

FTA SECTION 8 PROJECT C930

TRACK MAP CORRELATION

FINAL REPORT



Prepared by

DIVISION OF TRACK

DEPARTMENT OF RAPID TRANSIT

NEW YORK CITY TRANSIT AUTHORITY

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EXECUTIVE SUMMARY

Project C-930, "Track Map Correlation", was an FTA funded Section 8 grant sponsored by the New York City Transit Authority (NYCTA) and carried out by the Division of Track, formerly the Track and Structures Department. The purpose of the project was to upgrade and augment all paper and computer based track data pools in use throughout the NYCTA. The product of project C-930 would be absorbed into one complete, consistent, integrated computer aided design system and database network. Through this network all current track information would be instantly accessible to any user. Since software required to implement this program was available in the Track Information Planning System (TIPS), a program partially developed through FTA Section 8 Project C-920 ("Graphic Right of Way Charts"), Project C-930 itself was divided into the following steps:

- 1) Establish a universal system for referencing track locations and for operating on stored data (e.g. calculating distances); establish standards for computer hardware and software to be used.
- 2) Reorganize existing databases so as to conform to the new standards.
- 3) Update databases to reflect current field conditions.
- 4) Train field personnel to use the new system; establish programs of continual updating of data as a normal part of their work.
- 5) Add new data fields to the network; repeat steps 3 and 4.

A direct result of this project is the ongoing conversion of existing data to conform to the project's specifications. In addition, procedures have been established to enter new information into the databases as it is generated, thereby facilitating the planning process for track renewal. As the proposed systemwide network both absorbs more and better field data from various locations, and integrates and disseminates these data, the planning process will achieve higher degrees of integration and efficiency.

Track and switch databases have already been transformed according to the standards of this project, and function as part of the TIPS network in generating periodic and special reports. New types of reports can be generated as existing data fields are filled and as new fields are developed. User difficulties are minimal, since TIPS is compatible with dBase, a well known and widely used program. Expansion of the network to field sites, once completed, will permit timely data input at the point of generation. A Track Condition Survey being prepared this year incorporates the standards of this project, which will greatly enhance its value as a planning tool.

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1. SCOPE OF WORK

The objective of the project was to meld distinct sets of track data into an accurate and consistent system, and to develop reporting procedures to insure that data would continue to be updated in a timely manner. To this end, nine tasks were enumerated in the project proposal:

- TASK I Review organization and referencing of track drawings in use throughout the NYCTA.
- TASK II Identify track sites for installation of TG01/OBCAT (track geometry car/offboard computer analysis of track) reference markers.
- TASK III Create TG01/OBCAT track database from readings taken by the TG01.
- TASK IV Compare TG01/OBCAT data with drawings.
- TASK V Compare TIPS data with drawings.
- TASK VI Correlate stationing numbers, which reference right of way center lines, with TG01 data, which reference track center lines.
- TASK VII Convert elevated column numbers to stationing numbers.
- TASK VIII Establish procedures to be followed by the Track Division in updating drawings and databases.
- TASK IX Final report & recommendations.

Because it later became evident that technical and funding delays in TG01/OBCAT system development would impact on the usability of TG01 data, it was decided to make TIPS "OBCAT ready"; in this way data interface could be achieved once OBCAT became available. As the project's scope was quite broad, greater attention could easily be given to areas of more immediate concern, such as local area networks (LANs), whose support capabilities were becoming more attractive with time. Such networks will be discussed below.

Establishing Standards

The success of a new set of technical standards is determined by three considerations. First is technical superiority of the new system, including simplicity of design, ease of use, and problem solving capability. Next comes the degree of continuity or compatibility with the old system, and thus the level of disruption inevitable in any organizational changeover. Finally, level of personnel support is perhaps the most critical of all factors. With these criteria in mind, we will survey the various users of track data and their systems.

Rapid Transit Operations (RTO) works with lettered and numbered service routes, essentially the system designed for public use. While this has the benefit of wide familiarity, using service routes to identify track lines involves unresolvable difficulties. One line may accommodate several routes (the 'D' and 'Q' both operate along 6th Avenue), and routes are changed periodically. A database requires a well defined and settled system of fundamental categories. Hence, other operating divisions tend to avoid using RTO's route names.

Commonly used line names (e.g. "Astoria" or "6th Avenue") are cumbersome, though conceptually unambiguous. Unfortunately, they are not clearly defined in common use: where does the "6th Avenue" line become the "Prospect Park" line? A cleaner system, used by Engineering & Construction and by Track and Signals, will here be called the "stationing system". Each line is assigned a one or two letter code when the original construction contract is let. Tracks are numbered (e.g. "1" or "M" or "3/4"), the right of way is surveyed (stationed), and distance markers are affixed to the wall at 50 foot intervals. Signals are then identified by line, track and stationing number.

While clearly computer friendly, stationing does have its drawbacks. Extensions and abandonments can cause gaps in stationing numbers; stationing number sequencing can even reverse direction (southbound becomes northbound). More critically, Track and Signals use different track and switch names, which would have to be reconciled.

In the early 1980s the NYCTA commissioned the consulting firm London Transport International (LTI) to develop a system, later termed the "Track Section Matrix", which identified lines by codes like "AST" or "6AV". It was clear and consistent, but required a radical change in working procedures. Worker support was weak, and the system was not implemented.

With this experience in mind, it was decided to deviate as little as possible from the stationing system, and to make all required changes in the computer system itself. Track Division would convert to Signals' track and switch number system in all but a few difficult cases, yielding a system almost perfectly compatible between Track, Signals, and Engineering and Construction (E&C). This standard track location system uses four pieces of information to identify any spot on the track network:

Division IRT, BMT, IND⁹
Line One or two letter code, listed in Appendix A¹⁰
Track three character code¹¹, listed in Appendix B
Station # distance in feet from a starting point, corresponding to
numbers on tunnel walls, signal posts and in drawings.

Software standards have evolved as the project has developed. After using a specialized file format unique to Track's TED¹² program, modifications were undertaken to make TED compatible with dBASE files. The result of this conversion is called TIPS¹³; track data are now readable by most popular database programs for PCs or LANs, including dBASE III and IV, FoxPro, Clipper, dbFAST, Clarion and Alpha Four.

