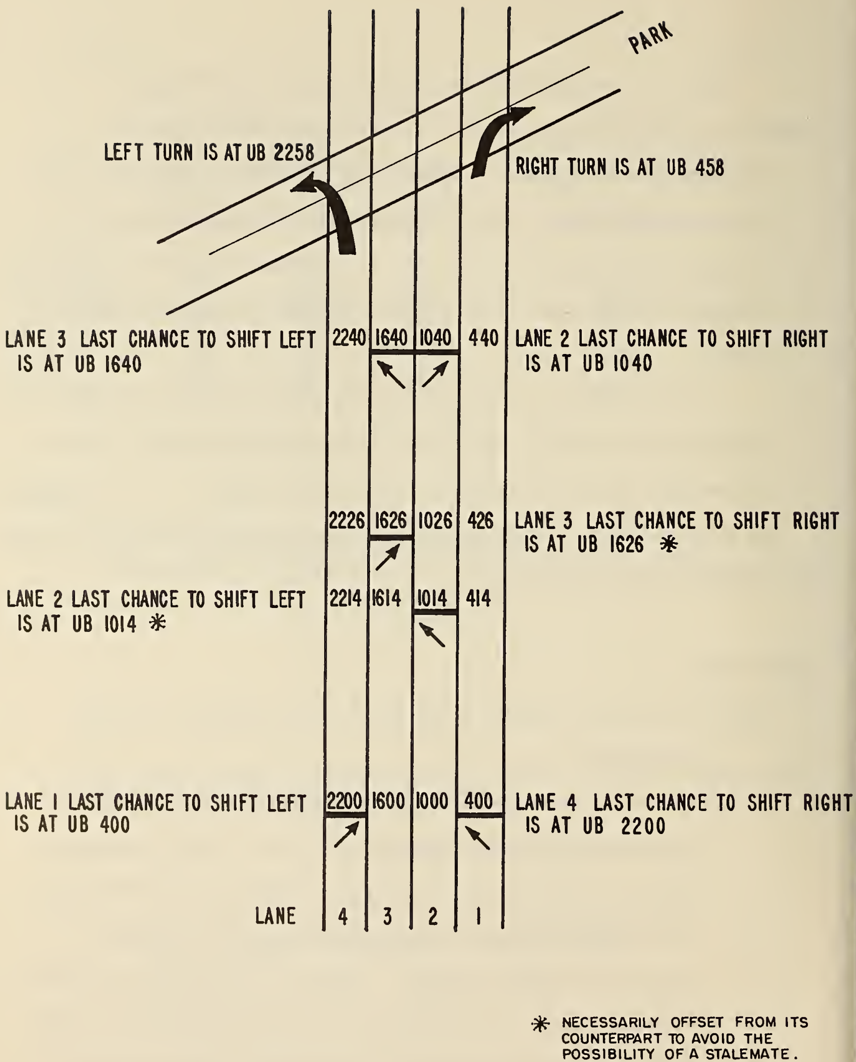



FIGURE 12. PATTERN OF LAST CHANCE UNIT BLOCKS

| Time | Car 1 | Car 2 | Car 3 | Time | Car 1 | Car 2 | Car 3 |
|---|---|---|---|---|---|---|---|
| 1 | 2502 | 2510 | 2560 | 26 | 2520 | 1916 | 2576 |
| 2 | 2504 | 2512 | 2562 | 27 | 2520 | 1918 | 2578 |
| 3 | 2506 | 2514 | 2564 | 28 | 2522 | 1918 | 2578 |
| 4 | 2508 | 2516 | 2566 | 29 | 2522 | 1920 | 2580 |
| 5 | 2508 | 2516 | 2566 | 30 | 2522 | 1920 | 2580 |
| 6 | 2510 | 2518 | 2568 | 31 | 2522 | 1922 | 2582 |
| 7 | 2512 | 2518 | 2568 | 32 | 2524 | 1924 | 2582 |
| 8 | 2514 | 2518 | 2568 | 33 | 2524 | 1924 | 2584 |
| 9 | 2514 | 2518 | 2568 | 34 | 3318 | 1926 | 2586 |
| 10 | 2514 | 2518 | 2568 | 35 | 3318 | 1928 | 2586 |
| 11 | 2516 | 2518 | 2568 | 36 | 112 | 1928 | 2588 |
| 12 | 2516 | 2520 | 2570 | 37 | 112 | 1930 | 2590 |
| 13 | 2516 | 2520 | 2570 | 38 | 114 | 1932 | 2590 |
| 14 | 2518 | 2520 | 2570 | 39 | 114 | 1934 | 2592 |
| 15 | 2518 | 2520 | 2570 | 40 | 116 | 1936 | 2594 |
| 16 | 2518 | 3322 | 2570 | 41 | 116 | 1938 | 2596 |
| 17 | 2518 | 3322 | 2570 | 42 | 118 | 1940 | 2598 |
| 18 | 2518 | 3322 | 2572 | 43 | 120 | 1942 | |
| 19 | 2518 | 3322 | 2572 | 44 | 120 | 1944 | |
| 20 | 2518 | 1912 | 2572 | 45 | 122 | 1946 | |
| 21 | 2520 | 1912 | 2572 | 46 | 124 | 1948 | |
| 22 | 2520 | 1912 | 2574 | 47 | 126 | 1950 | |
| 23 | 2520 | 1914 | 2574 | 48 | 128 | 1952 | |
| 24 | 2520 | 1914 | 2574 | 49 | 130 | 1954 | |
| 25 | 2520 | 1916 | 2576 | 50 | 130 | 1956 | |

Fig. 13. Table of Successive Car Positions in Left-Turn Exercise (Quarter Seconds and Unit Blocks Occupied)

Fig. 14 Unit Block Turn Sequences at 13th & Girard Streets

| | |
|---|---|
| Right from Lane 1 | 108-110-3312-2528-2530 |
| Left from Lane 4 | 1908-1910-1912-3314-2578-2580 |
| Right into Lane 1 | 2568-2570-3316-114-116 |
| Right into Lane 4 | 2568-2570-2572-2574-2576-3320-1914-1916 |
| Left into Lane 1 | 2518-2520-2522-2524-2526-3318-112-114-116 |
| Left into Lane 4 | 2518-2520-3322-1912-1914-1916 |

Fig. 14. Unit Block Turn Sequences at 13th and Girard Streets

| M. P. H. | Quarter-Second Jump | Stopping Distance | Clearance | Goal Pointe |
|---|---|---|---|---|
| 0 | 0 | 0 | 40 | 390 |
| 2 1/2 | 8 | 8 | 60 | 418 |
| 5 | 15 | 15 | 80 | 445 |
| 7 1/2 | 23 | 26 | 100 | 476 |
| 10 | 31 | 48 | 120 | 518 |
| 12 1/2 | 38 | 72 | 140 | 562 |
| 15 | 46 | 106 | 160 | 616 |
| 17 1/2 | 53 | 140 | 180 | 670 |
| 20 | 61 | 186 | 200 | 736 |
| 22 1/2 | 69 | 238 | 220 | 808 |
| 25 | 76 | 289 | 240 | 879 |
| 27 1/2 | 84 | 353 | 260 | 963 |
| 30 | 92 | 423 | 280 | 1053 |
| 32 1/2 | 99 | 490 | 300 | 1140 |
| 35 | 107 | 573 | 320 | 1243 |

Distances are in unit points (100 unit points = 12 feet)

Goal points = stopping distance + clearance + 350 (maximum possible length of leader)

Fig. 15. Jump-Stopping Distance-Goal Points Table

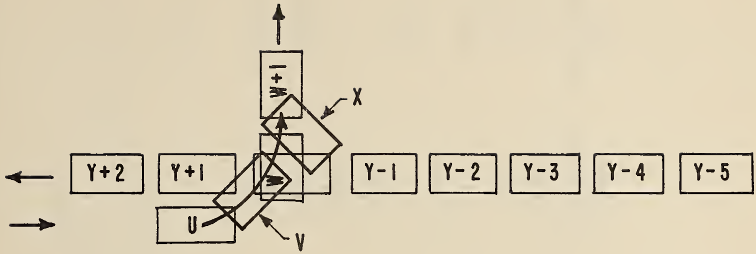
Fig. 16 Characteristics by Type of Vehicle

| Desired Speed Category | M.P.H. | Passenger Car | Truck A | Truck B |
|---|---|---|---|---|
| 0 | 35 | 15% | | |
| 1 | 30 | 35 | 20% | 15% |
| 2 | 25 | 35 | 60 | 35 |
| 3 | 20 | 15 | 20 | 35 |
| 4 | 15 | | | 15 |
| Length (feet) | | 18 | 30 | 42 |
| Acceleration (unit points per 1/4 sec. per 1/4 sec.) | | 3 | 2 | 2 |
| Deceleration (unit points per 1/4 sec. per 1/4 sec.) | | 10 | 10 | 10 |

Type of Vehicle by Street

| | 13th Street | Irving-Kenyon | Park | All Other |
|---|---|---|---|---|
| Passenger car | 99.0% | 92.0% | 97.0% | 99.0% |
| Truck A | 0.5 | 4.0 | 1.5 | 0.5 |
| Truck B | 0.5 | 4.0 | 1.5 | 0.5 |

Fig. 16. Characteristics by Type of Vehicle




| When In | Cannot Enter | Condition |
|---|---|---|
| U | V | If any car in X |
| | | If any car in Y + 2 |
| | | If any car in Y + 1 |
| | | If any car in Y |
| | | If any car in Y - 1 moving > 0 |
| | | If any car in Y - 2 moving > 10 |
| | | If any car in Y - 3 moving > 20 |
| | | If any car in Y - 4 moving > 30 |
| V | W | If any car in X |
| Y | X | If any car in V moving > 0 |
| | | If any car in W |
| X | W + 1 | No restriction |

Note: Stated speeds are in unit points per quarter second.

Fig. 17 Conditions for Conflicting Turn

| | Right From Lane 1 | Left From Lane 4 | Right Into Lane 1 | Left Into Lane 1 | Right Into Lane 4 | Left Into Lane 4 |
|---|---|---|---|---|---|---|
| Fairmont | 3300 | 3302 | 3304 | 3306 | 3308 | 3310 |
| Girard | 3312 | 3314 | 3316 | 3318 | 3320 | 3322 |
| Harvard → | 3324 | -- | -- | 3330 | -- | 3334 |
| Columbia ← | -- | 3338 | 3340 | -- | 3344 | -- |
| Irving → | 3348 | -- | -- | 3354 | -- | 3358 |
| Kenyon ← | -- | 3362 | 3364 | -- | 3368 | -- |
| Lamont | 3372 | -- | 3376 | -- | 3380 | -- |
| Park | 3384 | 3386 | 3388 | 3390 | 3392 | 3394 |
| Monroe | 3396 | 3398 | 3400 | 3402 | 3404 | 3406 |

Fig. 18. Numbering and Location of Diagonal Unit Blocks

Note: Lane 1 and Lane 4 are the east and west lanes of 13th Street, respectively.

VEHICLE GENERATION TABLE

| TIME | EXIT | SP CAT | GEN PT | TYPE | MARKED | LANE PREF |
|---|---|---|---|---|---|---|
| 1037 | 10 | 1 | 20 | 0 | 0 | 1 |
| 1039 | 13 | 0 | 22 | 0 | 0 | 1 |
| 1048 | 10 | 2 | 3 | 0 | 0 | 1 |
| 1048 | 0 | 1 | 5 | 0 | 0 | 0 |
| 1048 | 5 | 0 | 13 | 0 | 0 | 0 |
| 1051 | 0 | 3 | 5 | 0 | 0 | 1 |
| 1051 | 0 | 1 | 7 | 0 | 0 | 0 |
| 1057 | 12 | 1 | 23 | 0 | 0 | 0 |
| 1058 | 6 | 2 | 15 | 0 | 0 | 0 |
| 1060 | 0 | 2 | 5 | 0 | 0 | 0 |
| 1060 | 10 | 2 | 19 | 0 | 0 | 1 |
| 1060 | 12 | 0 | 23 | 0 | 0 | 0 |
| 1062 | 6 | 3 | 16 | 0 | 0 | 1 |
| 1063 | 7 | 1 | 18 | 0 | 0 | 1 |
| 1064 | 0 | 2 | 3 | 0 | 0 | 0 |
| 1065 | 10 | 2 | 19 | 0 | 0 | 0 |
| 1070 | 0 | 2 | 3 | 0 | 0 | 1 |
| 1070 | 6 | 3 | 16 | 0 | 0 | 0 |
| 1074 | 0 | 2 | 1 | 0 | 0 | 0 |
| 1078 | 0 | 2 | 5 | 0 | 0 | 1 |
| 1079 | 15 | 1 | 24 | 0 | 0 | 0 |
| 1084 | 0 | 0 | 1 | 0 | 0 | 1 |
| 1086 | 0 | 2 | 1 | 0 | 0 | 0 |
| 1087 | 5 | 1 | 3 | 0 | 0 | 1 |
| 1087 | 0 | 2 | 20 | 0 | 0 | 1 |
| 1088 | 12 | 2 | 23 | 0 | 0 | 0 |
| 1089 | 6 | 2 | 15 | 0 | 0 | 0 |
| 1091 | 7 | 3 | 17 | 0 | 0 | 0 |

VEHICLE GENERATION TABLE

| TIME | EXIT | SP CAT | GEN PT | TYPE | MARKED | LANE PREF |
|---|---|---|---|---|---|---|
| 1094 | 0 | 2 | 3 | 0 | 0 | 0 |
| 1097 | 0 | 0 | 5 | 0 | 0 | 1 |
| 1098 | 0 | 3 | 3 | 0 | 0 | 1 |
| 1100 | 1 | 2 | 9 | 0 | 0 | 1 |
| 1101 | 13 | 1 | 1 | 0 | 0 | 0 |
| 1103 | 10 | 0 | 20 | 0 | 0 | 0 |
| 1104 | 0 | 3 | 1 | 0 | 0 | 0 |
| 1107 | 0 | 2 | 5 | 0 | 0 | 1 |
| 1117 | 13 | 0 | 5 | 0 | 0 | 1 |
| 1117 | 13 | 2 | 16 | 0 | 0 | 0 |
| 1119 | 0 | 3 | 5 | 0 | 0 | 0 |
| 1119 | 10 | 3 | 19 | 0 | 0 | 0 |
| 1126 | 14 | 0 | 25 | 0 | 0 | 1 |
| 1127 | 0 | 1 | 3 | 0 | 0 | 0 |
| 1132 | 6 | 2 | 5 | 0 | 0 | 1 |
| 1135 | 12 | 0 | 23 | 0 | 0 | 0 |
| 1138 | 0 | 2 | 5 | 0 | 0 | 0 |
| 1142 | 0 | 1 | 1 | 0 | 0 | 0 |
| 1144 | 10 | 2 | 5 | 0 | 0 | 0 |
| 1145 | 11 | 2 | 7 | 0 | 0 | 0 |
| 1148 | 0 | 2 | 3 | 0 | 0 | 0 |
| 1149 | 13 | 2 | 22 | 0 | 0 | 0 |
| 1151 | 0 | 2 | 5 | 0 | 0 | 1 |
| 1153 | 0 | 1 | 7 | 0 | 0 | 0 |
| 1154 | 13 | 2 | 22 | 0 | 0 | 0 |
| 1156 | 0 | 1 | 3 | 0 | 0 | 1 |
| 1160 | 0 | 2 | 2 | 0 | 0 | 1 |
| 1162 | 5 | 2 | 13 | 0 | 0 | 1 |