3. CONVERTING AND UPDATING DATA

Converting Data

The Track Device Information System (TDIS) database, with its data fields for division, line, track, stationing number and track geometry, formed the basis of all subsequent efforts. After downloading the database from the mainframe to a PC, TDIS data were brought into conformity with both the signal drawing books and Signal's own Signal Equipment Information System (SEIS), all while preserving the logical integrity of the database.

Correcting and Updating the Database

By comparing all data records with Signals' drawings and database, errors were identified and eliminated. Since TDIS had been created in the 1970s, during a notably active period of yard expansion, all new track devices were added to the system of linked database files in TIPS¹⁴.

Track Geometry Car Interface

The NYCTA operated two track geometry cars. TG01 measures track geometry and measured geometry related defects such as wide gauge or bad surface. TG02 measured rail wear and tunnel clearances. As a part of this project a software interface was developed with the Off Board Analysis (OBCAT) program and the Automatic Location Detection System (ALDS) of the geometry cars to correlate track location numbers of the cars with TIPS numbers. The implementation of both OBCAT and ALDS (not a part of this project) have been delayed, so the interface remains inoperative.

Elevated Column Number Conversion

Tunnel walls were marked with stationing numbers, but workers on elevated structures were required to approximate stationing from signal posts, an inaccurate method, or to refer to known stationing at station platforms, if they were near one. Or they could use column numbers, an alternate system which numbers columns supporting the elevated structure.

When this project was conceived, it was understood that conversion tables existed between column and stationing numbers, which could easily be incorporated into TIPS. Unfortunately, a search turned up few of the tables, which anyway proved to be unreliable. A committee was then formed to examine alternative materials and placement methods for a pilot program of stationing number installation on one elevated line. Upon successful completion of this pilot program, placement of stationing numbers on all elevated lines will commence.

4. FUTURE UPDATING PROCEDURE

In establishing procedures for updating information, each data field was assigned to the office responsible for generating those data. That office would have full input responsibility and control of its field(s), and all offices would have visual access to every field through Track's computer network. By the time of this writing, a local area network (LAN) had been installed to connect fifteen PCs at Track's 370 Jay Street headquarters. In 1992 Track submitted a proposal to expand the network at Jay Street and to create a wide area network (WAN) encompassing field offices.

Many offices in the NYCTA generate periodic reports using standalone computer databases or spreadsheets. The task at hand is to integrate all such software and data into the network, while maintaining or enhancing their original utility for each office.

Adding New Fields

Track's database is dynamic in that fields not included at the start of the project have later been incorporated; it is expected that more will follow. The question becomes whether an office needing an additional data field can commit the resources required to maintain the database.

5. POSSIBLE ENHANCEMENTS FOR FUTURE DEVELOPMENT

This project involved both the design and the implementation of improvements. Some of its recommendations, creation of the TIPS program for example, were implemented during the life of the project; others, like the ongoing conversion of databases, continue to operate after project closeout. This section is devoted to a discussion of proposals designed to preserve and extend the benefits of the project.

Future Plans

Appendix C is a copy of one such proposal, to put the track data and drawings discussed in this report online at all major Track facilities, utilizing TIPS software. Its implementation would also render possible the division-wide coordinated use of the programs described below.

- o Track Degradation Analysis - a software based engineering model that predicts the life cycles of such track components as rail, ties, switch timbers, and switch frogs. This model was written to interface with the old TED BASIC file formats, and needs to be rewritten to accept dBASE files.
- o Trackwalker Inspection System (TIS) - a program that logs twice weekly track inspections and defects. This program currently runs on an IBM System 38 minicomputer. If converted to run on a wide area network, it could lower computer costs (by eliminating the System 38) and would make track defect data available to TIPS and standard PC packages like Lotus 123. This would greatly open up the possibilities for analysis of this important data. Migration of TIS would also obviate the need for a second copy of the track location data on the System 38.
- o Historical Data - The most recent maintenance actions are already kept on file in the database. But with changes in the database structure and linkage, a maintenance history could be compiled. Use of this historical data would greatly enhance Track's ability, by reviewing past maintenance actions and using current forecasting models, to compare actual with predicted performance levels of track components. By refining the models the quality of predictions can then be improved.
- o Data Entry From Hand Held Computers - This would eliminate the need for rekeying of data entered on paper forms in the field. Track inspectors would directly enter their data in the computer, which would be uploaded to the main system at the end of their shift. A hand held computer system is being developed now for the 1992 track condition survey. If successful, a similar system could be developed for trackwalker inspections.

Application to Other Rail Properties

TIPS has been successfully implemented on the Long Island Rail Road in the earlier version called TED. On that property, as at the NYCTA, TIPS is used to store and process all manner of track inventory data, and so is regarded as a valuable planning tool. Thus, while the track location system, which was the emphasis of this project, is specific to the NYCTA, the methodology can be adapted to the needs of any rail system.

Footnotes:

1. A distinction is made between correcting, which is making a change in erroneous data, and updating, which is changing data that had previously been correct but no longer is due to changing field conditions.
2. Contract drawings are organized by contract rather than by location. In fact, one location may have multiple drawings if it was ever reconstructed by one or more contractors.
3. A guarded curve contains an extra rail, placed between the two running rails, and bolted to the inside rail of the curve. The gap between these two rails is a bit wider than the flange of a wheel, and serves to keep the train on the track when going around a sharp curve.
4. Other device types at the NYCTA include crossing diamonds, lift rails, and expansion joints.
5. Lines used by the Division of Track are the ones used by Signals and Engineering & Construction and consist of one or two letter codes. They are not the same as service lines which are the numbers or letters designating each route such as the "D" train, "#7" train, etc.
6. Track names are four characters in length, of which the first three are visible to the user. A fourth hidden character is used by TIPS to distinguish two non-contiguous tracks on the same line which Signals identifies with the same name. Thus, the track names remain compatible between Track and Signals while serving the divergent needs of these divisions.
7. Stationing numbers are used by the NYCTA to determine locations and distances along a right of way. They are marked at 50 foot intervals on the walls or columns in the subway. They also appear on signal posts, rounded to the nearest 100. The numbers represent the number of feet from a starting point which is usually, but not always zero.
8. A wheel, or roller gauge, is a device that looks somewhat like a unicycle with a counter. It is rolled along the top of a rail, and distances are read off the counter in feet.
9. The three original rapid transit divisions, Interborough Rapid Transit (IRT), Brooklyn-Manhattan Transit (BMT) and Independent System (IND), have been consolidated into the "A" Division (IRT) and "B" Division (BMT and IND). The TIPS database preserves the original system due to duplicate line code assignments in the combined BMT-IND. Changeover would require extensive systemwide alterations to the drawings, and to name plates on signal posts, signal wire tags and survey markers.
10. To provide easy conversion for those more familiar with RTO service routes or line names these are listed with the line codes in Track's computer system, Track Information Planning System (TIPS). These are also listed in Appendix A.

APPENDIX A - NYCTA LINE DESIGNATIONS

DIV	LINE	DESCRIPTION	(SVC ROUTE)	CLASS
IRT	B	BWAY, 42 - 96 ST	(1/9,2,3)	MAIN
IRT	BB	BWAY, 96 - 242 ST	(1/9)	MAIN
IRT	C	FLUSHING LINE	(7)	MAIN
IRT	D	NOSTRAND AV LINE	(2,5)	MAIN
IRT	E	EASTERN PKY LINE	(2,3,4,5)	MAIN
IRT	F	LENOX, 96 - E180 ST	(2,3,5)	MAIN
IRT	J	JEROME AV LINE	(4)	MAIN
IRT	K	CLARK ST LINE	(2,3)	MAIN
IRT	L	LEX AV, 42 - 125 ST	(4,5,6)	MAIN
IRT	M	BKLYN BR - BORO HALL	(4,5)	MAIN
IRT	ML	CITY HALL LOOP	(6)	MAIN
IRT	MM	BKLYN BR - TMS SQ	(4,5,6,S)	MAIN
IRT	MV	SOUTH FERRY LOOP	(1)	MAIN
IRT	P	PELHAM LINE	(6)	MAIN
IRT	V	7 AV, 42 ST - SO. FERRY	(1)	MAIN
IRT	W	WHITE PLAINS RD LINE	(2,5)	MAIN
IRT	Y	DYRE AV LINE	(5)	MAIN
IRT	BV	240 ST YARD	(FROM IRT-BB)	YARD
IRT	CY	CORONA YARD	(FROM IRT-C)	YARD
IRT	EL	LIVONIA YARD	(FROM IRT-E)	YARD
IRT	FL	148 ST YARD	(FROM IRT-F)	YARD
IRT	JM	JEROME YARD	(FROM IRT-J)	YARD
IRT	PW	WESTCHESTER YD	(FROM IRT-P)	YARD
IRT	UN	UNIONPORT YARD	(FROM IRT-Y)	YARD
IRT	WE	E180 ST YARD	(FROM IRT-W)	YARD
IRT	WT	239 ST YARD	(FROM IRT-W)	YARD
BMT	A	BWAY/BRIGHTON	(D,N,Q,R)	MAIN
BMT	B	BWAY/VIA TUNNEL	(M,N,R)	MAIN
BMT	D	WEST END LINE	(B,M)	MAIN
BMT	E	SEA BEACH, STILLWL	(B,D,F,N)	MAIN
BMT	F	4 AV LINE	(B,M,N,R)	MAIN
BMT	G	ASTORIA	(N,R)	MAIN
BMT	GD	11ST CONNECT	(R)	MAIN
BMT	H	MANHATTAN BRIDGE	(closed)	MAIN
BMT	J	JAMAICA/ARCHER LINE	(J/Z,M)	MAIN
BMT	M	MYRTLE AV LINE	(M)	MAIN
BMT	O	FRANKLIN AV LINE	(S)	MAIN
BMT	P	CANAR, S/O BWAY JCT	(L)	MAIN
BMT	Q	CANAR, N/O BWAY JCT	(L)	MAIN
BMT	R	NASSAU ST LINE	(J/Z,M)	MAIN
BMT	CI	CONEY ISL YD	(FROM BMT-D&E)	YARD
BMT	38	38 ST YARD	(FROM BMT-D)	YARD
BMT	DO	EAST NY YD	(FROM BMT-J&P)	YARD
BMT	FP	FRESH POND YD	(FROM BMT-M)	YARD
BMT	AY	CANARSIE YARD	(FROM BMT-P)	YARD
BMT	ST	STILLWELL YD	(FROM BMT-D&E)	YARD
IND	A	8 AV LINE	(A,B,C,D,E,JFK)	MAIN
IND	B	6 AV LINE	(B,D,F,JFK,Q)	MAIN
IND	BJ	CHRISTIE ST CONN		MAIN
IND	C	CONCOURSE LINE	(C,D)	MAIN
IND	D	QUEENS LINE	(E,F,G,R)	MAIN

11. There are actually four characters in the Track field, of which only the first three are known to the user. These three are identical to Signals' track name. When the computer must distinguish between two tracks to which Signals has given the same name, a fourth, hidden character is used.
12. The Track Engineering Database (TED) was the predecessor to TIPS. TED ran on standalone IBM compatible PCs and used a BASIC random file format. This means that only custom software such as BASIC programs could directly access TED's data.
13. The Track Information Planning System (TIPS) differs from TED in two important ways. First, it reads dBASE formatted files. Second, TIPS can use shared databases when it is run on a network. Single PC operation is also available, as before.
14. The data in TIPS is not held in a single database, but rather, is kept in a dozen or more files of like information. The logical grouping of data makes it easier to work with and saves storage space. Linking the databases allows data from different files to be used together, as if it were all on one file.