VEHICLE GENERATION TABLE

| TIME | EXIT | SP CAT | GEN PT | TYPE | MARKED | LANE PREF |
|---|---|---|---|---|---|---|
| 1162 | 12 | 3 | 23 | 0 | 0 | 1 |
| 1167 | 0 | 1 | 4 | 0 | 0 | 0 |
| 1171 | 13 | 3 | 22 | 0 | 0 | 0 |
| 1174 | 10 | 0 | 19 | 0 | 0 | 1 |
| 1179 | 13 | 2 | 22 | 0 | 0 | 0 |
| 1181 | 10 | 1 | 19 | 0 | 0 | 1 |
| 1184 | 13 | 0 | 22 | 0 | 0 | 1 |
| 1189 | 13 | 2 | 22 | 0 | 0 | 0 |
| 1194 | 13 | 2 | 22 | 0 | 0 | 0 |
| 1199 | 13 | 1 | 22 | 0 | 0 | 0 |
| 1203 | 13 | 3 | 22 | 0 | 1 | 0 |
| 1209 | 12 | 0 | 23 | 0 | 1 | 0 |
| 1213 | 6 | 1 | 15 | 0 | 1 | 1 |
| 1217 | 13 | 0 | 22 | 0 | 1 | 0 |
| 1222 | 0 | 2 | 14 | 0 | 1 | 1 |
| 1229 | 7 | 2 | 17 | 0 | 1 | 0 |
| 1229 | 10 | 3 | 19 | 0 | 1 | 1 |
| 1236 | 10 | 3 | 20 | 0 | 1 | 0 |
| 1236 | 12 | 0 | 23 | 0 | 1 | 0 |
| 1242 | 6 | 2 | 16 | 0 | 1 | 0 |
| 1247 | 0 | 1 | 12 | 0 | 1 | 0 |
| 1248 | 13 | 1 | 18 | 0 | 0 | 1 |
| 1250 | 14 | 2 | 25 | 0 | 0 | 0 |
| 1252 | 12 | 2 | 23 | 0 | 0 | 0 |
| 1256 | 6 | 1 | 14 | 0 | 0 | 0 |
| 1257 | 12 | 2 | 23 | 0 | 0 | 1 |
| 1264 | 13 | 1 | 22 | 0 | 0 | 1 |
| 1267 | 13 | 0 | 22 | 0 | 0 | 0 |

VEHICLE GENERATION TABLE

| TIME | EXIT | SP CAT | GEN PT | TYPE | MARKED | LANE PREF |
|---|---|---|---|---|---|---|
| 1269 | 12 | 2 | 23 | 0 | 0 | 0 |
| 1275 | 5 | 3 | 2 | 0 | 0 | 1 |
| 1277 | 6 | 0 | 16 | 0 | 0 | 0 |
| 1280 | 12 | 1 | 3 | 0 | 0 | 1 |
| 1280 | 12 | 1 | 5 | 0 | 0 | 0 |
| 1280 | 0 | 0 | 7 | 0 | 0 | 1 |
| 1282 | 13 | 3 | 7 | 0 | 0 | 0 |
| 1283 | 12 | 2 | 3 | 0 | 0 | 1 |
| 1283 | 13 | 2 | 5 | 0 | 0 | 1 |
| 1283 | 5 | 2 | 13 | 1 | 0 | 1 |
| 1284 | 13 | 2 | 1 | 0 | 0 | 0 |
| 1287 | 0 | 3 | 5 | 0 | 0 | 1 |
| 1289 | 13 | 2 | 3 | 0 | 0 | 1 |
| 1292 | 7 | 0 | 18 | 0 | 0 | 1 |
| 1293 | 0 | 1 | 1 | 0 | 0 | 1 |
| 1293 | 0 | 3 | 3 | 0 | 0 | 1 |
| 1296 | 6 | 2 | 16 | 0 | 0 | 1 |
| 1298 | 0 | 1 | 1 | 0 | 0 | 0 |
| 1302 | 13 | 2 | 3 | 0 | 0 | 0 |
| 1303 | 0 | 0 | 5 | 0 | 0 | 1 |
| 1304 | 12 | 1 | 7 | 0 | 0 | 0 |
| 1305 | 0 | 1 | 1 | 0 | 0 | 1 |
| 1305 | 0 | 2 | 5 | 0 | 0 | 1 |
| 1310 | 7 | 1 | 18 | 0 | 0 | 1 |
| 1311 | 7 | 1 | 17 | 0 | 0 | 0 |
| 1313 | 0 | 0 | 3 | 0 | 0 | 1 |
| 1315 | 13 | 0 | 1 | 0 | 0 | 0 |
| 1315 | 15 | 3 | 3 | 0 | 0 | 1 |

VEHICLE GENERATION TABLE

| TIME | EXIT | SP CAT | GEN PT | TYPE | MARKED | LANE PREF |
|---|---|---|---|---|---|---|
| 1316 | 0 | 3 | 5 | 0 | 0 | 0 |
| 1318 | 0 | 1 | 1 | 0 | 0 | 0 |
| 1321 | 0 | 1 | 16 | 0 | 0 | 1 |
| 1324 | 13 | 2 | 7 | 0 | 0 | 0 |
| 1326 | 0 | 3 | 3 | 0 | 0 | 0 |
| 1327 | 0 | 0 | 1 | 0 | 0 | 0 |
| 1327 | 0 | 3 | 18 | 0 | 0 | 1 |
| 1330 | 0 | 1 | 1 | 0 | 0 | 0 |
| 1332 | 0 | 3 | 3 | 0 | 0 | 1 |
| 1333 | 0 | 3 | 1 | 0 | 0 | 1 |
| 1334 | 0 | 0 | 7 | 0 | 0 | 1 |
| 1337 | 0 | 1 | 7 | 0 | 0 | 0 |
| 1337 | 5 | 1 | 14 | 0 | 0 | 1 |
| 1339 | 0 | 3 | 1 | 0 | 0 | 0 |
| 1340 | 0 | 0 | 16 | 0 | 0 | 0 |
| 1341 | 0 | 0 | 5 | 0 | 0 | 1 |
| 1341 | 2 | 3 | 10 | 0 | 0 | 1 |
| 1343 | 12 | 3 | 7 | 0 | 0 | 1 |
| 1350 | 0 | 1 | 1 | 0 | 0 | 0 |
| 1351 | 6 | 3 | 15 | 0 | 0 | 1 |
| 1354 | 0 | 1 | 3 | 0 | 0 | 0 |
| 1356 | 0 | 1 | 1 | 0 | 0 | 1 |
| 1356 | 7 | 0 | 18 | 0 | 0 | 1 |
| 1357 | 0 | 2 | 3 | 0 | 0 | 1 |
| 1359 | 13 | 1 | 16 | 0 | 0 | 1 |
| 1360 | 0 | 2 | 1 | 0 | 0 | 1 |
| 1361 | 0 | 2 | 5 | 0 | 0 | 1 |
| 1365 | 12 | 1 | 7 | 0 | 0 | 1 |

VEHICLE GENERATION TABLE

| TIME | EXIT | SP CAT | GEN PT | TYPE | MARKED | LANE PREF |
|---|---|---|---|---|---|---|
| 1366 | 0 | 1 | 3 | 0 | 0 | 1 |
| 1368 | 0 | 2 | 7 | 0 | 0 | 0 |
| 1369 | 10 | 2 | 3 | 0 | 0 | 1 |
| 1369 | 6 | 1 | 15 | 0 | 0 | 0 |
| 1371 | 13 | 0 | 5 | 0 | 0 | 0 |
| 1371 | 5 | 1 | 13 | 0 | 0 | 1 |
| 1374 | 7 | 2 | 18 | 0 | 0 | 0 |
| 1376 | 0 | 3 | 14 | 0 | 0 | 1 |
| 1379 | 0 | 1 | 3 | 0 | 0 | 0 |
| 1379 | 0 | 2 | 18 | 0 | 0 | 0 |
| 1382 | 0 | 2 | 3 | 0 | 0 | 1 |
| 1382 | 7 | 3 | 17 | 0 | 0 | 0 |
| 1386 | 0 | 2 | 16 | 0 | 0 | 1 |
| 1388 | 0 | 2 | 3 | 0 | 0 | 0 |
| 1388 | 0 | 3 | 5 | 0 | 0 | 1 |
| 1388 | 0 | 2 | 7 | 0 | 0 | 0 |
| 1391 | 0 | 2 | 1 | 1 | 0 | 1 |
| 1396 | 0 | 1 | 3 | 0 | 0 | 0 |
| 1397 | 0 | 2 | 5 | 0 | 0 | 1 |
| 1397 | 13 | 2 | 14 | 0 | 0 | 1 |
| 1398 | 0 | 0 | 7 | 0 | 0 | 0 |
| 1399 | 5 | 2 | 13 | 0 | 0 | 0 |
| 1400 | 15 | 2 | 24 | 0 | 0 | 0 |
| 1401 | 0 | 1 | 3 | 0 | 0 | 0 |
| 1404 | 0 | 2 | 1 | 0 | 0 | 0 |
| 1404 | 13 | 1 | 22 | 0 | 0 | 1 |
| 1406 | 0 | 1 | 5 | 0 | 0 | 0 |
| 1407 | 0 | 1 | 3 | 0 | 0 | 1 |

VEHICLE GENERATION TABLE

| TIME | EXIT | SP CAT | GEN PT | TYPE | MARKED | LANE PREF |
|---|---|---|---|---|---|---|
| 1408 | 13 | 0 | 22 | 0 | 0 | 0 |
| 1409 | 0 | 3 | 5 | 0 | 0 | 1 |
| 1410 | 0 | 3 | 3 | 0 | 0 | 1 |
| 1418 | 6 | 2 | 7 | 0 | 0 | 1 |
| 1419 | 0 | 2 | 3 | 0 | 0 | 1 |
| 1420 | 5 | 3 | 13 | 0 | 0 | 1 |
| 1422 | 0 | 1 | 21 | 0 | 0 | 1 |
| 1426 | 6 | 2 | 15 | 0 | 0 | 0 |
| 1428 | 0 | 2 | 1 | 0 | 0 | 1 |
| 1428 | 0 | 1 | 3 | 0 | 0 | 0 |
| 1429 | 10 | 2 | 20 | 0 | 0 | 0 |
| 1431 | 0 | 1 | 5 | 0 | 0 | 0 |
| 1433 | 15 | 1 | 3 | 0 | 0 | 1 |
| 1440 | 0 | 0 | 5 | 0 | 0 | 0 |
| 1440 | 0 | 2 | 14 | 0 | 0 | 0 |
| 1441 | 0 | 1 | 1 | 0 | 0 | 1 |
| 1444 | 12 | 0 | 3 | 0 | 0 | 1 |
| 1444 | 6 | 1 | 16 | 0 | 0 | 1 |
| 1447 | 0 | 0 | 5 | 0 | 0 | 1 |
| 1456 | 13 | 1 | 22 | 0 | 0 | 0 |
| 1456 | 12 | 3 | 23 | 0 | 0 | 0 |
| 1458 | 0 | 1 | 1 | 0 | 0 | 1 |
| 1460 | 13 | 3 | 22 | 0 | 0 | 1 |
| 1461 | 5 | 0 | 13 | 0 | 0 | 0 |
| 1464 | 12 | 0 | 23 | 0 | 0 | 1 |
| 1468 | 13 | 1 | 22 | 0 | 0 | 1 |
| 1471 | 0 | 2 | 14 | 0 | 0 | 0 |
| 1471 | 12 | 1 | 23 | 0 | 0 | 1 |

VEHICLE GENERATION TABLE

| TIME | EXIT | SP CAT | GEN PT | TYPE | MARKED | LANE PREF |
|---|---|---|---|---|---|---|
| 1476 | 5 | 1 | 3 | 0 | 0 | 0 |
| 1477 | 0 | 3 | 21 | 0 | 0 | 0 |
| 1486 | 7 | 3 | 17 | 0 | 0 | 0 |
| 1494 | 7 | 1 | 17 | 0 | 0 | 0 |
| 1503 | 13 | 1 | 22 | 0 | 0 | 0 |
| 1506 | 6 | 1 | 15 | 0 | 0 | 1 |
| 1519 | 13 | 1 | 16 | 0 | 0 | 1 |
| 1520 | 10 | 0 | 19 | 0 | 0 | 0 |
| 1522 | 6 | 2 | 16 | 0 | 0 | 0 |
| 1524 | 7 | 3 | 17 | 0 | 0 | 0 |
| 1528 | 6 | 2 | 15 | 0 | 0 | 0 |
| 1549 | 0 | 2 | 24 | 0 | 0 | 1 |
| 1552 | 14 | 2 | 25 | 0 | 0 | 0 |
| 1561 | 6 | 1 | 15 | 0 | 0 | 0 |
| 1562 | 1 | 2 | 9 | 0 | 0 | 0 |
| 1566 | 14 | 1 | 25 | 0 | 0 | 1 |
| 1569 | 7 | 2 | 17 | 0 | 0 | 0 |
| 1585 | 12 | 0 | 23 | 0 | 0 | 1 |
| 1587 | 12 | 0 | 23 | 0 | 0 | 0 |
| 1589 | 4 | 2 | 12 | 0 | 0 | 0 |
| 1590 | 0 | 1 | 22 | 0 | 0 | 1 |
| 1594 | 6 | 2 | 16 | 0 | 0 | 1 |
| 1600 | 0 | 2 | 1 | 0 | 0 | 0 |
| 1600 | 0 | 3 | 3 | 0 | 0 | 1 |
| 1600 | 0 | 2 | 5 | 0 | 0 | 0 |
| 1600 | 4 | 1 | 7 | 0 | 0 | 0 |
| 1602 | 13 | 0 | 22 | 0 | 0 | 1 |
| 1603 | 0 | 2 | 7 | 0 | 0 | 1 |

VEHICLE GENERATION TABLE

| TIME | EXIT | SP CAT | GEN PT | TYPE | MARKED | LANE PREF |
|---|---|---|---|---|---|---|
| 1606 | 0 | 2 | 5 | 0 | 0 | 1 |
| 1606 | 0 | 2 | 25 | 0 | 0 | 1 |
| 1607 | 15 | 1 | 24 | 0 | 0 | 0 |
| 1608 | 0 | 1 | 1 | 0 | 0 | 1 |
| 1610 | 0 | 3 | 5 | 0 | 0 | 0 |
| 1611 | 0 | 3 | 1 | 0 | 0 | 0 |
| 1611 | 0 | 1 | 3 | 0 | 0 | 1 |
| 1617 | 0 | 1 | 3 | 0 | 0 | 1 |
| 1618 | 0 | 2 | 25 | 0 | 0 | 0 |
| 1620 | 5 | 2 | 1 | 0 | 0 | 0 |
| 1620 | 1 | 0 | 9 | 0 | 0 | 0 |
| 1624 | 5 | 1 | 3 | 0 | 0 | 1 |
| 1625 | 6 | 1 | 7 | 0 | 0 | 0 |
| 1627 | 0 | 2 | 3 | 0 | 0 | 1 |
| 1628 | 5 | 2 | 13 | 0 | 0 | 0 |
| 1629 | 5 | 1 | 1 | 0 | 0 | 1 |
| 1630 | 0 | 1 | 7 | 0 | 0 | 0 |
| 1630 | 10 | 1 | 20 | 2 | 0 | 0 |
| 1632 | 0 | 1 | 5 | 0 | 0 | 1 |
| 1633 | 5 | 1 | 13 | 0 | 0 | 0 |
| 1633 | 0 | 1 | 14 | 0 | 0 | 1 |
| 1635 | 0 | 1 | 3 | 0 | 0 | 0 |
| 1637 | 5 | 1 | 1 | 0 | 0 | 0 |
| 1638 | 0 | 1 | 5 | 0 | 0 | 1 |
| 1639 | 6 | 3 | 15 | 0 | 0 | 1 |
| 1639 | 6 | 3 | 16 | 0 | 0 | 0 |
| 1640 | 0 | 3 | 7 | 0 | 0 | 1 |
| 1644 | 0 | 1 | 5 | 0 | 0 | 0 |

VEHICLE GENERATION TABLE

| TIME | EXIT | SP CAT | GEN PT | TYPE | MARKED | LANE PREF |
|---|---|---|---|---|---|---|
| 1645 | 6 | 3 | 15 | 0 | 0 | 1 |
| 1648 | 0 | 2 | 22 | 0 | 0 | 1 |
| 1650 | 0 | 1 | 5 | 0 | 0 | 1 |
| 1651 | 5 | 0 | 13 | 0 | 0 | 0 |
| 1654 | 0 | 2 | 5 | 0 | 0 | 0 |
| 1655 | 0 | 1 | 3 | 0 | 0 | 0 |
| 1657 | 10 | 0 | 20 | 0 | 0 | 0 |
| 1659 | 0 | 1 | 1 | 0 | 0 | 1 |
| 1660 | 13 | 2 | 7 | 0 | 0 | 0 |
| 1661 | 13 | 1 | 3 | 0 | 0 | 1 |
| 1662 | 0 | 2 | 1 | 0 | 0 | 1 |
| 1666 | 0 | 2 | 7 | 0 | 0 | 0 |
| 1666 | 0 | 1 | 14 | 0 | 0 | 0 |
| 1666 | 12 | 2 | 23 | 0 | 0 | 0 |
| 1667 | 0 | 1 | 5 | 0 | 0 | 0 |
| 1669 | 5 | 1 | 13 | 0 | 0 | 0 |
| 1670 | 0 | 3 | 7 | 0 | 0 | 0 |
| 1683 | 0 | 1 | 3 | 0 | 0 | 1 |
| 1686 | 0 | 2 | 3 | 0 | 0 | 1 |
| 1692 | 0 | 1 | 7 | 0 | 0 | 1 |
| 1694 | 0 | 1 | 3 | 0 | 0 | 1 |
| 1695 | 0 | 2 | 7 | 0 | 0 | 0 |
| 1697 | 0 | 2 | 5 | 0 | 0 | 1 |
| 1704 | 0 | 1 | 7 | 0 | 0 | 1 |
| 1707 | 7 | 1 | 18 | 0 | 0 | 0 |
| 1710 | 0 | 1 | 7 | 0 | 0 | 1 |
| 1713 | 0 | 2 | 7 | 0 | 0 | 1 |
| 1714 | 0 | 1 | 3 | 0 | 0 | 0 |