APPENDIX A - NYCTA LINE DESIGNATIONS

DIV	LINE	DESCRIPTION	(SVC ROUTE)	CLASS
IND	DA	ARCHER AVE LINE	(E)	MAIN
IND	E	CROSSTOWN N/O FULTON ST	(G)	MAIN
IND	EX	CROSSTOWN S/O FULTON ST	(G)	MAIN
IND	F	RKWAY, TO RKWAY PK	(A,C,H)	MAIN
IND	FA	RKWAY, WYE - MOTT AV	(A,H)	MAIN
IND	K	LIBERTY AV LINE	(A,C,JFK)	MAIN
IND	T	63RD ST TUNNEL	(B,Q)	MAIN
IND	AP	PITKIN YARD	(FROM IND-A&K)	YARD
IND	AT	207 ST YARD	(FROM IND-A)	YARD
IND	BX	CULVER-AV X YD	(FROM IND-B)	YARD
IND	CC	CONCOURSE YD	(FROM IND-C)	YARD
IND	DJ	JAMAICA YARD	(FROM IND-D)	YARD
IND	FR	ROCKAWAY PK YD	(FROM IND-F)	YARD

APPENDIX B - NYCTA TRACK DESIGNATIONS

DIV	LINE	TRACK	DESCRIPTION	S/E Sta#	N/E Sta#
IRT	L	3	N/B EXPRESS	0+00	246+93
IRT	L	4	N/B LOCAL	0+00	248+50
IRT	L	1A	S/B S/O 125ST	217+69	228+83
IRT	L	1A	POCKET N/O 59ST	63+87	70+10
IRT	L	1S	S/B S/O 125ST	216+92	229+35
IRT	L	3A	N/B POCKET 125ST	237+45	245+75
IRT	L	4B	N/B POCKET 125ST	222+44	230+00
IRT	M	1	S/B LCL @BB STA	10+10	0+00
IRT	M	2	S/B LOCAL/EXP	113+03	0+00
IRT	M	2	X S/B LOCAL/EXP	11+20	0+00
IRT	M	3	N/B LOCAL/EXP	113+01	0+00
IRT	M	3	X N/B LOCAL/EXP	11+20	0+00
IRT	M	5	PKT S/O BB STA	10+30	2+49
IRT	M	B	TO IRT-MV-B N/E	33+13	32+04
IRT	M	BX	TO IRT-MV-B S/E	33+44	32+06
IRT	M	S	BOWLNG GRN SHUT	32+06	29+74
IRT	ML	LP	CITY HALL LOOP	13+80	1+55
IRT	MM	1	S/B LOCAL	0+00	153+37
IRT	MM	2	S/B EXPRESS	0+00	153+37
IRT	MM	3	N/B EXPRESS	0+00	153+37
IRT	MM	4	N/B LOCAL	0+00	153+37
IRT	MM	1S	TS SHUTTLE TK1	154+49	191+85
IRT	MM	1S3	TS SHUT TK1-TK3	170+52	172+45
IRT	MM	3S	TS SHUTTLE TK3	167+04	193+10
IRT	MM	4S	TS SHUTTLE TK4	166+30	194+10
IRT	MM	B	PKT @UNION SQ	82+17	87+91
IRT	MV	A	OUTER LOOP	0+00	20+58
IRT	MV	B	INNER LOOP	0+31	20+58
IRT	P	2	S/B LOCAL	246+19	642+20
IRT	P	3	N/B LOCAL	246+93	641+76
IRT	P	M	MIDDLE	277+41	635+35
IRT	P	M3	DIA @PEL BAY PK	634+15	634+86
IRT	V	1	S/B LOCAL	215+15	0+00
IRT	V	2	S/B EXPRESS	165+52	0+00
IRT	V	3	N/B EXPRESS	164+58	0+00
IRT	V	4	N/B LOCAL	215+15	0+00
IRT	V	M	POCKET PENN STA	25+95	13+20
IRT	W	2	S/B LOCAL	365+00	622+75
IRT	W	3	N/B LOCAL	365+00	622+75
IRT	W	M	MIDDLE	365+00	615+93
IRT	Y	1	S/B LOCAL	161+05	348+63
IRT	Y	1	S/B LOCAL	101+61	122+00
IRT	Y	2	N/B LOCAL	161+05	348+63
IRT	Y	2	N/B LOCAL	103+16	122+00
IRT	Y	3	M PKT @ MORRIS PK	172+10	203+85
IRT	Y	3	D PKT S/O DYRE AV	313+17	326+90
IRT	Y	4	M PKT @ MORRIS PK	172+10	210+08
IRT	Y	4	D PKT S/O DYRE AV	313+17	326+90

▲ Hidden char in track name S/E = South End
N/E = North End

APPENDIX B - NYCTA TRACK DESIGNATIONS

DIV	LINE	TRACK	DESCRIPTION	S/E Sta#	N/E Sta#
IRT	FL	23	LAY-UP TK	171+73	177+14
IRT	FL	24	LAY-UP TK	170+17	177+17
IRT	FL	25	LAY-UP TK	171+78	177+32
IRT	FL	26	LAY-UP TK	171+78	176+86
IRT	FL	27	OUT OF SERVICE	169+09	173+17
IRT	FL	A	YARD LEAD	166+42	170+28
IRT	FL	B	YARD LEAD	167+15	171+78
IRT	FL	DRL	DRILL TK	163+25	167+45
IRT	JM	1	INSP SHED	541+36	542+21
IRT	JM	2	INSP SHED	540+93	542+23
IRT	JM	3	INSP SHED	541+53	542+23
IRT	JM	4	INSP SHED	540+36	542+33
IRT	JM	5	LAY-UP TK	541+54	548+53
IRT	JM	5	TO CONCRS	509+40	524+79
IRT	JM	8	LAY-UP TK	540+84	549+00
IRT	JM	9	LAY-UP TK	542+78	549+12
IRT	JM	10	LAY-UP TK	542+09	549+16
IRT	JM	11	LAY-UP TK	542+55	549+29
IRT	JM	12	LAY-UP TK	542+55	549+36
IRT	JM	12	YARD LEAD	535+01	537+46
IRT	JM	13	LAY-UP TK	543+19	549+90
IRT	JM	13	YARD LEAD	526+58	537+46
IRT	JM	14	LAY-UP TK	542+49	549+82
IRT	JM	15	LAY-UP TK	542+95	550+00
IRT	JM	16	LAY-UP TK	541+85	550+04
IRT	JM	17	LAY-UP TK	543+74	550+30
IRT	JM	18	LAY-UP TK	543+04	550+32
IRT	JM	19	LAY-UP TK	543+51	550+45
IRT	JM	20	LAY-UP TK	542+33	550+53
IRT	JM	21	LAY-UP TK	544+28	550+83
IRT	JM	22	LAY-UP TK	543+58	550+91
IRT	JM	23	LAY-UP TK	544+03	551+02
IRT	JM	24	LAY-UP TK	544+74	551+06
IRT	JM	25	LAY-UP TK	544+74	551+12
IRT	JM	A	YARD LEAD	537+46	544+74
IRT	JM	B	YARD LEAD	537+46	542+55
IRT	PW	1	LAY-UP TK	591+34	598+51
IRT	PW	2	LAY-UP TK	591+20	597+77
IRT	PW	3	LAY-UP TK	590+49	596+49
IRT	PW	4	LAY-UP TK	597+12	602+86
IRT	PW	5	LAY-UP TK	597+94	603+40
IRT	PW	6	LAY-UP TK	598+91	603+40
IRT	PW	7	LAY-UP TK	596+21	603+64
IRT	PW	8	LAY-UP TK	598+46	603+81
IRT	PW	9	LAY-UP TK	597+06	603+79
IRT	PW	10	LAY-UP TK	598+03	603+83
IRT	PW	11	LAY-UP TK	595+25	603+80
IRT	PW	12	LAY-UP TK	597+64	603+35
IRT	PW	13	LAY-UP TK	595+25	603+02
IRT	PW	14	OUT OF SERVICE	597+55	603+02

▲ Hidden char in track name S/E = South End
N/E = North End

APPENDIX B - NYCTA TRACK DESIGNATIONS

DIV	LINE	TRACK	DESCRIPTION	S/E Sta#	N/E Sta#
IRT	WT	43	LAY-UP TK	634+43	641+31
IRT	WT	44	LAY-UP TK	634+00	641+97
IRT	WT	45	LAY-UP TK	632+13	642+67
IRT	WT	46	LAY-UP TK	634+26	643+00
IRT	WT	47	LAY-UP TK	633+84	642+95
IRT	WT	48	LAY-UP TK	632+66	642+60
IRT	WT	49	LAY-UP TK	634+64	643+44
IRT	WT	50	LAY-UP TK	634+21	643+50
IRT	WT	51	LAY-UP TK	634+21	643+60
IRT	WT	52	LAY-UP TK	634+85	643+45
IRT	WT	53	LAY-UP TK	634+39	643+98
IRT	WT	54	LAY-UP TK	633+05	643+95
IRT	WT	55	LAY-UP TK	635+21	644+33
IRT	WT	56	LAY-UP TK	634+75	643+95
IRT	WT	57	LAY-UP TK	635+62	645+44
IRT	WT	58	LAY-UP TK	633+56	644+44
IRT	WT	60	LAY-UP TK	636+19	636+85
IRT	WT	62	INSP SHED	636+68	638+64
IRT	WT	63	INSP SHED	635+85	638+53
IRT	WT	64	INSP SHED	636+95	638+81
IRT	WT	65	INSP SHED	637+34	638+62
IRT	WT	66	INSP SHED	636+53	638+77
IRT	WT	67	INSP SHED	637+58	638+87
IRT	WT	68	INSP SHED	637+20	638+88
IRT	WT	69	INSP SHED	637+20	638+94
IRT	WT	1B	YARD LEAD	609+27	634+21
IRT	WT	1C	LOOP	617+96	637+18
IRT	WT	4A	YARD LEAD	608+75	627+72
IRT	WT	4B	YARD LEAD	604+35	637+20

▲ Hidden char in track name

S/E = South End
N/E = North End

APPENDIX B - NYCTA TRACK DESIGNATIONS

DIV	LINE	TRACK	DESCRIPTION	S/E Sta#	N/E Sta#
BMT	F	1	S/B LOCAL	628+00	312+66
BMT	F	2	N/B LOCAL	628+00	312+11
BMT	F	3	S/B EXPRESS	532+14	292+31
BMT	F	4	N/B EXPRESS	532+14	283+33
BMT	F	3/4	PKT N/O 95 ST	617+61	604+15
BMT	G	1	S/B LCL (MANH)	-3+54	256+15
BMT	G	2	N/B LCL (MANH)	-3+61	255+91
BMT	G	3/4	MIDDLE	142+23	246+79
BMT	G	3	S/B 63RD ST TUN	100+00	147+65
BMT	G	4	N/B 63RD ST TUN	100+00	147+65
BMT	GD	1	S/B TO IND-D	103+39	135+35
BMT	GD	2	N/B TO IND-D	104+16	141+06
BMT	H	1	S/B MANHATTN BR	293+36	183+30
BMT	H	2	N/B MANHATTN BR	291+96	183+30
BMT	H	3	N/O DEKALB AVE	301+96	287+93
BMT	J	1	S/B LOCAL	681+75	19+62
BMT	J	1	J PKT N/O CANAL	29+57	1+83
BMT	J	2	N/B LOCAL	682+41	1+83
BMT	J	3/4	MIDDLE	351+02	154+00
BMT	J	3	S/B EXP (ESSEX)	58+20	22+00
BMT	J	3	PKT @111th ST	581+05	564+74
BMT	J	3	J PKT N/O CANAL	28+36	1+83
BMT	J	4	N/B EXP (ESSEX)	70+60	28+77
BMT	J	4	POCKET CRESCENT	448+20	440+21
BMT	J	4	J S/B N/O CANAL	19+62	1+83
BMT	J	J2A	TO BMT-P E.PKY	347+42	342+46
BMT	M	1	S/B LOCAL	385+69	246+25
BMT	M	2	N/B LOCAL	385+69	246+72
BMT	M	3	TO BMT-J LINE	246+25	235+48
BMT	M	4	TO BMT-J LINE	246+72	235+11
BMT	O	1	S/B LOCAL	264+71	194+35
BMT	O	2	N/B LOCAL	264+42	201+81
BMT	P	1	S/B LOCAL	97+07	0+64
BMT	P	2	N/B LOCAL	95+96	2+72
BMT	P	5	LINDEN FLYOVER	213+40	206+40
BMT	P	7/8	LINDEN FLYOVER	227+30	208+00
BMT	P	1	K S/B ATLANTIC AV	362+25	336+09
BMT	P	2	K N/B ATLANTIC AV	362+82	341+56
BMT	P	J1A	TO BMT-J LINE	336+67	333+65
BMT	P	J2A	TO BMT-J LINE	338+61	336+37
BMT	P	K1	OLD FULTON EL	359+52	336+67
BMT	P	K3	OLD FULTON EL	360+55	342+21
BMT	P	K4	OLD FULTON EL	360+55	338+67
BMT	P	Y4	ATLANTIC AVE	341+56	337+56
BMT	Q	1	S/B LOCAL	401+49	0+00
BMT	Q	2	N/B LOCAL	404+08	0+00
BMT	Q	3/4	PKT S/O MYRTLE	322+75	306+34
BMT	Q	1W	S/B LOCAL	118+46	100+59
BMT	Q	2W	N/B LOCAL	118+46	100+59
BMT	Q	3/4	W PKT S/O 8th AV	117+45	110+45