VEHICLE GENERATION TABLE

| TIME | EXIT | SP CAT | GEN PT | TYPE | MARKEO | LANE PREF |
|---|---|---|---|---|---|---|
| 1717 | 6 | 1 | 5 | 0 | 0 | 1 |
| 1717 | 4 | 3 | 7 | 0 | 0 | 0 |
| 1724 | 10 | 2 | 19 | 0 | 0 | 0 |
| 1725 | 13 | 1 | 14 | 0 | 0 | 0 |
| 1727 | 0 | 3 | 1 | 0 | 0 | 0 |
| 1728 | 0 | 2 | 5 | 0 | 0 | 1 |
| 1729 | 6 | 1 | 16 | 0 | 0 | 1 |
| 1729 | 13 | 2 | 22 | 2 | 0 | 1 |
| 1730 | 7 | 2 | 7 | 0 | 0 | 1 |
| 1734 | 0 | 1 | 3 | 0 | 0 | 1 |
| 1734 | 0 | 2 | 5 | 0 | 0 | 0 |
| 1739 | 12 | 2 | 7 | 0 | 0 | 1 |
| 1747 | 0 | 1 | 5 | 0 | 0 | 1 |
| 1752 | 0 | 1 | 3 | 0 | 0 | 0 |
| 1752 | 0 | 1 | 5 | 0 | 0 | 1 |
| 1757 | 0 | 1 | 5 | 0 | 0 | 1 |
| 1758 | 0 | 1 | 7 | 0 | 0 | 0 |
| 1764 | 0 | 0 | 5 | 0 | 0 | 1 |
| 1765 | 5 | 2 | 1 | 0 | 0 | 1 |
| 1765 | 6 | 0 | 15 | 0 | 0 | 0 |
| 1766 | 0 | 2 | 5 | 0 | 0 | 1 |
| 1773 | 12 | 2 | 3 | 0 | 0 | 1 |
| 1779 | 12 | 3 | 23 | 0 | 0 | 1 |
| 1781 | 0 | 1 | 5 | 0 | 0 | 1 |
| 1781 | 5 | 3 | 13 | 0 | 0 | 1 |
| 1784 | 7 | 3 | 18 | 2 | 0 | 0 |
| 1788 | 0 | 1 | 9 | 0 | 0 | 1 |
| 1791 | 13 | 0 | 22 | 0 | 0 | 1 |

VEHICLE GENERATION TABLE

| TIME | EXIT | SP CAT | GEN PT | TYPE | MARKEO | LANE PREF |
|---|---|---|---|---|---|---|
| 1800 | 13 | 0 | 4 | 0 | 0 | 0 |
| 1802 | 0 | 3 | 4 | 0 | 0 | 0 |
| 1804 | 12 | 2 | 23 | 0 | 0 | 0 |
| 1815 | 13 | 3 | 22 | 2 | 0 | 0 |
| 1816 | 4 | 2 | 12 | 0 | 0 | 1 |
| 1819 | 6 | 0 | 15 | 0 | 0 | 1 |
| 1820 | 10 | 0 | 19 | 0 | 0 | 1 |
| 1821 | 0 | 0 | 16 | 0 | 0 | 0 |
| 1826 | 13 | 2 | 22 | 0 | 0 | 1 |
| 1832 | 13 | 1 | 22 | 0 | 0 | 1 |
| 1843 | 6 | 3 | 16 | 0 | 0 | 1 |
| 1847 | 0 | 1 | 23 | 0 | 0 | 1 |
| 1852 | 0 | 2 | 16 | 0 | 0 | 0 |
| 1854 | 13 | 3 | 22 | 0 | 0 | 1 |
| 1860 | 6 | 0 | 15 | 0 | 0 | 1 |
| 1864 | 7 | 2 | 18 | 0 | 0 | 0 |
| 1872 | 6 | 2 | 15 | 0 | 0 | 1 |
| 1885 | 13 | 3 | 22 | 0 | 0 | 0 |
| 1893 | 13 | 1 | 22 | 0 | 0 | 0 |
| 1898 | 13 | 2 | 22 | 0 | 0 | 1 |
| 1899 | 14 | 2 | 25 | 0 | 0 | 0 |
| 1903 | 13 | 2 | 22 | 1 | 0 | 0 |
| 1905 | 7 | 1 | 17 | 0 | 0 | 0 |
| 1920 | 13 | 3 | 1 | 0 | 0 | 0 |
| 1920 | 0 | 1 | 3 | 0 | 0 | 0 |
| 1920 | 0 | 2 | 5 | 0 | 0 | 1 |
| 1920 | 0 | 1 | 7 | 0 | 0 | 0 |
| 1923 | 0 | 3 | 3 | 0 | 0 | 1 |

VEHICLE GENERATION TABLE

| TIME | EXIT | SP CAT | GEN PT | TYPE | MARKED | LANE PREF |
|---|---|---|---|---|---|---|
| 1923 | 10 | 2 | 7 | 0 | 0 | 1 |
| 1926 | 5 | 3 | 1 | 0 | 0 | 0 |
| 1928 | 6 | 1 | 5 | 0 | 0 | 0 |
| 1936 | 12 | 1 | 23 | 0 | 0 | 0 |
| 1937 | 0 | 1 | 1 | 0 | 0 | 1 |
| 1940 | 0 | 3 | 1 | 0 | 0 | 0 |
| 1943 | 0 | 2 | 7 | 0 | 0 | 1 |
| 1945 | 0 | 1 | 3 | 0 | 0 | 0 |
| 1948 | 0 | 2 | 5 | 0 | 0 | 1 |
| 1949 | 0 | 2 | 1 | 0 | 0 | 1 |
| 1951 | 0 | 1 | 3 | 0 | 0 | 1 |
| 1955 | 0 | 2 | 1 | 0 | 0 | 1 |
| 1956 | 0 | 1 | 5 | 0 | 0 | 1 |
| 1960 | 6 | 3 | 7 | 0 | 0 | 1 |
| 1960 | 6 | 3 | 15 | 0 | 0 | 1 |
| 1961 | 12 | 1 | 5 | 0 | 0 | 1 |
| 1965 | 12 | 1 | 1 | 0 | 0 | 1 |
| 1973 | 0 | 1 | 3 | 0 | 0 | 1 |
| 1973 | 6 | 2 | 16 | 0 | 0 | 1 |
| 1977 | 12 | 2 | 23 | 1 | 0 | 1 |
| 1978 | 12 | 3 | 5 | 1 | 0 | 0 |
| 1978 | 6 | 2 | 15 | 0 | 0 | 1 |
| 1980 | 0 | 0 | 3 | 0 | 0 | 0 |
| 1982 | 0 | 1 | 7 | 0 | 0 | 1 |
| 1983 | 6 | 1 | 15 | 0 | 0 | 0 |
| 1985 | 0 | 0 | 3 | 0 | 0 | 1 |
| 1988 | 6 | 2 | 15 | 0 | 0 | 0 |
| 1989 | 0 | 1 | 3 | 0 | 0 | 0 |

VEHICLE GENERATION TABLE

| TIME | EXIT | SP CAT | GEN PT | TYPE | MARKED | LANE PREF |
|---|---|---|---|---|---|---|
| 1989 | 6 | 2 | 16 | 0 | 0 | 0 |
| 1993 | 0 | 3 | 7 | 0 | 0 | 1 |
| 1994 | 3 | 1 | 11 | 0 | 0 | 1 |

STATION B CHECK

| TIME | LANE 1 | LANE 2 | LANE 3 | LANE 4 |
|---|---|---|---|---|
| 1037 | | | | 768 |
| 1041 | 785 | | | |
| 1047 | 802 | | | |
| 1052 | | 777 | | |
| 1061 | | 830 | | |
| 1063 | 764 | | | |
| 1068 | 781 | | | |
| 1087 | | | | 818 |
| 1088 | 817 | | | |
| 1100 | | | | 830 |
| 1103 | 808 | | | |
| 1163 | | | | 1087 |
| 1220 | | | | 819 |
| 1225 | 839 | | | |
| 1230 | | | | 1019 |
| 1235 | | | | 790 |
| 1236 | | 776 | | |
| 1239 | | | 884 | |
| 1241 | | 814 | | |
| 1253 | | | 794 | |
| 1258 | 922 | | | |
| 1258 | | | | 829 |
| 1259 | | 960 | | |
| 1263 | | | | 965 |
| 1268 | 1024 | | | |
| 1268 | | | 960 | |
| 1269 | | 808 | | |
| 1271 | | | | 981 |

STATION B CHECK

| TIME | LANE 1 | LANE 2 | LANE 3 | LANE 4 |
|---|---|---|---|---|
| 1276 | 1011 | | | |
| 1282 | 995 | | | |
| 1291 | 972 | | | |
| 1298 | | | | 821 |
| 1299 | | 972 | | |
| 1300 | 960 | | | |
| 1303 | | | 877 | |
| 1305 | 1002 | | | |
| 1305 | | 977 | | |
| 1305 | | | | 984 |
| 1310 | | | 960 | |
| 1311 | | 966 | | |
| 1311 | | | | 965 |
| 1316 | | | 979 | |
| 1317 | 1003 | | | |
| 1318 | | 985 | | |
| 1323 | 1013 | | | |
| 1323 | | | 991 | |
| 1325 | | 1024 | | |
| 1325 | | | | 963 |
| 1329 | 1084 | | | |
| 1329 | | | 1011 | |
| 1331 | | | | 968 |
| 1332 | | 977 | | |
| 1334 | 1019 | | | |
| 1337 | | | 1030 | |
| 1337 | | | | 998 |
| 1343 | | | 1048 | |

STATION B CHECK

| TIME | LANE 1 | LANE 2 | LANE 3 | LANE 4 |
|---|---|---|---|---|
| 1344 | | | | 1004 |
| 1346 | 989 | | | |
| 1346 | | 993 | | |
| 1349 | | | 991 | |
| 1351 | | | | 1028 |
| 1352 | 1004 | | | |
| 1359 | | | 1051 | |
| 1361 | 1028 | | | |
| 1361 | | 1060 | | |
| 1364 | | | | 1097 |
| 1366 | 1022 | | | |
| 1369 | | | | 1127 |
| 1372 | | | 1007 | |
| 1373 | | 1142 | | |
| 1377 | 976 | | | |
| 1378 | | | | 1086 |
| 1381 | | 1035 | | |
| 1387 | 1117 | | | |
| 1388 | | | | 1074 |
| 1393 | 1101 | | | |
| 1393 | | | | 1070 |
| 1396 | | 1064 | | |
| 1403 | | 1078 | | |
| 1408 | | 1094 | | |
| 1414 | | | 1020 | |
| 1419 | | 1148 | | |
| 1420 | | | 1107 | |
| 1425 | | 1151 | | |

STATION B CHECK

| TIME | LANE 1 | LANE 2 | LANE 3 | LANE 4 |
|---|---|---|---|---|
| 1425 | | | 1138 | |
| 1430 | | 1167 | | |
| 1432 | | | | 1051 |
| 1434 | 1098 | | | |
| 1440 | 1104 | | | |
| 1464 | | | | 1422 |
| 1517 | 1477 | | | |
| 1545 | | 1153 | | |
| 1556 | 1248 | | | |
| 1556 | | | 1156 | |
| 1561 | | | 1321 | |
| 1562 | 1340 | | | |
| 1563 | | 1386 | | |
| 1569 | 1293 | | | |
| 1573 | | | 1222 | |
| 1574 | 1379 | | | |
| 1580 | 1247 | | | |
| 1581 | | 1160 | | |
| 1581 | | | | 1327 |
| 1586 | 1117 | | | |
| 1588 | | 1298 | | |
| 1589 | | | 1280 | |
| 1589 | | | | 1119 |
| 1591 | 1359 | | | |
| 1596 | | | | 1283 |
| 1602 | | | | 1280 |
| 1606 | | | 1305 | |
| 1607 | 1284 | | | |

STATION B CHECK

| TIME | LANE 1 | LANE 2 | LANE 3 | LANE 4 |
|---|---|---|---|---|
| 1609 | | | | 1280 |
| 1610 | | 1283 | | |
| 1611 | | | 1318 | |
| 1612 | 1289 | | | |
| 1616 | | 1327 | | |
| 1616 | | | | 1304 |
| 1618 | 1315 | | | |
| 1618 | | | 1330 | |
| 1622 | | 1303 | | |
| 1625 | | | 1334 | |
| 1627 | 1354 | | | |
| 1632 | | 1366 | | |
| 1637 | | | 1313 | |
| 1637 | | | | 1379 |
| 1652 | 1282 | | | |
| 1658 | | | | 1305 |
| 1659 | 1302 | | | |
| 1659 | | 1337 | | |
| 1665 | 1324 | | | |
| 1666 | | | | 1365 |
| 1670 | | | 1287 | |
| 1671 | | | | 1341 |
| 1679 | | 1293 | | |
| 1684 | | | | 1357 |
| 1685 | 1333 | | | |
| 1685 | | 1326 | | |
| 1692 | 1339 | | | |
| 1692 | | | 1350 | |

STATION B CHECK

| TIME | LANE 1 | LANE 2 | LANE 3 | LANE 4 |
|---|---|---|---|---|
| 1699 | 1371 | | | |
| 1699 | | 1356 | | |
| 1706 | | | 1332 | |
| 1708 | | | | 1343 |
| 1711 | | 1368 | | |
| 1714 | 1407 | | | |
| 1716 | | | | 1388 |
| 1719 | | | 1396 | |
| 1721 | | 1398 | | |
| 1722 | | | 1447 | |
| 1726 | 1315 | | | |
| 1728 | | | | 1431 |
| 1729 | | 1401 | | |
| 1732 | 1391 | | | |
| 1732 | | | 1316 | |
| 1733 | | | | 1441 |
| 1735 | | 1361 | | |
| 1741 | 1419 | | | |
| 1746 | 1428 | | | |
| 1747 | | 1360 | | |
| 1753 | | | | 1410 |
| 1754 | | | 1388 | |
| 1755 | | 1404 | | |
| 1759 | | | | 1409 |
| 1873 | | | | 1444 |
| 1876 | 1458 | | | |
| 1876 | | 1406 | | |
| 1882 | | | 1382 | |

STATION B CHECK

| TIME | LANE 1 | LANE 2 | LANE 3 | LANE 4 |
|---|---|---|---|---|
| 1884 | | 1440 | | |
| 1887 | | | | 1428 |
| 1888 | 1433 | | | |
| 1893 | 1519 | | | |
| 1893 | | | 1397 | |
| 1894 | | | | 1617 |
| 1900 | | 1440 | | |
| 1900 | | | 1633 | |
| 1905 | 1397 | | | |
| 1905 | | | 1608 | |
| 1908 | | 1630 | | |
| 1910 | | | 1600 | |
| 1910 | | | | 1388 |
| 1911 | 1471 | | | |
| 1914 | | 1638 | | |
| 1916 | | | 1606 | |
| 1917 | 1600 | | | |
| 1917 | | | | 1666 |
| 1919 | | 1655 | | |
| 1922 | 1650 | | | |
| 1922 | | | 1635 | |
| 1925 | | | | 1376 |
| 1927 | | | 1667 | |
| 1930 | | 1627 | | |
| 1931 | | | | 1611 |
| 1933 | | | 1683 | |
| 1934 | 1692 | | | |
| 1937 | | | | 1632 |