▲ Hidden char in track name S/E = South End
N/E = North End

APPENDIX B - NYCTA TRACK DESIGNATIONS

DIV	LINE	TRACK	DESCRIPTION	S/E Sta#	N/E Sta#
BMT	R	1	S/B LOCAL	273+45	218+89
BMT	R	2	N/B LOCAL	274+20	218+89
BMT	R	3	POCKET BROAD ST	263+55	254+12
BMT	R	3	S/O CHAMBERS ST	221+21	218+89
BMT	R	4	POCKET BROAD ST	263+55	255+83
BMT	R	4	S/O CHAMBERS ST	227+90	218+89

▲ Hidden char in track name

S/E = South End
N/E = North End

APPENDIX B - NYCTA TRACK DESIGNATIONS

DIV	LINE	TRACK	DESCRIPTION	S/E Sta#	N/E Sta#
BMT	CI	1	TO OUTER LOOP	17+50	
BMT	CI	1	TO OUTER LOOP	29+70	6+78
BMT	CI	1	OUTER LP	39+11	17+20
BMT	CI	2	INNER LP	31+86	24+75
BMT	CI	2	LAY-UP TK	31+86	24+10
BMT	CI	3	LAY-UP TK	28+95	16+49
BMT	CI	4	LAY-UP TK	32+18	22+42
BMT	CI	5	LAY-UP TK	32+80	21+81
BMT	CI	6	LAY-UP TK	33+06	21+07
BMT	CI	7	LAY-UP TK	33+27	20+14
BMT	CI	8	LAY-UP TK	33+40	19+50
BMT	CI	9	LAY-UP TK	33+50	15+62
BMT	CI	10	LAY-UP TK	33+64	18+78
BMT	CI	11	LAY-UP TK	33+77	18+18
BMT	CI	12	LAY-UP TK	33+88	17+52
BMT	CI	13	LAY-UP TK	33+95	16+86
BMT	CI	14	YARD LEAD	34+03	16+20
BMT	CI	15	YARD LEAD	21+14	14+26
BMT	CI	16	LAY-UP TK	24+10	14+26
BMT	CI	17	LAY-UP TK	21+41	13+82
BMT	CI	18	LAY-UP TK	22+60	15+06
BMT	CI	19	LAY-UP TK	23+31	14+43
BMT	CI	20	LAY-UP TK	22+32	12+50
BMT	CI	21	LAY-UP TK	24+10	14+28
BMT	CI	22	LAY-UP TK	26+93	13+80
BMT	CI	24A	INSP SHED	22+22	13+12
BMT	CI	25A	INSP SHED	20+24	9+76
BMT	CI	26A	INSP SHED	23+36	11+15
BMT	CI	27	INSP SHED	20+62	10+48
BMT	CI	28	INSP SHED	21+63	9+40
BMT	CI	29	INSP SHED	22+80	10+65
BMT	CI	30	INSP SHED	20+98	11+51
BMT	CI	31	LAY-UP TK	21+60	8+80
BMT	CI	32	CAR SHOP	23+45	10+42
BMT	CI	33	CAR SHOP	21+50	6+78
BMT	CI	34	CAR SHOP	24+75	17+36
BMT	CI	35	WHEEL+AXL	11+60	8+76
BMT	CI	36	WHEEL+AXL	22+60	9+43
BMT	CI	37	WHEEL+AXL	22+10	17+11
BMT	CI	38	WHEEL+AXL	23+79	17+11
BMT	CI	39	WHEEL+AXL	21+92	17+11
BMT	CI	40	WHEEL+AXL	22+41	17+11
BMT	CI	41	WHEEL+AXL	21+32	10+00
BMT	CI	42	WHEEL+AXL	21+87	17+11
BMT	CI	43	WHEEL+AXL	20+74	17+11
BMT	CI	44	WHEEL+AXL	21+32	17+11
BMT	CI	45	WHEEL+AXL	20+69	17+11
BMT	CI	46	TRUCK SHP	24+75	17+11
BMT	CI	47	NEW LAY-UP (HT)	25+44	17+11
BMT	CI	48	NEW LAY-UP (HT)	24+34	17+84
					17+70

▲ Hidden char in track name S/E = South End
N/E = North End

DIV	LINE	TRACK	DESCRIPTION	S/E Sta#	N/E Sta#
BMT	CI	A14	CARWASH TO LOOP	33+93	27-
BMT	CI	A15	MAINL N/B TO LP	41+00	31+
BMT	CI	A16	CAR WASH TK	35+43	17+
BMT	CI	A17	TO 'A' TRACKS	18+80	16+
BMT	CI	A18	CAR WASH SPUR	17+85	10+
BMT	38	2	LAY-UP TK	22+69	17+
BMT	38	3	LAY-UP TK	19+99	16+
BMT	38	4	LAY-UP TK	21+03	17+
BMT	38	5	LAY-UP TK	27+71	18+
BMT	38	6	LAY-UP TK	23+67	22+
BMT	38	7	LAY-UP TK	24+44	16+
BMT	38	8	LAY-UP TK	20+42	12+
BMT	38	11	LAY-UP TK	22+40	13+
BMT	38	12	LAY-UP TK	23+06	13+
BMT	38	13	LAY-UP TK	23+80	14+
BMT	38	14	LAY-UP TK	22+50	14+
BMT	38	15	LAY-UP TK	22+63	14+
BMT	38	16	LAY-UP TK	21+88	14+
BMT	38	17	LAY-UP TK	21+96	15+
BMT	38	18	LAY-UP TK	21+29	15+
BMT	38	19	LAY-UP TK	20+67	15+
BMT	38	20	LAY-UP TK	23+30	16+
BMT	38	21	LAY-UP TK	25+47	16+
BMT	38	22	LAY-UP TK	27+56	10+
BMT	38	23	LAY-UP TK	18+79	16+
BMT	38	26	LAY-UP TK	23+54	12+
BMT	38	27	LAY-UP TK	55+31	25+
BMT	38	28	LAY-UP TK	55+31	48+
BMT	38	29	LAY-UP TK	46+84	28+
BMT	38	30	LAY-UP TK	29+22	25+
BMT	38	31	LAY-UP TK	40+98	36+
BMT	38	32	LAY-UP TK	39+74	27+
BMT	38	33	LAY-UP TK	39+14	36+
BMT	38	34	LAY-UP TK	39+14	37+
BMT	38	35	LAY-UP TK	44+33	40+
BMT	38	36	LAY-UP TK	46+15	40+
BMT	38	10	LAY-UP TK	21+75	13+
BMT	38	9	LAY-UP TK	21+09	13+
BMT	38	C2	YARD LEAD	48+95	42+
BMT	38	Y1	YARD LEAD	31+99	27+
BMT	38	Y2	YARD LEAD	31+98	24+
BMT	DO	1	INSP SHED	350+60	347+
BMT	DO	3	INSP SHED	351+39	350+
BMT	DO	4	INSP SHED	351+38	350+
BMT	DO	5	INSP SHED	351+25	349+
BMT	DO	6	INSP SHED	351+25	350+
BMT	DO	7	INSP SHED	351+02	348+
BMT	DO	8	INSP SHED	351+01	350+
BMT	DO	9	INSP SHED	350+94	349+
BMT	DO	10	INSP SHED	350+74	350+

▲ Hidden char in track name S/E = South E
N/E = North E

APPENDIX B - NYCTA TRACK DESIGNATION

DIV	LINE	TRACK	DESCRIPTION	S/E Sta#
BMT	ST	YA1	YARD LEAD	
BMT	ST	YA2	YARD LEAD	9+80
BMT	ST	YA3	YARD LEAD	6+00
BMT	ST	YA4	YARD LEAD	4+53
BMT	ST	YB2	YARD LEAD	1+09
BMT	ST	YB3	YARD LEAD	9+48
BMT	ST	YB4	YARD LEAD	7+38
BMT	ST	YB5	YARD LEAD	4+56
			YARD LEAD	1+00

▲ Hidden char in track name S/E =
N/E =

APPENDIX B - NYCTA TRACK DESIGNATIONS

DIV	LINE	TRACK	DESCRIPTION	S/E Sta#	N/E Sta#
IND	A	1	S/B LCL (MANH)	892+02	1439+10
IND	A	1	S/B LCL (BKLYN)	412+04	787+58
IND	A	2	N/B LCL (MANH)	892+00	1439+10
IND	A	2	N/B LCL (BKLYN)	411+49	787+58
IND	A	3	S/B EXP	411+49	1541+18
IND	A	4	N/B EXP	411+49	1541+18
IND	A	5	M PKT S/O UTICA	593+68	602+40
IND	A	5	N PKT N/O WASH'TN	717+75	726+54
IND	A	5	P TO PITKIN	415+27	424+13
IND	A	5	Q PKT @CHAMBERS	906+15	915+40
IND	A	5	R S/O 34TH ST STA	1032+01	1051+10
IND	A	5	S N/O 72nd ST STA	1157+04	1168+87
IND	A	5	T TO 207 ST YARD	1509+13	1548+30
IND	A	5	V POCKET 135TH ST	1307+39	1332+05
IND	A	5	W POCKET 175TH ST	1436+12	1439+10
IND	A	6	P TO PITKIN	415+27	425+05
IND	A	6	S PKT N/O 72 ST	1157+04	1168+87
IND	A	6	T TO 207 ST YARD	1509+13	1548+30
IND	A	6	V POCKET 135TH ST	1307+32	1332+06
IND	A	6	W POCKET 175TH ST	1432+00	1439+10
IND	A	7	T TO 207 ST YARD	1540+17	1545+67
IND	A	7	W POCKET 175TH ST	1430+60	1439+10
IND	B	1	S/B LCL	324+50	1089+32
IND	B	2	N/B LCL	316+35	1089+45
IND	B	3	S/B EXP (MANH)	877+51	1110+90
IND	B	3	S/B EXP (BKLYN)	534+42	769+79
IND	B	4	N/B EXP (MANH)	877+51	1110+90
IND	B	4	N/B EXP (BKLYN)	533+29	769+79
IND	B	3/4	MIDDLE (BKLYN)	353+89	533+29
IND	B	5	N/B-57 ST	1075+45	1096+84
IND	B	5	X AVE X YARD LEAD	342+07	353+89
IND	B	5	C CHURCH AVE YARD	540+50	555+80
IND	B	5	M POCKET SMITH-9TH	694+05	702+49
IND	B	5	S POCKET 2nd AVE	897+98	914+10
IND	B	6	S/B-57 ST	1075+84	1096+84
IND	B	6	X AVE X YARD LEAD	344+40	353+01
IND	B	6	C CHURCH AVE YARD	540+50	555+80
IND	B	6	S POCKET 2nd AVE	897+98	912+93
IND	B	C1	TO BMT-A LINE	310+48	324+50
IND	B	C2	TO BMT-A LINE	310+48	316+35
IND	B	AB1	TO IND-A W.4TH	952+06	958+00
IND	B	AB2	TO IND-A W.4TH	952+53	958+18
IND	B	7	C CHURCH AVE YARD	540+50	550+67
IND	B	8	C CHURCH AVE YARD	540+50	550+67
IND	BJ	1	S/B TO BMT-J	889+15	915+10
IND	BJ	2	N/B TO BMT-J	895+68	921+00
IND	C	1	S/B LOCAL	1339+27	1667+51
IND	C	2	N/B LOCAL	1335+78	1667+51
IND	C	3/4	MIDDLE	1333+27	1608+81
IND	C	3	BEDFORD PARK	1608+81	1617+37