STATION B CHECK

| TIME | LANE 1 | LANE 2 | LANE 3 | LANE 4 |
|---|---|---|---|---|
| 1938 | | | 1644 | |
| 1941 | | 1654 | | |
| 1942 | 1600 | | | |
| 1944 | | | 1659 | |
| 1944 | | | | 1603 |
| 1947 | | 1694 | | |
| 1949 | 1611 | | | |
| 1949 | | | 1714 | |
| 1950 | | | | 1666 |
| 1953 | | 1710 | | |
| 1955 | 1661 | | | |
| 1959 | | 1734 | | |
| 1960 | | | | 1686 |
| 1961 | 1662 | | | |
| 1962 | | | 1610 | |
| 1966 | | 1704 | | |
| 1966 | | | | 1697 |
| 1971 | 1660 | | | |
| 1971 | | 1747 | | |
| 1976 | | 1752 | | |
| 1977 | 1764 | | | |
| 1977 | | | 1695 | |
| 1983 | | | 1713 | |
| 1986 | | | | 1640 |
| 1991 | 1800 | | | |
| 1994 | | 1758 | | |

VEHICLE RETIREMENT TABLE

| LANE | EXIT | ACT SP | LAUNCH TIME | RETIRE TIME | RUN TIME |
|---|---|---|---|---|---|
| 3 | 0 | 92 | 743 | 1037 | 294 |
| 3 | 0 | 107 | 797 | 1050 | 253 |
| 3 | 0 | 107 | 802 | 1056 | 254 |
| 4 | 0 | 61 | 735 | 1059 | |
| 3 | 0 | 76 | 720 | 1076 | 356 |
| 3 | 0 | 76 | 726 | 1082 | 356 |
| 4 | 0 | 107 | 804 | 1084 | 280 |
| 1 | 0 | 61 | .650 | 1094 | 444 |
| 2 | 0 | 76 | 740 | 1096 | 356 |
| 4 | 0 | 107 | 774 | 1101 | 327 |
| 3 | 0 | 76 | 747 | 1103 | 356 |
| 3 | 0 | 76 | 755 | 1112 | 357 |
| 3 | 0 | 92 | 777 | 1124 | 347 |
| 4 | 0 | 76 | 768 | 1124 | 356 |
| 2 | 0 | 61 | 683 | 1127 | 444 |
| 3 | 0 | 92 | 830 | 1133 | 303 |
| 1 | 0 | 76 | 764 | 1150 | 386 |
| 1 | 0 | 76 | 781 | 1155 | 374 |
| 3 | 0 | 107 | 819 | 1283 | |
| 1 | 0 | 75 | 817 | 1285 | 468 |
| 4 | 0 | 75 | 818 | 1285 | 467 |
| 2 | 0 | 92 | 1019 | 1302 | |
| 2 | 0 | 92 | 776 | 1308 | |
| 4 | 0 | 76 | 830 | 1308 | 478 |
| 2 | 0 | 92 | 814 | 1313 | |
| 4 | 0 | 94 | 884 | 1313 | |
| 3 | 0 | 76 | 1087 | 1315 | |
| 4 | 0 | 92 | 829 | 1330 | |

VEHICLE RETIREMENT TABLE

| LANE | EXIT | ACT SP | LAUNCH TIME | RETIRE TIME | RUN TIME |
|---|---|---|---|---|---|
| 2 | 0 | 92 | 960 | 1331 | 371 |
| 4 | 0 | 92 | 965 | 1335 | 370 |
| 4 | 0 | 92 | 981 | 1343 | 362 |
| 4 | 0 | 76 | 960 | 1355 | 395 |
| 3 | 0 | 61 | 794 | 1361 | 567 |
| 1 | 0 | 76 | 1024 | 1367 | |
| 3 | 0 | 107 | 977 | 1375 | 398 |
| 2 | 0 | 61 | 808 | 1378 | 570 |
| 2 | 0 | 76 | 972 | 1386 | 414 |
| 1 | 0 | 107 | 1002 | 1392 | 390 |
| 2 | 0 | 76 | 966 | 1398 | 432 |
| 1 | 0 | 92 | 1024 | 1402 | 378 |
| 4 | 0 | 76 | 984 | 1404 | 420 |
| 2 | 0 | 76 | 985 | 1405 | 420 |
| 1 | 0 | 92 | 960 | 1412 | 452 |
| 3 | 0 | 61 | 877 | 1412 | 535 |
| 4 | 0 | 76 | 979 | 1412 | 433 |
| 1 | 0 | 92 | 1013 | 1417 | 404 |
| 4 | 0 | 76 | 991 | 1417 | 426 |
| 2 | 0 | 76 | 977 | 1419 | 442 |
| 1 | 0 | 107 | 1084 | 1422 | 338 |
| 2 | 0 | 76 | 1030 | 1424 | 394 |
| 3 | 0 | 76 | 1011 | 1424 | 413 |
| 1 | 0 | 92 | 1048 | 1428 | 380 |
| 3 | 0 | 91 | 1019 | 1429 | 410 |
| 4 | 0 | 61 | 963 | 1433 | 470 |
| 2 | 0 | 76 | 989 | 1436 | 447 |
| 3 | 0 | 76 | 991 | 1436 | 445 |

VEHICLE RETIREMENT TABLE

| LANE | EXIT | ACT SP | LAUNCH TIME | RETIRE TIME | RUN TIME |
|---|---|---|---|---|---|
| 4 | 0 | 61 | 968 | 1439 | 471 |
| 3 | 0 | 76 | 1028 | 1441 | 413 |
| 1 | 0 | 76 | 1004 | 1442 | 438 |
| 2 | 0 | 92 | 1051 | 1443 | 392 |
| 4 | 0 | 79 | 998 | 1445 | 447 |
| 1 | 0 | 91 | 1028 | 1446 | 418 |
| 3 | 0 | 92 | 1142 | 1449 | 307 |
| 4 | 0 | 87 | 1004 | 1450 | 446 |
| 1 | 0 | 100 | 1022 | 1452 | 430 |
| 3 | 0 | 92 | 1035 | 1454 | 419 |
| 4 | 0 | 93 | 1097 | 1455 | 358 |
| 2 | 0 | 61 | 993 | 1456 | 463 |
| 1 | 0 | 76 | 1060 | 1458 | 398 |
| 4 | 0 | 92 | 1127 | 1460 | 333 |
| 3 | 0 | 76 | 1086 | 1465 | 379 |
| 4 | 0 | 76 | 1074 | 1475 | 401 |
| 3 | 0 | 61 | 1007 | 1480 | 473 |
| 4 | 0 | 76 | 1070 | 1480 | 410 |
| 2 | 0 | 76 | 1064 | 1483 | 419 |
| 1 | 0 | 61 | 976 | 1485 | 509 |
| 2 | 0 | 76 | 1078 | 1490 | 412 |
| 1 | 0 | 75 | 1549 | 1606 | |
| 2 | 0 | 76 | 1094 | 1627 | 533 |
| 1 | 0 | 76 | 1151 | 1628 | 477 |
| 3 | 0 | 76 | 1020 | 1628 | 608 |
| 4 | 0 | 76 | 1107 | 1628 | 521 |
| 4 | 0 | 92 | 1167 | 1633 | 466 |
| 2 | 0 | 76 | 1148 | 1637 | 489 |

VEHICLE RETIREMENT TABLE

| LANE | EXIT | ACT SP | LAUNCH TIME | RETIRE TIME | RUN TIME |
|---|---|---|---|---|---|
| 4 | 0 | 92 | 1422 | 1638 | |
| 3 | 0 | 76 | 1138 | 1639 | 501 |
| 1 | 0 | 92 | 1156 | 1642 | 486 |
| 3 | 0 | 91 | 1321 | 1644 | |
| 4 | 0 | 107 | 1340 | 1645 | |
| 1 | 0 | 61 | 1098 | 1650 | 552 |
| 3 | 0 | 76 | 1386 | 1650 | |
| 4 | 0 | 107 | 1280 | 1653 | 373 |
| 1 | 0 | 61 | 1104 | 1656 | 552 |
| 2 | 0 | 61 | 1051 | 1656 | 605 |
| 1 | 0 | 79 | 1153 | 1661 | 508 |
| 4 | 0 | 76 | 1222 | 1661 | |
| 3 | 0 | 92 | 1298 | 1662 | 364 |
| 2 | 0 | 61 | 1477 | 1664 | |
| 1 | 0 | 87 | 1293 | 1666 | 373 |
| 2 | 0 | 76 | 1379 | 1669 | |
| 1 | 0 | 92 | 1247 | 1671 | |
| 3 | 0 | 76 | 1160 | 1671 | 511 |
| 3 | 0 | 92 | 1305 | 1677 | 372 |
| 3 | 0 | 92 | 1318 | 1683 | 365 |
| 4 | 0 | 61 | 1327 | 1689 | |
| 3 | 0 | 92 | 1330 | 1690 | 360 |
| 2 | 0 | 107 | 1303 | 1691 | 388 |
| 3 | 0 | 107 | 1334 | 1694 | 360 |
| 4 | 0 | 61 | 1119 | 1698 | 579 |
| 3 | 0 | 107 | 1313 | 1699 | 386 |
| 2 | 0 | 92 | 1354 | 1705 | 351 |
| 1 | 0 | 92 | 1366 | 1710 | 344 |

VEHICLE RETIREMENT TABLE

| LANE | EXIT | ACT SP | LAUNCH TIME | RETIRE TIME | RUN TIME |
|---|---|---|---|---|---|
| 3 | 0 | 92 | 1379 | 1714 | 335 |
| 3 | 0 | 107 | 1327 | 1720 | 393 |
| 2 | 0 | 92 | 1337 | 1731 | 394 |
| 3 | 0 | 107 | 1341 | 1736 | 395 |
| 4 | 0 | 76 | 1305 | 1744 | 439 |
| 4 | 0 | 76 | 1357 | 1770 | 413 |
| 4 | 0 | 92 | 1356 | 1776 | 420 |
| 3 | 0 | 61 | 1287 | 1778 | 491 |
| 4 | 0 | 88 | 1350 | 1782 | 432 |
| 2 | 0 | 61 | 1293 | 1787 | 494 |
| 2 | 0 | 61 | 1326 | 1793 | 467 |
| 1 | 0 | 61 | 1333 | 1794 | 461 |
| 3 | 0 | 92 | 1396 | 1798 | 402 |
| 2 | 0 | 76 | 1368 | 1799 | 431 |
| 1 | 0 | 61 | 1339 | 1801 | 462 |
| 2 | 0 | 92 | 1401 | 1805 | 404 |
| 1 | 0 | 79 | 1407 | 1806 | 399 |
| 4 | 0 | 76 | 1388 | 1806 | 418 |
| 1 | 0 | 82 | 1398 | 1811 | 413 |
| 4 | 0 | 90 | 1431 | 1811 | 380 |
| 3 | 0 | 61 | 1332 | 1815 | 483 |
| 4 | 0 | 76 | 1606 | 1828 | |
| 1 | 0 | 75 | 1618 | 1835 | |
| 1 | 0 | 75 | 1447 | 1925 | 478 |
| 4 | 0 | 75 | 1590 | 1925 | |
| 2 | 0 | 76 | 1648 | 1929 | |
| 3 | 0 | 92 | 1847 | 1929 | |
| 4 | 0 | 92 | 1441 | 1941 | 500 |

VEHICLE RETIREMENT TABLE

| LANE | EXIT | ACT SP | LAUNCH TIME | RETIRE TIME | RUN TIME |
|---|---|---|---|---|---|
| 2 | 0 | 76 | 1361 | 1948 | 587 |
| 2 | 0 | 76 | 1419 | 1958 | 539 |
| 4 | 0 | 76 | 1388 | 1958 | 570 |
| 3 | 0 | 61 | 1316 | 1959 | 643 |
| 4 | 0 | 76 | 1360 | 1963 | 603 |
| 2 | 0 | 76 | 1391 | 1965 | 574 |
| 3 | 0 | 76 | 1428 | 1968 | 540 |
| 1 | 0 | 76 | 1404 | 1971 | 567 |
| 2 | 0 | 76 | 1382 | 1973 | 591 |
| 4 | 0 | 61 | 1410 | 1976 | 566 |
| 1 | 0 | 92 | 1406 | 1977 | 571 |
| 3 | 0 | 76 | 1397 | 1980 | 583 |
| 4 | 0 | 79 | 1428 | 1981 | 553 |
| 1 | 0 | 92 | 1458 | 1982 | 524 |
| 2 | 0 | 61 | 1409 | 1985 | 576 |
| 3 | 0 | 91 | 1608 | 1985 | 377 |
| 1 | 0 | 107 | 1440 | 1987 | 547 |
| 4 | 0 | 90 | 1617 | 1987 | 370 |
| 3 | 0 | 92 | 1630 | 1990 | 360 |
| 4 | 0 | 92 | 1633 | 1992 | |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1201 | 456 | 520 | 926 | 936 | 2094 | 1538 | 2170 | 2256 | 2320 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1202 | 456 | 520 | 928 | 938 | 1540 | 2096 | 2172 | 2256 | 2320 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1203 | 456 | 520 | 928 | 940 | 1542 | 2096 | 2174 | 2256 | 2320 | 3100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1204 | 456 | 520 | 930 | 942 | 1542 | 2096 | 2176 | 2256 | 2320 | 3102 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1205 | 456 | 520 | 930 | 944 | 1544 | 2098 | 2178 | 2256 | 2320 | 3102 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1206 | 456 | 520 | 932 | 946 | 1544 | 2098 | 2180 | 2256 | 2320 | 3104 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1207 | 456 | 520 | 934 | 948 | 1546 | 2100 | 2182 | 2256 | 2320 | 3106 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1208 | 456 | 520 | 934 | 950 | 1548 | 2100 | 2186 | 2256 | 2320 | 3106 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1209 | 456 | 520 | 936 | 950 | 1548 | 2100 | 2188 | 2256 | 2320 | 3108 | 3152 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1210 | 456 | 520 | 938 | 952 | 1548 | 2102 | 2190 | 2256 | 2320 | 3108 | 3154 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1211 | 456 | 520 | 938 | 954 | 1548 | 2104 | 2192 | 2256 | 2320 | 3110 | 3156 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1212 | 456 | 520 | 940 | 956 | 1548 | 2104 | 2194 | 2256 | 2320 | 3112 | 3158 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1213 | 456 | 520 | 940 | 958 | 1548 | 2106 | 2196 | 2256 | 2320 | 3112 | 3160 | 2700 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1214 | 456 | 520 | 942 | 960 | 1550 | 2106 | 2198 | 2256 | 2320 | 2702 | 3114 | 3162 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1215 | 456 | 520 | 944 | 962 | 1550 | 2108 | 2200 | 2256 | 2320 | 2704 | 3114 | 3164 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1216 | 456 | 520 | 944 | 964 | 1550 | 2110 | 2202 | 2256 | 2320 | 2706 | 3116 | 3166 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1217 | 456 | 520 | 946 | 966 | 1550 | 2110 | 2204 | 2256 | 2320 | 2708 | 3118 | 3168 | 3102 | 0 | 0 | 0 | 0 | 0 |
| 1218 | 456 | 520 | 946 | 968 | 2150 | 2112 | 2206 | 2256 | 2320 | 2710 | 3104 | 3118 | 3170 | 0 | 0 | 0 | 0 | 0 |
| 1219 | 456 | 520 | 948 | 970 | 2112 | 2152 | 2208 | 2256 | 2320 | 2712 | 3106 | 3120 | 3172 | 0 | 0 | 0 | 0 | 0 |
| 1220 | 456 | 520 | 950 | 972 | 2114 | 2152 | 2210 | 2256 | 2320 | 2714 | 3108 | 3120 | 3174 | 0 | 0 | 0 | 0 | 0 |
| 1221 | 456 | 520 | 950 | 974 | 2116 | 2152 | 2212 | 2256 | 2320 | 2714 | 3110 | 3122 | 3176 | 0 | 0 | 0 | 0 | 0 |
| 1222 | 456 | 520 | 952 | 974 | 2116 | 2154 | 2214 | 2256 | 2320 | 2716 | 3112 | 3124 | 3178 | 2650 | 0 | 0 | 0 | 0 |
| 1223 | 456 | 520 | 952 | 976 | 2118 | 2154 | 2218 | 2256 | 2320 | 2652 | 2718 | 3114 | 3124 | 3182 | 0 | 0 | 0 | 0 |
| 1224 | 456 | 520 | 954 | 978 | 2118 | 2154 | 2220 | 2256 | 2320 | 2654 | 2718 | 3116 | 3126 | 3184 | 0 | 0 | 0 | 0 |
| 1225 | 456 | 520 | 956 | 980 | 2120 | 2156 | 2222 | 2256 | 2320 | 2656 | 2718 | 3118 | 3128 | 3186 | 0 | 0 | 0 | 0 |
| 1226 | 456 | 520 | 956 | 982 | 2122 | 2156 | 2224 | 2256 | 2320 | 2656 | 2718 | 3120 | 3128 | 3188 | 0 | 0 | 0 | 0 |
| 1227 | 456 | 520 | 958 | 984 | 2122 | 2158 | 2226 | 2256 | 2320 | 2658 | 2718 | 3122 | 3130 | 3190 | 0 | 0 | 0 | 0 |
| 1228 | 456 | 520 | 960 | 986 | 2124 | 2158 | 2228 | 2256 | 2320 | 2660 | 2718 | 3124 | 3130 | 3192 | 0 | 0 | 0 | 0 |
| 1229 | 456 | 520 | 960 | 988 | 2124 | 2160 | 2230 | 2256 | 2320 | 2662 | 2718 | 3126 | 3132 | 3194 | 2800 | 2900 | 0 | 0 |
| 1230 | 456 | 520 | 962 | 990 | 2126 | 2162 | 2232 | 2256 | 2320 | 2662 | 2718 | 2802 | 2902 | 3128 | 3134 | 3196 | 0 | 0 |
| 1231 | 456 | 520 | 962 | 992 | 2128 | 2162 | 2234 | 2256 | 2320 | 2664 | 2718 | 2804 | 2902 | 3130 | 3134 | 3198 | 0 | 0 |
| 1232 | 456 | 520 | 964 | 994 | 2128 | 2164 | 2236 | 2256 | 2320 | 2664 | 2718 | 2806 | 2904 | 3130 | 3136 | 0 | 0 | 0 |
| 1233 | 456 | 520 | 966 | 996 | 2130 | 2166 | 2238 | 2256 | 2320 | 2666 | 2718 | 2806 | 2906 | 3132 | 3136 | 0 | 0 | 0 |
| 1234 | 456 | 520 | 966 | 996 | 2130 | 2166 | 1640 | 2256 | 2320 | 2666 | 2718 | 2808 | 2906 | 3134 | 3138 | 0 | 0 | 0 |
| 1235 | 456 | 520 | 968 | 998 | 1642 | 2132 | 2168 | 2256 | 2320 | 2666 | 2718 | 2810 | 2908 | 3134 | 3140 | 0 | 0 | 0 |
| 1236 | 456 | 520 | 968 | 1000 | 1644 | 2134 | 2170 | 2256 | 2320 | 2656 | 2718 | 2812 | 2908 | 3136 | 3140 | 2950 | 3152 | 0 |
| 1237 | 456 | 520 | 970 | 1002 | 1646 | 2134 | 2172 | 2256 | 2320 | 2656 | 2718 | 2812 | 2910 | 2952 | 3136 | 3142 | 3154 | 0 |
| 1238 | 456 | 520 | 972 | 1004 | 1648 | 2136 | 2172 | 2256 | 2320 | 2666 | 2718 | 2814 | 2912 | 2952 | 3138 | 3142 | 3156 | 0 |
| 1239 | 456 | 520 | 972 | 1006 | 1650 | 2138 | 2174 | 2256 | 2320 | 2666 | 2718 | 2816 | 2912 | 2954 | 3140 | 3144 | 3158 | 0 |
| 1240 | 456 | 520 | 974 | 1008 | 1652 | 2138 | 2176 | 2256 | 2320 | 2666 | 2718 | 2816 | 2912 | 2956 | 3140 | 3146 | 3160 | 0 |
| 1241 | 456 | 520 | 974 | 1010 | 1654 | 2140 | 2178 | 2256 | 2320 | 2666 | 2718 | 2818 | 2912 | 2956 | 3142 | 3146 | 3162 | 0 |
| 1242 | 456 | 520 | 976 | 1012 | 1656 | 2140 | 2180 | 2256 | 2320 | 2656 | 2718 | 2818 | 2912 | 2958 | 3142 | 3148 | 3164 | 2750 |
| 1243 | 456 | 520 | 978 | 1014 | 1656 | 2142 | 2182 | 2256 | 2320 | 2656 | 2718 | 2752 | 2818 | 2912 | 2958 | 3144 | 3164 | 0 |
| 1244 | 456 | 520 | 978 | 1016 | 1658 | 2144 | 2184 | 2256 | 2320 | 2656 | 2718 | 2754 | 2818 | 2912 | 2960 | 3146 | 3166 | 0 |
| 1245 | 458 | 520 | 980 | 1018 | 1660 | 2144 | 2186 | 2256 | 2320 | 2656 | 2718 | 2756 | 2818 | 2912 | 2962 | 3146 | 3166 | 0 |
| 1246 | 3384 | 520 | 980 | 1020 | 1662 | 2146 | 2188 | 2258 | 2320 | 2666 | 2718 | 2756 | 2818 | 2912 | 2962 | 3148 | 3168 | 0 |
| 1247 | 520 | 982 | 1020 | 1664 | 2146 | 2190 | 2258 | 2320 | 2666 | 2718 | 2758 | 2818 | 2912 | 2964 | 3168 | 3384 | 2550 | 0 |
| 1248 | 520 | 984 | 1022 | 1666 | 2148 | 2192 | 2258 | 2320 | 2552 | 2666 | 2718 | 2760 | 2818 | 2912 | 2964 | 3168 | 3384 | 0 |
| 1249 | 520 | 984 | 1024 | 1668 | 2150 | 2194 | 2260 | 2320 | 2554 | 2666 | 2718 | 2762 | 2818 | 2912 | 2966 | 3168 | 3384 | 0 |
| 1250 | 520 | 986 | 1026 | 1670 | 2150 | 2194 | 2260 | 2320 | 2556 | 2666 | 2718 | 2762 | 2818 | 2912 | 2968 | 3168 | 3128 | 0 |
| 1251 | 520 | 988 | 1028 | 1674 | 2152 | 2196 | 2260 | 2320 | 2558 | 2666 | 2718 | 2764 | 2818 | 2912 | 2968 | 3130 | 3168 | 0 |
| 1252 | 520 | 988 | 1030 | 1676 | 2152 | 2198 | 2262 | 2320 | 2560 | 2666 | 2718 | 2764 | 2818 | 2912 | 2968 | 3130 | 3168 | 0 |
| 1253 | 520 | 990 | 1032 | 1678 | 2154 | 2200 | 2262 | 2320 | 2562 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3130 | 3168 | 0 |
| 1254 | 520 | 990 | 1034 | 1680 | 2156 | 2202 | 2262 | 2320 | 2564 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3132 | 3168 | 0 |
| 1255 | 520 | 992 | 1036 | 1682 | 2156 | 2204 | 2264 | 2320 | 2564 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3132 | 3168 | 0 |
| 1256 | 520 | 994 | 1038 | 1684 | 2158 | 2206 | 2264 | 2320 | 2566 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3134 | 3168 | 0 |
| 1257 | 520 | 994 | 1040 | 1686 | 2160 | 2208 | 2266 | 2320 | 2568 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3134 | 3168 | 0 |
| 1258 | 520 | 996 | 1042 | 1688 | 2160 | 2210 | 2268 | 2320 | 2568 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3136 | 3168 | 0 |
| 1259 | 520 | 996 | 1042 | 1690 | 2162 | 2212 | 2268 | 2320 | 2568 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3136 | 3168 | 0 |
| 1260 | 520 | 998 | 1044 | 1692 | 2162 | 2214 | 2270 | 2320 | 2568 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3138 | 3168 | 0 |
| 1261 | 520 | 1000 | 1046 | 1694 | 2164 | 2216 | 2270 | 2320 | 2568 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3140 | 3168 | 0 |
| 1262 | 520 | 1000 | 1048 | 1696 | 2166 | 2216 | 2272 | 2320 | 2568 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3140 | 3168 | 0 |
| 1263 | 520 | 1002 | 1050 | 1698 | 2166 | 2218 | 2274 | 2320 | 2570 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3142 | 3168 | 0 |
| 1264 | 522 | 1002 | 1052 | 1700 | 2168 | 2220 | 2276 | 2320 | 2570 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3144 | 3168 | 0 |

HARVARD LANE 2

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1265 | 522 | 1004 | 1054 | 1704 | 2168 | 2222 | 2276 | 2322 | 2570 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3146 | 3168 | 0 |
| 1266 | 522 | 1006 | 1056 | 1706 | 2170 | 2224 | 2278 | 2322 | 2570 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3146 | 3168 | 0 |
| 1267 | 522 | 1006 | 1058 | 1708 | 2172 | 2226 | 2280 | 2322 | 3316 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3148 | 3168 | 0 |
| 1268 | 522 | 1008 | 1060 | 1710 | 2172 | 2228 | 2282 | 2322 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 3316 | 0 | 0 |
| 1269 | 524 | 1010 | 1062 | 1712 | 2174 | 2230 | 2282 | 2324 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 3316 | 0 | 0 |
| 1270 | 524 | 1010 | 1064 | 1714 | 2174 | 2232 | 2284 | 2324 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 3316 | 0 | 0 |
| 1271 | 524 | 1012 | 1066 | 1716 | 2176 | 2234 | 2286 | 2324 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 114 | 0 | 0 |
| 1272 | 114 | 526 | 1012 | 1066 | 1718 | 2178 | 2236 | 2288 | 2326 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 |
| 1273 | 114 | 526 | 1014 | 1068 | 1720 | 2178 | 2238 | 2288 | 2326 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 |
| 1274 | 116 | 528 | 1016 | 1070 | 1722 | 2180 | 2240 | 2290 | 2328 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 |
| 1275 | 116 | 528 | 1016 | 1072 | 1724 | 2182 | 2240 | 2292 | 2328 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 |
| 1276 | 118 | 530 | 1018 | 1074 | 1726 | 2182 | 2242 | 2294 | 2330 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 |
| 1277 | 118 | 530 | 1018 | 1076 | 1728 | 2184 | 2244 | 2294 | 2330 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 |
| 1278 | 120 | 532 | 1020 | 1078 | 1730 | 2184 | 2246 | 2296 | 2332 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 |
| 1279 | 120 | 532 | 1022 | 1080 | 1732 | 2186 | 2248 | 2298 | 2332 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 |
| 1280 | 122 | 534 | 1022 | 1082 | 1736 | 2188 | 2250 | 2300 | 2334 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 |
| 1281 | 122 | 536 | 1024 | 1084 | 1738 | 2188 | 2252 | 2302 | 2336 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 |
| 1282 | 124 | 536 | 1024 | 1086 | 1740 | 2190 | 2254 | 2302 | 2336 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 |
| 1283 | 126 | 538 | 1026 | 1088 | 2190 | 2256 | 2304 | 2338 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 |
| 1284 | 126 | 540 | 1028 | 1088 | 2192 | 2258 | 2306 | 2340 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 |
| 1285 | 128 | 1028 | 1090 | 2194 | 2260 | 2308 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1286 | 130 | 1030 | 1092 | 2194 | 2262 | 2308 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1287 | 130 | 1030 | 1094 | 2196 | 2262 | 2310 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1288 | 132 | 1032 | 1096 | 2196 | 2264 | 2312 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1289 | 134 | 1034 | 1098 | 2198 | 2266 | 2314 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1290 | 136 | 1034 | 1100 | 2200 | 2268 | 2314 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1291 | 138 | 1036 | 1102 | 2200 | 2270 | 2316 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1292 | 140 | 1038 | 1104 | 2202 | 2272 | 2318 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1293 | 142 | 1038 | 1106 | 2202 | 2274 | 2320 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1294 | 144 | 1040 | 1108 | 2204 | 2276 | 2320 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1295 | 146 | 1040 | 1110 | 2206 | 2278 | 2322 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1296 | 146 | 1042 | 1112 | 2206 | 2280 | 2324 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1297 | 148 | 1044 | 1112 | 2208 | 2282 | 2326 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1298 | 150 | 1044 | 1114 | 2210 | 2284 | 2326 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1299 | 152 | 1046 | 1116 | 2210 | 2286 | 2328 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1300 | 154 | 1046 | 1118 | 2212 | 2286 | 2330 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1301 | 156 | 1048 | 1120 | 2212 | 2288 | 2332 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1302 | 158 | 1050 | 1122 | 2214 | 2290 | 2332 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1303 | 158 | 1050 | 1124 | 2216 | 2292 | 2334 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1304 | 160 | 1052 | 1126 | 2216 | 2294 | 2336 | 2666 | 2718 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1305 | 160 | 1052 | 1128 | 2218 | 2296 | 2338 | 2666 | 2720 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1306 | 160 | 1054 | 1130 | 2218 | 2298 | 2340 | 2666 | 2720 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1307 | 162 | 1056 | 1132 | 2220 | 2300 | 2340 | 2668 | 2720 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 |
| 1308 | 162 | 1056 | 1134 | 2222 | 2302 | 2668 | 2720 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1309 | 162 | 1058 | 1134 | 2222 | 2304 | 2668 | 2720 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1310 | 162 | 1060 | 1136 | 2224 | 2306 | 2668 | 2720 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1311 | 162 | 1060 | 1138 | 2224 | 2308 | 2670 | 2722 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1312 | 162 | 1062 | 1140 | 2226 | 2308 | 2670 | 2722 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1313 | 162 | 1062 | 2228 | 2310 | 3324 | 2722 | 2766 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1314 | 162 | 1064 | 2228 | 2312 | 2722 | 2766 | 2818 | 2912 | 2968 | 3168 | 3324 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1315 | 162 | 1066 | 2230 | 2314 | 2724 | 2766 | 2818 | 2912 | 2968 | 3168 | 1970 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1316 | 162 | 1066 | 1970 | 2232 | 2316 | 2724 | 2768 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1317 | 162 | 1068 | 1972 | 2232 | 2318 | 2726 | 2768 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1318 | 162 | 1068 | 1972 | 2234 | 2320 | 2726 | 2768 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1319 | 162 | 1070 | 1974 | 2234 | 2322 | 2728 | 2770 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1320 | 162 | 1072 | 1974 | 2236 | 2324 | 2728 | 2770 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1321 | 162 | 1072 | 1976 | 2238 | 2326 | 2730 | 2770 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1322 | 162 | 1074 | 1976 | 2238 | 2328 | 2730 | 2772 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1323 | 162 | 1074 | 1978 | 2240 | 2330 | 2732 | 2772 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1324 | 162 | 1076 | 1980 | 2240 | 2332 | 2732 | 2774 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1325 | 162 | 1078 | 1980 | 2242 | 2332 | 2734 | 2774 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1326 | 162 | 1078 | 1982 | 2244 | 2334 | 2736 | 2776 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1327 | 162 | 1080 | 1984 | 2244 | 2336 | 2736 | 2776 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1328 | 162 | 1082 | 1986 | 2246 | 2338 | 2738 | 2778 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1329 | 162 | 1082 | 1988 | 2246 | 2340 | 2740 | 2780 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1330 | 162 | 1084 | 1988 | 2248 | 2742 | 2780 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1331 | 162 | 1084 | 1990 | 2248 | 2744 | 2782 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1332 | 162 | 1086 | 1992 | 2248 | 2746 | 2784 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1333 | 162 | 1088 | 1994 | 2250 | 2746 | 2784 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1334 | 162 | 1088 | 1994 | 2250 | 2748 | 2786 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1335 | 162 | 1090 | 1996 | 2252 | 2788 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1336 | 162 | 1090 | 1998 | 2252 | 2790 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1337 | 162 | 1092 | 2000 | 2254 | 2790 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1338 | 162 | 1094 | 2000 | 2254 | 2792 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1339 | 162 | 1094 | 2002 | 2256 | 2794 | 2818 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1340 | 162 | 1096 | 2004 | 2256 | 2796 | 2820 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1341 | 162 | 1096 | 2006 | 2256 | 2796 | 2820 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1342 | 162 | 1098 | 2006 | 2258 | 2798 | 2820 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1343 | 162 | 1100 | 2008 | 3386 | 2820 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1344 | 162 | 1100 | 2010 | 2820 | 2912 | 2968 | 3168 | 3178 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1345 | 162 | 1102 | 2012 | 2820 | 2912 | 2968 | 3168 | 3180 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1346 | 162 | 1102 | 2012 | 2820 | 2912 | 2968 | 3168 | 3180 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1347 | 162 | 1104 | 2014 | 2822 | 2912 | 2968 | 3168 | 3182 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1348 | 162 | 1106 | 2016 | 2822 | 2912 | 2968 | 3168 | 3182 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1349 | 162 | 1106 | 2016 | 2822 | 2912 | 2968 | 3168 | 3184 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1350 | 162 | 1108 | 2016 | 2822 | 2912 | 2968 | 3168 | 3186 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1351 | 162 | 1110 | 2016 | 2824 | 2912 | 2968 | 3168 | 3186 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1352 | 162 | 1110 | 2016 | 2824 | 2912 | 2968 | 3168 | 3188 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1353 | 162 | 1112 | 2016 | 2826 | 2912 | 2968 | 3168 | 3188 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1354 | 162 | 1112 | 2016 | 2826 | 2912 | 2968 | 3168 | 3190 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1355 | 162 | 1114 | 2016 | 2828 | 2912 | 2968 | 3168 | 3192 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1356 | 162 | 1116 | 2016 | 2828 | 2912 | 2968 | 3168 | 3192 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1357 | 162 | 1116 | 2016 | 2830 | 2912 | 2968 | 3168 | 3194 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1358 | 162 | 1118 | 2016 | 2830 | 2912 | 2968 | 3168 | 3194 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1359 | 162 | 1118 | 2016 | 2832 | 2912 | 2968 | 3168 | 3196 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1360 | 162 | 1120 | 2016 | 2832 | 2912 | 2968 | 3168 | 3198 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1361 | 162 | 1122 | 2016 | 2834 | 2912 | 2968 | 3168 | 3198 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1362 | 162 | 1122 | 2016 | 2836 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1363 | 162 | 1124 | 2016 | 2836 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1364 | 162 | 1124 | 2016 | 2838 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1365 | 162 | 1126 | 2016 | 2840 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1366 | 162 | 1128 | 2016 | 2842 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1367 | 162 | 1128 | 2016 | 2844 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1368 | 162 | 1130 | 2016 | 2844 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1369 | 162 | 1132 | 2016 | 2846 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1370 | 162 | 1132 | 2016 | 2848 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1371 | 162 | 1134 | 2016 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1372 | 162 | 1134 | 2016 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1373 | 162 | 1136 | 2016 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1374 | 162 | 1138 | 2016 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1375 | 162 | 1138 | 2016 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1376 | 162 | 1140 | 2016 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1377 | 162 | 1140 | 2016 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1378 | 162 | 2016 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1379 | 162 | 2016 | 2912 | 2968 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1380 | 162 | 2016 | 2912 | 2970 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1381 | 162 | 2016 | 2912 | 2970 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1382 | 162 | 2016 | 2912 | 2970 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1383 | 162 | 2016 | 2912 | 2970 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1384 | 162 | 2016 | 2912 | 2970 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1385 | 162 | 2016 | 2912 | 2970 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1386 | 162 | 2016 | 2912 | 2970 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1387 | 162 | 2016 | 2912 | 2972 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1388 | 162 | 2016 | 2912 | 2972 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1389 | 162 | 2016 | 2912 | 2972 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1390 | 162 | 2016 | 2912 | 2972 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1391 | 162 | 2016 | 2912 | 2974 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1392 | 162 | 2016 | 2912 | 2974 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1393 | 162 | 2016 | 2914 | 2976 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1394 | 162 | 2016 | 2914 | 2976 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1395 | 162 | 2016 | 2914 | 2978 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1396 | 162 | 2016 | 2916 | 2978 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1397 | 162 | 2016 | 2916 | 2980 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1398 | 162 | 2016 | 2916 | 2980 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1399 | 164 | 2016 | 2918 | 2982 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1400 | 164 | 2016 | 2918 | 2982 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1401 | 164 | 2016 | 2920 | 2984 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1402 | 166 | 2016 | 2920 | 2986 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1403 | 166 | 2016 | 2922 | 2986 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1404 | 166 | 2016 | 2922 | 2988 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1405 | 168 | 2016 | 2924 | 2988 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1406 | 168 | 2016 | 2926 | 2990 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1407 | 170 | 2016 | 2926 | 2992 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1408 | 170 | 2016 | 2928 | 2992 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1409 | 172 | 2016 | 2928 | 2994 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1410 | 172 | 2016 | 2930 | 2996 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1411 | 174 | 2016 | 2932 | 2996 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1412 | 176 | 2016 | 2932 | 2998 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1413 | 176 | 2016 | 2934 | 2998 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1414 | 178 | 2016 | 2934 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1415 | 180 | 2016 | 2936 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1416 | 180 | 2016 | 2938 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1417 | 182 | 2016 | 2938 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1418 | 184 | 2016 | 2940 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1419 | 186 | 2016 | 2940 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1420 | 188 | 2016 | 2942 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1421 | 190 | 2016 | 2944 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1422 | 190 | 2016 | 2944 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1423 | 192 | 2016 | 2946 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1424 | 194 | 2016 | 2948 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1425 | 196 | 2016 | 2948 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1426 | 198 | 2016 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1427 | 200 | 2016 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1428 | 202 | 2016 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1429 | 204 | 2016 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1430 | 206 | 2016 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1431 | 208 | 2016 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1432 | 210 | 2016 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1433 | 210 | 2018 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1434 | 212 | 2018 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1435 | 214 | 2018 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1436 | 216 | 2018 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1437 | 216 | 2018 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1438 | 218 | 2018 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1439 | 218 | 2018 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1440 | 220 | 2020 | 3168 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1441 | 222 | 2020 | 3170 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1442 | 222 | 2020 | 3170 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1443 | 224 | 2020 | 3170 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1444 | 224 | 2022 | 3170 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1445 | 226 | 2022 | 3170 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1446 | 226 | 2024 | 3170 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1447 | 228 | 2024 | 3172 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1448 | 230 | 2026 | 3172 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1449 | 232 | 2026 | 3172 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1450 | 232 | 2028 | 3172 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1451 | 234 | 2028 | 3174 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1452 | 836 | 2030 | 3174 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1453 | 838 | 2030 | 3176 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1454 | 838 | 2032 | 3176 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1455 | 840 | 2034 | 3178 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1456 | 842 | 2034 | 3178 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1457 | 844 | 2036 | 3180 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1458 | 846 | 2038 | 3180 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1459 | 848 | 2040 | 3182 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1460 | 850 | 2042 | 3182 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1461 | 852 | 2042 | 3184 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1462 | 854 | 2044 | 3186 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1463 | 856 | 2046 | 3186 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1464 | 858 | 2048 | 3188 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1465 | 858 | 1448 | 3190 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1466 | 860 | 1450 | 3192 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1467 | 862 | 1452 | 3194 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1468 | 864 | 1454 | 3194 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1469 | 866 | 1454 | 3196 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1470 | 868 | 1456 | 3198 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1471 | 870 | 1458 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1472 | 872 | 1460 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1473 | 874 | 1460 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1474 | 876 | 1462 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1475 | 878 | 1464 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1476 | 880 | 1466 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1477 | 882 | 1466 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1478 | 882 | 1468 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1479 | 884 | 1470 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1480 | 886 | 1472 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1481 | 888 | 1472 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1482 | 890 | 1474 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1483 | 892 | 1476 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1484 | 894 | 1478 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1485 | 896 | 1480 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1486 | 898 | 1480 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1487 | 900 | 1482 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1488 | 902 | 1484 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1489 | 904 | 1486 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1490 | 904 | 1486 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1491 | 906 | 1488 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1492 | 908 | 1490 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1493 | 910 | 1492 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1494 | 912 | 1492 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1495 | 914 | 1494 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1496 | 916 | 1496 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1497 | 318 | 1498 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1498 | 320 | 1498 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1499 | 322 | 1500 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1500 | 322 | 1502 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1501 | 324 | 1504 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1502 | 326 | 1504 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1503 | 326 | 1506 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1504 | 326 | 1508 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1505 | 328 | 1510 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1506 | 328 | 1510 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1507 | 328 | 1512 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1508 | 328 | 1514 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1509 | 328 | 1516 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1510 | 328 | 1518 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1511 | 328 | 1518 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1512 | 328 | 1520 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1513 | 328 | 1522 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1514 | 328 | 1524 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1515 | 328 | 1524 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1516 | 328 | 1526 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1517 | 328 | 1528 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1518 | 328 | 1528 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1519 | 328 | 15[illegible]0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1520 | 330 | 15[illegible]2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1521 | 330 | 1532 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1522 | 330 | 1534 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1523 | 332 | 1534 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1524 | 332 | 1536 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1525 | 332 | 1538 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1526 | 334 | 1538 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1527 | 334 | 1540 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1528 | 336 | 1542 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1529 | 336 | 1542 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1530 | 338 | 1544 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1531 | 338 | 1546 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1532 | 340 | 1546 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1533 | 340 | 1548 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1534 | 342 | 1550 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1535 | 344 | 1552 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1536 | 344 | 1552 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1537 | 346 | 1554 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1538 | 348 | 1556 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1539 | 350 | 1558 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1540 | 350 | 1560 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1541 | 352 | 1560 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1542 | 354 | 1562 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1543 | 354 | 1564 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1544 | 356 | 1566 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1545 | 358 | 1566 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1546 | 358 | 1568 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1547 | 360 | 1570 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1548 | 362 | 1572 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1549 | 362 | 1572 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1550 | 364 | 1574 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1551 | 366 | 1576 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1552 | 368 | 1578 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1553 | 368 | 1578 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1554 | 370 | 1580 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1555 | 372 | 1582 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1556 | 374 | 1584 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1557 | 374 | 1584 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1558 | 376 | 1586 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1559 | 378 | 1588 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1560 | 380 | 1590 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1561 | 382 | 1590 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1562 | 382 | 1592 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1563 | 384 | 1594 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1564 | 386 | 1596 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1565 | 388 | 1598 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1566 | 388 | 1598 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1567 | 390 | 1600 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1568 | 392 | 1602 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1569 | 394 | 1604 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1570 | 394 | 1604 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1571 | 396 | 1606 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1572 | 398 | 1608 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1573 | 400 | 1610 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1574 | 400 | 1610 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1575 | 402 | 1612 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1576 | 404 | 1614 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1577 | 406 | 1616 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1578 | 406 | 1616 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1579 | 408 | 1618 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1580 | 410 | 1620 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1581 | 412 | 1622 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1582 | 412 | 1622 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1583 | 414 | 1624 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1584 | 416 | 1626 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1585 | 418 | 1628 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1586 | 420 | 1628 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1587 | 420 | 1630 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1588 | 422 | 1632 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1589 | 424 | 1634 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1590 | 426 | 1636 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1591 | 426 | 1636 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1592 | 428 | 1638 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1593 | 430 | 1640 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1594 | 432 | 1642 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1595 | 434 | 1642 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1596 | 436 | 1644 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1597 | 436 | 1646 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1598 | 438 | 1646 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1599 | 440 | 1648 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1600 | 440 | 2250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1601 | 442 | 2252 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1602 | 444 | 2252 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1603 | 444 | 2254 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1604 | 446 | 2256 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1605 | 446 | 2258 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1606 | 448 | 2260 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1607 | 450 | 2260 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1608 | 450 | 2262 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1609 | 452 | 2264 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1610 | 452 | 2266 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1611 | 454 | 2266 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1612 | 456 | 2268 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1613 | 456 | 2270 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1614 | 458 | 2270 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1615 | 460 | 2272 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1616 | 460 | 2274 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1617 | 462 | 2276 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1618 | 464 | 2278 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1619 | 466 | 2278 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1620 | 468 | 2280 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1621 | 470 | 2282 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1622 | 472 | 2284 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1623 | 472 | 2284 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1624 | 474 | 2286 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1625 | 476 | 2288 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1626 | 478 | 2290 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1627 | 480 | 2290 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1628 | 482 | 2292 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1629 | 484 | 2294 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1630 | 484 | 2296 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1631 | 486 | 2296 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1632 | 488 | 2298 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1633 | 490 | 2300 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1634 | 490 | 2302 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1635 | 492 | 2302 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1636 | 494 | 2304 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1637 | 496 | 2306 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1638 | 496 | 2308 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1639 | 498 | 2308 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1640 | 498 | 2310 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1641 | 500 | 2312 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1642 | 502 | 2314 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1643 | 502 | 2314 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1644 | 504 | 2316 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1645 | 504 | 2318 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1646 | 506 | 2318 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1647 | 508 | 2320 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1648 | 508 | 2322 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1649 | 510 | 2324 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1650 | 510 | 2324 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1651 | 512 | 2326 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1652 | 514 | 2328 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1653 | 514 | 2330 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1654 | 516 | 2330 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1655 | 516 | 2332 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1656 | 518 | 2334 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1657 | 520 | 2336 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1658 | 520 | 2336 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1659 | 522 | 2338 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1660 | 524 | 2340 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1661 | 524 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1662 | 526 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1663 | 528 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1664 | 530 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1665 | 530 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1666 | 532 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1667 | 534 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1668 | 536 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1669 | 538 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1670 | 540 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1671 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1672 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1673 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1674 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1675 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1676 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1677 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1678 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1679 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1680 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1681 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1682 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1683 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1684 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1685 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1686 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1687 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1688 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1689 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1690 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1691 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1692 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1693 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1694 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1695 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1696 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1697 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1698 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1699 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1700 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1701 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1702 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1703 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1704 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1705 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1706 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1707 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1708 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1709 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1710 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1711 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1712 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## THE BASIC FORWARD MOVE

(Refer to Fig. 10)

Ours is vehicle B. After considering our present speed (last jump) and acceleration rate, it is determined we may hope to jump as far as N. We must, however, have an adequate clear (sight) distance ahead. For a first try, if we can probe ahead unit block by unit block and find no car as far as P, a distance taken from a table, we may proceed to jump to N as desired, without further ado.

Suppose however, we find an obstacle in car C. We now do a "second approximation" which takes into consideration the length of leader C, the leader's speed and the required clearance at that speed. A new comparison is made. If C is going fast enough, the "credit" for C's momentum will still give us an effective clear distance to P and we can move to N as desired.

Let us assume that the revised sight distance is still less than P. Now we "toss a coin" to determine on which side we will try first to overtake (on this 1-way street). Suppose we will try left first. We will probe behind us a sufficient distance in the L lane to determine whether we can pull out safely. Then we will probe forward in the L lane in the same manner as we did in the A lane. We will also check the LL lane to make sure someone in that lane is not also attempting to shift into the L lane.

When our check of the L lane is completed, we will proceed to shift into the L lane if our effective clear distance achieves P. Otherwise we will try the R lane. Ultimately we may have to compare the effective clear distances in the L, A and R lane tries. We will select the best. To the extent that our best effective clear distance is still less than the desired P, we will scale down our actual jump to a point short of N.

The general case involves five lanes. Actually, 13th Street has only four lanes. Before testing a side lane, a test is made to ensure that such a lane exists.

Superimposed on the basic maneuver described in the preceding paragraphs is a constant check to see whether any unit block is irregular. The "irregular routine" will take over to do the necessary in case a significant irregularity is encountered. The irregularities have been described elsewhere and include such items as the following: traffic lights, turns, check points, cross flow.

## LIST OF ROUTINES

SQ4 Sequence Control. Handles the order of the principal routines.

L2 Generation. Generates cars, including their characteristics, at 25 gates and launches them.

B7 13th Street Master Routine. Searches for a car on 13th Street and supervises the processing of it.

XL Turn Bias. Checks each 13th Street car to see if "turn bias" is in effect. (If car is within 100 UBs of an intended turn, it must try continually to shift into correct lane for turn.)

C2 Lane Control. Supervises the trying and selection of the "A", "R" and "L" lanes.

TA1 Try "A" Lane. Subroutine for trying to achieve goal points in "A" lane of 13th Street.

TL1 Try "L" Lane. Subroutine for trying to achieve goal points to overtake on left.

TR1 Try "R" Lane. Subroutine for trying to achieve goal points to overtake on right.

ST2 Straddle. If car is in "straddle" position, this subroutine continues the lane switch already started.

D2 13th Street Diagonal Routine. Main routine for processing cars found half way around turns off 13th Street.

XT1 Cross Street Master Routine. Main routine for processing traffic on nine cross streets.

TY2 Cross Traffic Turn. Supervises right turns and unopposed left turns from cross streets.

LTU2 Left Turn. Starts the left turn from cross street when subject to opposing traffic.

XD2 Cross Street Diagonal Routine. Main routine for processing cars found halfway around turns off cross streets.

LTV2 Left Turn Diagonal Routine. Diagonal routine for completing left turn in face of opposing traffic.

M1 — 13th Street Move. Subroutine for using previously determined clear distance and making actual move for 13th Street car.

DM1 — 13th Street Diagonal Move. Subroutine for using previously determined clear distance and making actual move when car is found in diagonal block turning off 13th Street.

XM1 — Cross Street Move. Subroutine for using previously determined clear distance and making actual move for cross traffic.

XDM1 — Cross Street Diagonal Move. Subroutine for using previously determined clear distance and making actual move when car is found in diagonal block turning off cross street.

IR2 — Irregular. Generalized master subroutine for handling "irregularities" on both 13th Street and cross streets (traffic signal, cross flow, turn, end block, etc.).

F6 — 13th Street Cross Flow. Subroutine under IR2 applicable to 13th Street traffic for testing for road block by cross traffic.

KF2 — Cross Street Cross Flow. Subroutine (under IR2) applicable to cross street traffic for testing for road block by 13th Street traffic.

K3 — 13th Street Turn. Subroutine for heading into a turn off 13th Street.

LL2 — Traffic Light. Generalized subroutine to evaluate traffic signal indication..

SG2 — Stop Sign. Requires cross-street car to stop and then checks main street for sufficient gap to proceed.

LC1 — Last Chance. Subroutine for imposing last chance restriction (on 13th Street cars intending to turn).

TLT1 — Traffic Light and Turn Special Routine. Checks for significant irregularities independent of car ahead (on 13th Street).

XTLT1 — Traffic Light and Turn Special Routine for Cross Traffic. Checks for significant irregularities independent of car ahead (on cross street).

2PX2 — 2nd Approximation. Subroutine for rechecking effective clear distance ahead in light of speed and length of leader and clearance at particular speed.

GP2 Goal Points. Subroutine which considers present speed, desired speed and allowable acceleration and sets up goal points (clear distance ahead) needed to permit desired move.

SS1 Stopping Distance. Subroutine for computing stopping distance from jump.

SL1 Slow. Subroutine for slowing cars to 15 m.p.h. for turns.

CLC1 Clearance. Subroutine for selecting the proper clearance for a particular speed.

SB1 Backward Goal Points. Subroutine for computing required clear distance behind, in adjacent lane, to permit pulling out of lane to overtake.

SA1 Backward Stopping Distance Adjustment. Subroutine for determining own stopping distance and applying it in computation of "backward goal points."

P2 Preparation. One-time routine for (1) spotting bits in appropriate UBs to identify irregularities (traffic light, turn, end block, etc.) and (2) adjusting the vehicle probability figures to conform with a binary number system.

EDIT Edit. Assigns coordinates to car and signal positions and writes the information on magnetic tape to be used later by SEAC for plotting points on oscilloscope display.

# THE TWO-WORD FORMAT

(Refer to Fig. 5)

Two words of information are assigned to each UB. The first word and the first part of the second word describe the characteristics of a car, if there is one in the UB. The last part of the second word describes the roadway at that point by noting the presence of one or more "irregularities", if any exist. When a significant irregularity is noted, the program is alerted to go to a table stored in memory where the necessary, detailed additional information is on file for that UB.

As the car moves, all the information describing the car is "lifted" and is transferred to the new UB to which the car progresses. The information in the last part of word 2 describing the roadway is stationary. It is masked and remains always with the UB to which it refers.

There follows a basic explanation of the information content of the bits in the two words used to describe the car and the roadway:

P-bit in word 1: A bit here, where it can be easily checked, indicates that the UB contains (the nose of a) car.

Bits 1 to 7: These indicate the exact position of the car within the UB in terms of unit points (100 unit points = 12 feet).

Bits 8 to 10: A non-zero straddle position means that the car is in the process of shifting lanes. Values of 1, 2 or 3 indicate progressive intermediate positions in a right shift. Values of 5, 6 or 7 indicate progressive intermediate positions in a left shift.

Bits 12 to 15: Sixteen exits (or destinations) are possible. For convenience, 0 exit is straight out 13th Street, odd non-zero exits are to the right and even non-zero exits are to the left.

Bits 18 to 24: Actual or present speed is shown here by the "last jump" expressed in terms of unit points per quarter second.

Bits 25 to 28: Desired speed is shown by category. The format allows for 16 categories. Actually only 5 are presently used (corresponding to 35, 30, 25, 20 and 15 m.p.h.). The program refers to a table to find the speed corresponding to the category number.

Bit 34: A bit here indicates a preference for lane 4. This has meaning only to cross traffic turning into 13th Street where the turning car is destined straight out 13th Street and has no real preference between lane 1 or lane 4. At the time of generation a bit is entered here, or not, on a random basis.

Bit 35: A bit here indicates that this is a "marked car". The computer printout sheets have provision for tracing the quarter-second movements of a small number of cars. These cars are the so-called "marked cars" and cannot at any one time exceed 18, which is the number of columns on the printout sheet. It should be clear that this device in no way limits the number of cars simulated, or treated in the summary tables and in the moving picture. It is useful for sampling car performance and for recording detailed movements of specific cars as an aid in debugging or analyzing a special situation.

P-bit in word 2: A bit here indicates that the car originated at the base of 13th Street. Running times are computed only for those cars which traverse the entire 13th Street course.

Bits 1 to 11: The launch time is the time when the car enters the model. Expressed in quarter seconds, it is nearly always specific to a single car and thus serves to identify the car so that the specific car can be spotted as it passes later check points.

Bits 12 to 14: These three bits can identify eight possible vehicle types. At present only three are used: passenger car, truck A and truck B. The program will refer to a table to find the vehicle length and acceleration rate applicable to each type.

Bit 18: A bit here indicates that the car has stopped at a stop sign. The stop sign routine will not clear a car for proceeding until it has stopped.

Bit 24: A bit here tells the program that this UB is the Station B check point.

Bit 35: A bit here is the general alert for an irregularity in the UB. The program must then check in detail through bits 27 to 34 (shown below) to determine the specific irregularity or irregularities applicable to the UB in question.

Bit 27, left turn: A bit here calls the routine which will guide car into left turn in the face of opposing traffic (necessarily cross traffic in this model because 13th Street is one-way).

Bit 28, stop sign: The stop sign routine will perform here.

Bit 29, last chance: A car cannot go past this point without shifting lanes, to be in the correct lane for an intended turn. If necessary a car will actually halt in a last-chance UB until it can shift to the next lane. However, this seldom happens because for 100 UBs (1200 feet) in advance of an intersection an intending turner will keep "trying" to get into the correct lane for the turn and usually succeeds.

Bit 30, cross flow: The program will check all UBs in the intersection crossing the path of the car being processed, for a possible road block.

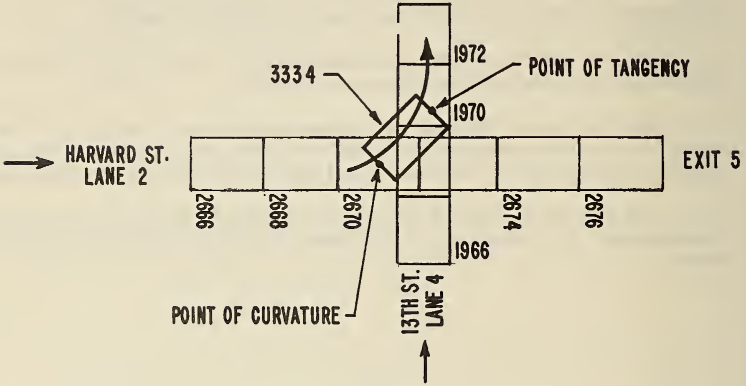
Bit 31, turn: This indicates an unopposed, simple turn as distinguished from the "left turn under conflict" (bit 27).

Bit 32, traffic light: The traffic light routine will read the signal indication and control the car accordingly.

Bit 33, end: The last UB in each lane is marked as an "end block". A car reaching this point is "in the clear" and can be retired. Also, the program is alerted to set up for searching the next lane.

Bit 34, beginning: For purposes of stabilizing the send-off, no lane shifting is permitted in the first 10 UBs of the four 13th Street lanes.

ILLUSTRATION OF A SIMPLE TURN




When car reaches UB 2670, the program seeks out an "information package" filed for turn block 2670. The package is shown at the left below, with a brief explanation of each item:

2670 - The turn block which identifies the package.
5 - The straight-through exit.
54 - The location of point of curvature (unit points).
3334 - The identity of the diagonal block.
1970 - The identity of the tangent block.
21 - The location of point of tangency (unit points).
4 - Turn is into lane 4 of 13th Street.
0 - No opposing lane.

In making the turn the car would progress through UBs 2666-2668-2670-3334-1970-1972. When the program has searched out the special information package for UB 2670, it will first check the exit of our car. If it is not "5", our car is interested in turning into 13th Street. Further checks are made to determine whether we should turn into lane 4 or lane 1 of 13th Street. If lane 4 is desired, the information package provides the necessary information regarding the movement from one UB to the next. The package also notes (in item 8) that there is no opposing lane to hamper the turn (that is, turn is from a one-way street). Had there been an opposing lane a more complicated routine would be used which would identify and check the opposing UBs.

## LEFT TURN EXERCISE

Three cars were planted on Girard Street. A diagram (Fig. 8) shows the numbering of the 12-foot unit blocks involved in turning left from Girard Street into 13th Street. The numbering steps by two (because of two-word information packages for each unit block). It may be noted that each of the four lanes on 13th Street is progressively numbered and differs from adjacent lanes by 600.

The unit block numbering on the cross streets also follows a simple system. The eastbound lane of Girard Street starts at unit block 2500 and progresses 2502, 2504, ... up to 2548. The westbound lane is numbered 50 higher, starting at 2550 and progressing (by twos) to 2598. The two diagonal blocks 3322 and 3318 are special blocks out of sequence which serve as transition links between the Girard Street series and the 13th Street series for those cars making left turns into lane 4 and lane 1, respectively, of 13th Street.

The three cars were planted as follows: (nose of) car 1 in unit block 2502 desiring to make a left turn, car 2 in UB 2510 also desiring to turn left and car 3 in UB 2560 symmetrically opposed to car 2 intending however to go straight.

Let us turn our attention to Fig. 13 which traces through the movement of these three cars. The data have been extracted directly from a computer printout sheet showing how the simulation program processed the cars. The first column represents time in terms of quarter seconds. In the second column the successive positions of car 1 are followed through. Similarly columns 3 and 4 describe the movement of cars 2 and 3.

At the start each car is moving at a speed of about 30 mph (the assigned "desired" speed) and thus traverses about one 12-foot unit block each quarter second. The computer retains the exact position of each car within the unit block although the printout shows only the identity of the UB. Thus if the printout shows a car spending two time intervals in the same UB, conceptually the car is in the tail of the UB in the first interval and at the head of it in the second interval.

The movement of the three cars can be visualized by reference to the diagram simultaneously with noting in what UB each car is after each quarter second. Comments on the vehicle behaviors are given below referenced to the applicable time interval:

Time 4: The cars are beginning to slow up because of Stop signs in UBs 2518 and 2568.

Time 10: Cars 2 and 3 are coming to a complete stop at the Stop signs. Car 1 is crawling. An incidental note is that to this point the behavior of cars 2 and 3 has been exactly symmetrical.

Time 12: Having completed their stops, cars 2 and 3 now proceed because no traffic was found on 13th Street.

Time 16: Car 2 quickly swings into its turn (diagonal UB 3322) before car 3 becomes a hazard.

Time 20: Car 2 completes its turn into lane 4 of 13th Street (UBs in 1900 series).

Time 22: Car 1 is moving up and would like to make the same turn but car 3 is too close.

Time 25: Car 1 will give up its aspiration to turn into lane 4, will settle for lane 1. The rules governing this situation are described in the paragraphs entitled "Turns" and "Lane Preference" in Chapter 8.

Time 34: Car 1 now turns into lane 1. Had there been opposition, car 1 would have waited until it could turn.

Time 42: Car 3 reaches the last UB on Girard Street and retires from the display. Note that car 2 has resumed its desired speed and that car 1 is rapidly picking up speed having completed its turn into lane 1 (UBs in 100 series).

## TRAFFIC SIGNAL PACKAGE

The information package for a traffic signal UB is shown at the left below, with explanations:

| | |
|---|---|
| 272 - | Irving Street traffic light UB |
| 30 - | Unit point location of stop line |
| 44 - | End of green alone on 13th (quarter sec.) |
| 60 - | End of green-amber on 13th |
| 164 - | End of green alone on cross street |
| 180 - | End of green-amber on cross street |

When the irregularity for a traffic signal is noted, the program first finds the information package (like the above) relating to the UB in question (272 in the example). The clock (0 to 319) is consulted to determine whether signal is green, red or amber. If it is green, the effect is as though there were no signal, and control is returned to the main scan routine which will continue to check successive UBs in attempting to achieve a required clear (sight) distance ahead. If signal is red, the confirmed points from car to stop line are determined, and the car will prepare to stop accordingly. If signal is amber, car's stopping distance is computed (from a look-up table). If car can stop, it will. Otherwise it will "run" the amber light.

The same information package is used for all four 13th Street lanes by utilizing the "modulo 600" feature of the numbering of the 13th Street lanes. Thus when the traffic signal UB in lane 1 is 272, in lane 2 it is 872, in lane 3, 1472 and in lane 4, 2072. Cross traffic also uses the same information package through reference to a cross index which notes that for Irving Street traffic signal UB 2718, the program should refer to the data for UB 272 (with green and red indications properly reversed, of course).

The timing of the signal can be easily modified by merely changing the values in the information package, once the desired offsets have been calculated referenced to the Euclid Street zero point and expressed in quarter seconds.

## CONDITIONS FOR CONFLICTING TURN

The diagram and table of conditions (See Fig. 17) indicate the general procedure involved in moving a car into a turn when there may be opposing traffic that will block or interfere with the movement of our car.

In the diagram, three lanes are depicted at an intersection: an eastbound lane, westbound and northbound. A car turning from eastbound to northbound must cross the westbound through lane as well as avoid any car turning from westbound to northbound. Also, a car turning from westbound to northbound must be on its guard for a car turning from eastbound to northbound. The condition table spells out these "right of way" priorities that have been built into the program. It is axiomatic (and not mentioned in the table) that no car can ever move into the next UB if another car is already in the next UB. Also, cross flow (at 90°) is routinely checked at intersections and is not covered in the table.

# DETAILED MOVEMENT OF MARKED CARS

Appendix D is a reduction of the chain printout sheets as they came off the computer after the simulation run. On these sheets are charted the paths of the "marked cars". The first column represents time in ascending quarter seconds. The computer run began at time 1036, but the portion shown begins at time 1201.

Other columns show the successive unit block positions of marked cars referenced to the quarter second. Thus it is possible to trace through the movement of a marked car from beginning to end. For illustrative purposes, we will consider a car generated in time 1222 and launched in UB 2650. A connecting line has been superimposed on the printout sheet to link the successive quarter-second positions of this car.

The launch time is unique and will serve as an identification of the car for tracing purposes. The Generation Table (Appendix A) shows this car, noting that the exit is 0 (13th Street), the desired speed category is 2 (25 mph), it is type 0 (passenger car), it is a marked car (otherwise we could not follow it), and it has a "1" lane preference (prefers lane 4 of 13th Street; "0" would indicate Lane 1).

If we follow the car's progress, we see it moving east along the north lane of Harvard Street. (See Fig. 2 for orientation on UB numbers.) It slows for the 13th Street intersection and stops at time 1233 in UB 2666 to wait for a red light. Zigzags in the connecting line are of no consequence. They are caused by the fact that cars are processed in ascending order of their unit block number. Furthermore, newly generated cars enter the list last and must then be rearranged in numerical order for their next processing.

Our car (No. 1222) waits until time 1307, when it starts up slowly. At time 1313 it swings into diagonal UB 3334 for the turn. It proceeds into UB 1970 which is lane 4 of 13th Street. It gradually builds up speed until it approaches the next cross street (Columbia Road) where it meets a red light at UB 2016. At time 1433, the light changes and the car again accelerates toward its desired speed.

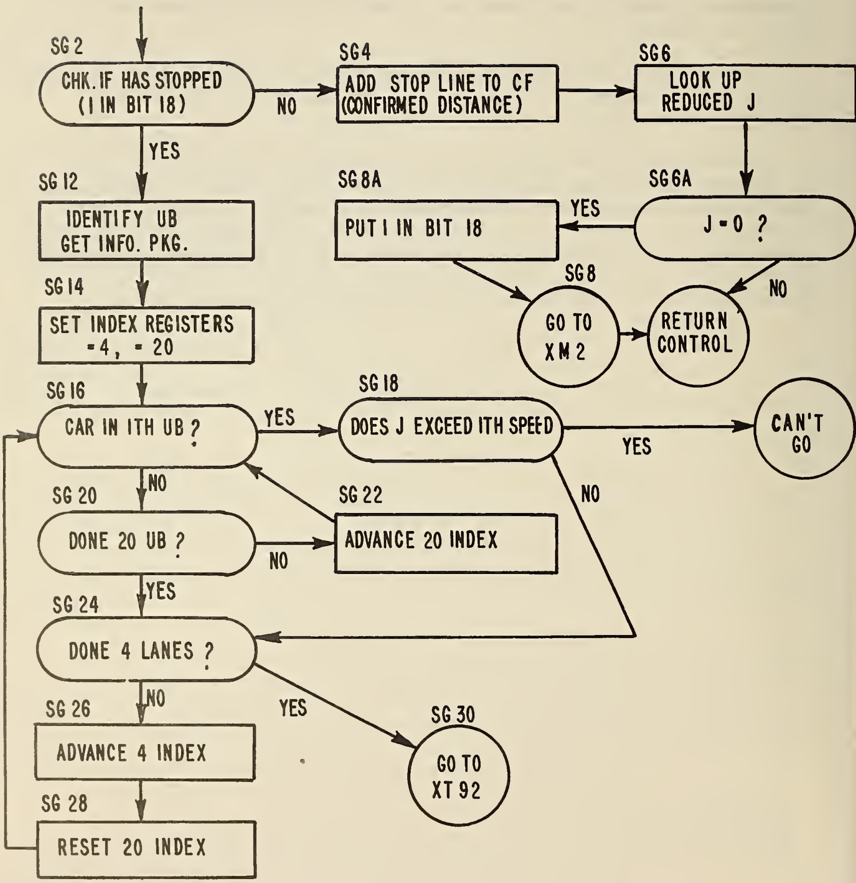
At time 1465, our car shifts from 13th Street lane 4 to lane 3. This is indicated by the change in UB number of 600. The 13th Street lanes are numbered "modulo 600". An increase of 600 means a shift to the left; a decrease of 600 means a shift to the right.

The reason for the lane shift is presumably another car in the way. We do not know what car because it is not a marked car.

At time 1573 our car enters UB 1610, the Station B check point. The Station B Count (Appendix B) can be referred to. We note our car No. 1222 passing in time 1573 in lane 3. We note also that there are various other cars in the immediate vicinity which might be considered "ghost" cars because we have no other information as to their movements.

Our car No. 1222 continues up the street. At time 1600, it shifts back to lane 4 because of a ghost car. It finally reaches the last UB 2340 and retires.

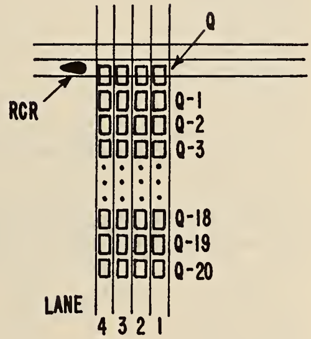
If we look in the Vehicle Retirement Table (Appendix C), we verify that our car No. 1222 was retired at time 1661. We note also that its actual speed was 76 unit points per quarter second. When converted (for approximation divide by 3) the speed is 25 mph which is the original desired speed of No. 1222. Appendix C does not enter a running time in the last column because No. 1222 did not traverse the full course of 13th Street. (It entered from Harvard Street.)




FLOW CHART OF SG 2 STOP SIGN ROUTINE

## Critical Speed for Stop Sign Routine

| No. of Unit Block | Critical J |
|---|---|
| Q - 0 | 0 |
| - 1 | 0 A |
| - 2 | 0 A |
| - 3 | 0 A |
| - 4 | 0 A |
| - 5 | 0 A |
| - 6 | 38 |
| - 7 | 44 |
| - 8 | 50 |
| - 9 | 56 |
| - 10 | 62 |
| - 11 | 69 |
| - 12 | 75 |
| - 13 | 81 |
| - 14 | 88 |
| - 15 | 94 |
| - 16 | 100 |
| - 17 | 106 |
| - 18 | 112 |
| - 19 | 119 |
| - 20 | 125 |

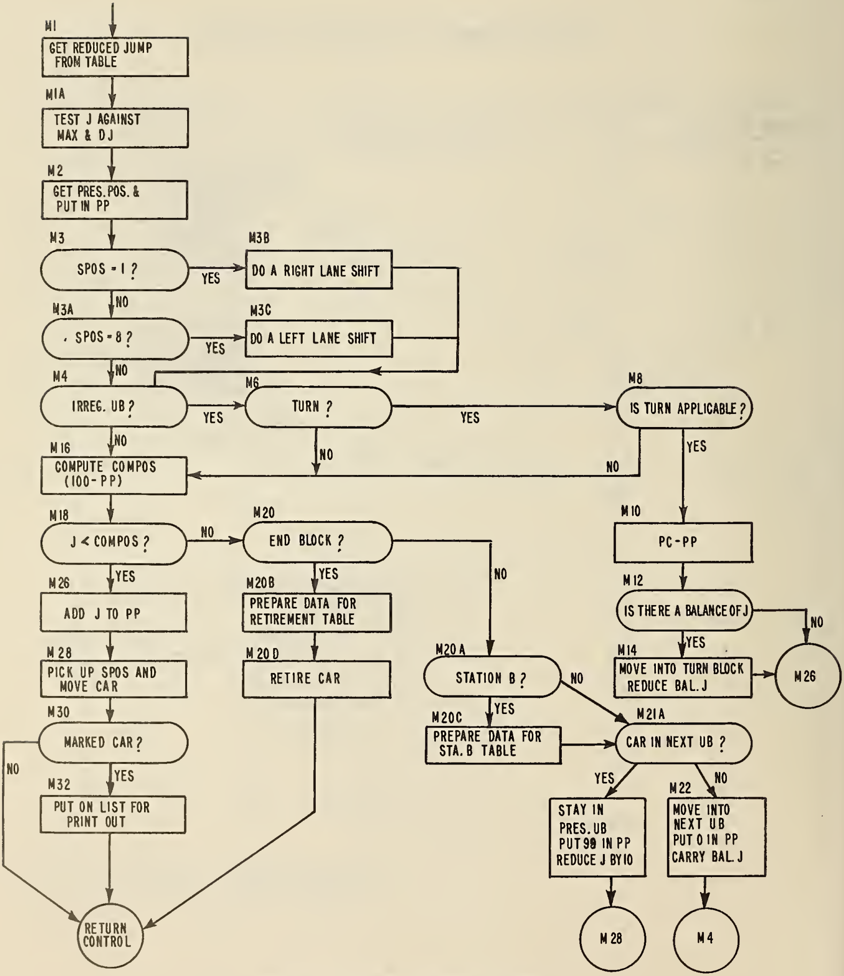



J = jump in terms of unit points per 1/4 sec.
Critical J is based on "acceptable gap" of 4 seconds (16 quarter-second time intervals).
Sample computation

$$\frac{6 \times 100}{16} = 38$$

$$\frac{7 \times 100}{16} = 44$$

A: Arbitrarily set at 0 as a safety factor.




FLOW CHART OF M1 MOVE ROUTINE

# TERMS

(Accompanied by Symbolic Notation Used in Program)

| | | |
|---|---|---|
| A | lane: | Our own lane. |
| L | lane: | Lane to the left of ours. |
| LL | lane: | Lane two lanes to left of ours. |
| R | lane: | Lane to right of ours. |
| RR | lane: | Lane two lanes to right of ours. |

Unit block (UB): All lanes are divided into consecutively numbered sections 12 feet long.

Unit points: Each unit block is divided into 100 unit points. Thus one unit point represents a distance equal to the hundredth part of 12 feet, or 1.44 inches.

Our car (RCR): The car that is being processed.

Leader (LDR): The car ahead of our car.

Follower (FLW): The car behind our car.

Present position (PP): Precise location of (nose of) car within the unit block, expressed in unit points.

Straddle position (SPOS): Refers to the lateral position of a car with respect to its lane. When a car shifts lanes it passes through a series of intermediate lateral positions before the shift is completed. The successive intermediate positions and their designations are described in Appendix G on the "Two-Word Format". (Refer to bits 8 to 10 in word 1.)

Generation point: Cars are generated by random numbers and enter the model at the beginning of each lane. If a generated car cannot be safely launched it is saved in the "gate". Furthermore a backlog is kept in case additional cars are generated which cannot be launched.

Exit (EXIT): The exits are determined initially from a probability distribution so set up as to produce the required volumes and percentages of right-turn, left-turn and through movements at each intersection to correspond with the stated field counts at key points.

Desired speed (DJ): That speed at which a car will try to go. If a car starts from rest and has a clear signt distance ahead, it will accelerate at its permissible rate as determined by its type until it attains its desired speed. Obstructions will of course hold down the speed of the car but it will constantly strive to attain its desired speed whenever it can. The desired speed is determined at the time the car is generated, according to an assigned probability distribution. (See Figure 16.)

Desired speed category (SPCAT): Car's desired speed is expressed by a category designation. Five categories are included ranging from 15 mph to 35 mph in 5 mph increments.

Present speed (LJ): Expressed by the "last jump" (in unit points per quarter second) and carried in the information about the car.

Acceleration (ACL): A car's acceleration rate is keyed to its type. (See Fig. 16, for assumed acceleration and deceleration rates.)

Move (J): Every quarter second each car is processed and makes a quarter second "jump" which can be translated into a mph speed. (For approximate result, divide by 3.)

Goal points (GP): Total net effective clear distance ahead that must be achieved (analogous to sight distance) in order to permit a particular move.

Confirmed points (CF): Those unit points that have been cleared ahead (by inspecting successive unit blocks) counting toward the required goal points.

Sight distance: Unobstructed space in front of a moving vehicle. If a vehicle is moving at any specified speed, safety requires enough clear road ahead to permit the driver to react in case of an unexpected obstruction and to stop before collision, staying within the physical limitations of a realistic deceleration rate. (Fig. 15 is a table of stopping distances for different speeds.)

Net clear distance ahead: Clear distance ahead (sight distance) after adjustment for the speed and length of a car ahead. If our leader is going at least as fast as our car and is ahead of our car by at least the minimum clearance dictated by the leader's speed, then he will not be an obstruction to our car even though he is fairly close.

Clock: The simulation has two clocks. One (known as CLK) starts over every time it reaches 320 quarter seconds. This is the length of traffic signal cycle. This clock is consulted to determine signal indications. The other clock (known as ABCLK), also in quarter seconds, goes on indefinitely, and is used to define car running times and the duration of the simulation run.

Launch time: The time at which a car is safely launched on the street. The car carries its launch time with it. Being expressed in quarter seconds it is almost always unique and serves as an identification of the car thereafter comparable to a license number.

Turn bias: When a car is within 1200 feet (100 unit blocks) of an intended turn, it will persist in trying to get in the correct lane for the turn (right lane for right turn, left lane for left turn). The first try will be to shift; if that is impossible it will proceed in the A lane; under no circumstances will it shift lanes in the wrong direction.

Last chance block: If a car with a turn bias is long enough unsuccessful in shifting lanes, it will ultimately reach a last chance block which serves as a barrier beyond which the car cannot proceed without shifting lanes. If necessary, the car will actually stop and wait for a gap.

Point of curvature: The geometric point at which a turning vehicle leaves its original lane to begin a turn.

Point of tangency: The geometric point at which a turning vehicle completes its turn and resumes a straight course.

Lane preference: The specialized meaning of this term is explained in the paragraphs headed "Turns" and "Lane Preference" in Chapter 8, "Details of the Program".

# LIST OF SIMULATION RUNS

Run No. 1: From Time 0 to Time 637. The computer halted after 637 quarter seconds of simulated time because of an error in processing one of several hundred cars. At the beginning the layout was empty of cars.

Run No. 2: From Time 637 to Time 1036. This was a test run of 400 quarter seconds to verify that the program error described above had been corrected and to ensure that the model was full of correctly performing cars. It utilized the final positions of cars in Run No. 1 as starting positions for Run No. 2.

Run No. 3: From Time 1037 to Time 1996. This run was the "production run" of the desired 960 quarter seconds of simulated time (covering three full 80-second traffic signal cycles) to which the result figures in this report refer and which was used to make the movie. Initial car positions were taken from the final output of Run No. 2.

Run No. 4: Later it was possible to repeat Run No. 3 using as the starting positions the final output positions of the original Run No. 3 instead of those of Run No. 2. This run in essence represented another "throw of the dice" in the Monte Carlo method. Also it possibly reflected a more "mature" full layout of cars. Since the layout was entirely empty of card at Time 0, the passage of several traffic signal cycles after initial fullness might be advisable to produce stability.

Run No. 5: This run was similar to Run No. 4. It utilized the same initial positions of cars (from output of Run No. 3) but the traffic signal setting at Columbia Road was altered by 5 seconds.

Run No. 6: Rerun of Run No. 5 using as initial car positions the output positions of original Run No. 5.

Runs No. 1 and 2 were preliminary runs the principal purpose of which was to fill the model with cars.

Run No. 3 was the "production run" used for the basis of this report.

Runs No. 4, 5 and 6 were made later to demonstrate the use of stochastic inputs and the facility for varying specific parameters. There were no apparent errors in these additional runs. However, no statistical examinations of the results were made because the purpose at this stage was to demonstrate a working device rather than to derive statistically significant output values.

U. S. DEPARTMENT OF COMMERCE
Luther H. Hodges, *Secretary*

NATIONAL BUREAU OF STANDARDS
A. V. Astin, *Director*

# THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards at its major laboratories in Washington, D.C., and Boulder, Colorado, is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section carries out specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant publications, appears on the inside of the front cover.

## WASHINGTON, D.C.

**Electricity.** Resistance and Reactance. Electrochemistry. Electrical Instruments. Magnetic Measurements. Dielectrics. High Voltage.

**Metrology.** Photometry and Colorimetry. Refractometry. Photographic Research. Length. Engineering Metrology. Mass and Scale. Volumetry and Densimetry.

**Heat.** Temperature Physics. Heat Measurements. Cryogenic Physics. Equation of State. Statistical Physics.

**Radiation Physics.** X-ray. Radioactivity. Radiation Theory. High Energy Radiation. Radiological Equipment. Nucleonic Instrumentation. Neutron Physics.

**Analytical and Inorganic Chemistry.** Pure Substances. Spectrochemistry. Solution Chemistry. Standard Reference Materials. Applied Analytical Research.

**Mechanics.** Sound. Pressure and Vacuum. Fluid Mechanics. Engineering Mechanics. Rheology. Combustion Controls.

**Organic and Fibrous Materials.** Rubber. Textiles. Paper. Leather. Testing and Specifications. Polymer Structure. Plastics. Dental Research.

**Metallurgy.** Thermal Metallurgy. Chemical Metallurgy. Mechanical Metallurgy. Corrosion. Metal Physics. Electrolysis and Metal Deposition.

**Mineral Products.** Engineering Ceramics. Glass. Refractories. Enameled Metals. Crystal Growth. Physical Properties. Constitution and Microstructure.

**Building Research.** Structural Engineering. Fire Research. Mechanical Systems. Organic Building Materials. Codes and Safety Standards. Heat Transfer. Inorganic Building Materials.

**Applied Mathematics.** Numerical Analysis. Computation. Statistical Engineering. Mathematical Physics. Operations Research.

**Data Processing Systems.** Components and Techniques. Computer Technology. Measurements Automation. Engineering Applications. Systems Analysis.

**Atomic Physics.** Spectroscopy. Infrared Spectroscopy. Solid State Physics. Electron Physics. Atomic Physics.

**Instrumentation.** Engineering Electronics. Electron Devices. Electronic Instrumentation. Mechanical Instruments. Basic Instrumentation.

**Physical Chemistry.** Thermochemistry. Surface Chemistry. Organic Chemistry. Molecular Spectroscopy. Molecular Kinetics. Mass Spectrometry.

**Office of Weights and Measures.**

## BOULDER, COLO.

**Cryogenic Engineering.** Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Cryogenic Technical Services.

**Ionosphere Research and Propagation.** Low Frequency and Very Low Frequency Research. Ionosphere Research. Prediction Services. Sun-Earth Relationships. Field Engineering. Radio Warning Services. Vertical Soundings Research.

**Radio Propagation Engineering.** Data Reduction Instrumentation. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Propagation-Terrain Effects. Radio-Meteorology. Lower Atmosphere Physics.

**Radio Standards.** High Frequency Electrical Standards. Radio Broadcast Service. Radio and Microwave Materials. Atomic Frequency and Time Interval Standards. Electronic Calibration Center. Millimeter-Wave Research. Microwave Circuit Standards.

**Radio Systems.** Applied Electromagnetic Theory. High Frequency and Very High Frequency Research. Modulation Research. Antenna Research. Navigation Systems.

**Upper Atmosphere and Space Physics.** Upper Atmosphere and Plasma Physics. Ionosphere and Exosphere Scatter. Airglow and Aurora. Ionospheric Radio Astronomy.

NBS