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N/E = North End

APPENDIX B - NYCTA TRACK DESIGNATIONS

DIV	LINE	TRACK	DESCRIPTION	S/E Sta#	N/E Sta#
IND	AT	4	CAR SHOP		
IND	AT	5	CAR SHOP	3+81	
IND	AT	6	CAR SHOP	3+01	7+68
IND	AT	7	CAR SHOP	2+69	7+67
IND	AT	8	CAR SHOP	3+32	19+64
IND	AT	9	CAR SHOP	4+01	7+76
IND	AT	10	CAR SHOP	2+13	7+83
IND	AT	11	CAR SHOP	4+60	7+84
IND	AT	12	CAR SHOP	2+57	7+94
IND	AT	13	CAR SHOP	3+48	7+98
IND	AT	14	CAR SHOP	1+56	8+07
IND	AT	15	TRAIN HS2	4+78	8+18
IND	AT	16	PAINT SHP	6+09	7+92
IND	AT	17	PAINT SHP	5+41	7+43
IND	AT	18	PAINT SHP	2+61	7+43
IND	AT	19	INSP SHED	4+75	7+48
IND	AT	20	INSP SHED	7+21	18+30
IND	AT	21	INSP SHED	6+52	17+36
IND	AT	22	INSP SHED	5+93	17+70
IND	AT	23	INSP SHED	5+34	16+96
IND	AT	24	INSP SHED	7+44	17+04
IND	AT	25	LAY-UP TK	8+62	21+47
IND	AT	26	LAY-UP TK	5+68	20+14
IND	AT	27	LAY-UP TK	8+09	20+34
IND	AT	28	LAY-UP TK	8+09	20+26
IND	AT	29	LAY-UP TK	7+42	20+68
IND	AT	30	LAY-UP TK	6+83	20+79
IND	AT	31	LAY-UP TK	6+89	20+97
IND	AT	32	LAY-UP TK	8+84	21+29
IND	AT	33	LAY-UP TK	8+16	21+36
IND	AT	34	LAY-UP TK	7+57	21+57
IND	AT	35	LAY-UP TK	7+59	21+66
IND	AT	36	LAY-UP TK	9+54	21+57
IND	AT	37	LAY-UP TK	8+85	21+58
IND	AT	38	LAY-UP TK	8+23	22+38
IND	AT	39	LAY-UP TK	10+15	22+37
IND	AT	40	LAY-UP TK	10+15	22+42
IND	AT	41	LAY-UP TK	9+46	22+40
IND	AT	42	LAY-UP TK	8+86	22+40
IND	AT	43	LAY-UP TK	8+61	22+39
IND	AT	44	LAY-UP TK	10+53	22+23
IND	AT	45	LAY-UP TK	9+84	22+20
IND	AT	46	LAY-UP TK	9+24	22+16
IND	AT	47	LAY-UP TK	9+26	22+13
IND	AT	48	LAY-UP TK	11+17	22+09
IND	AT	49	LAY-UP TK	10+48	22+07
IND	AT	50	LAY-UP TK	9+90	21+97
IND	AT	51	LAY-UP TK	9+95	21+94
IND	AT	52	LAY-UP TK	11+86	21+92
IND	AT	53	LAY-UP TK	11+19	21+78
			LAY-UP TK	10+58	21+56
					21+28

* Hidden char in track name

S/E = South End
N/E = North End

APPENDIX B - NYCTA TRACK DESIGNATIONS

DIV	LINE	TRACK	DESCRIPTION	S/E Sta#	N/E Sta#
IND	DJ	55	LAY-UP TK	19+24	28+08
IND	DJ	56	LAY-UP TK	19+92	28+07
IND	DJ	57	LAY-UP TK	14+20	28+07
IND	DJ	58	LAY-UP TK	19+45	28+02
IND	DJ	59	LAY-UP TK	20+14	28+03
IND	DJ	60	LAY-UP TK	18+79	28+17
IND	DJ	61	LAY-UP TK	20+40	28+18
IND	DJ	62	LAY-UP TK	19+75	28+09
IND	DJ	63	LAY-UP TK	18+09	28+02
IND	DJ	64	LAY-UP TK	20+65	28+15
IND	DJ	65	LAY-UP TK	21+33	28+01
IND	DJ	66	LAY-UP TK	19+84	27+79
IND	DJ	67	LAY-UP TK	21+44	27+60
IND	DJ	68	LAY-UP TK	20+65	26+95
IND	DJ	69	LAY-UP TK	20+65	33+00
IND	FR	5	LAY-UP TK	861+59	852+58
IND	FR	6	LAY-UP TK	861+59	848+65
IND	FR	7	LAY-UP TK	861+59	850+70
IND	FR	8	LAY-UP TK	861+59	851+38
IND	FR	9	LAY-UP TK	861+59	852+06
IND	FR	10	LAY-UP TK	861+59	852+74
IND	FR	11	LAY-UP TK	861+59	853+38
IND	FR	12	LAY-UP TK	861+59	854+04

▲ Hidden char in track name

S/E = South End
N/E = North End

APPENDIX C

NEW INFORMATION SYSTEM INITIATIVE -
TRACK INFORMATION PLANNING SYSTEM

NEW INFORMATION SYSTEM INITIATIVE

ISP NUMBER _____ PAGE: 1
(ISD Use Only!)

PROJECT NAME: Track Information Planning System

> NEW YORK CITY TRANSIT AUTHORITY
 > PRC#: _____
 > (ISD Use Only!)
 > Requesting Department: Track Date Prepared: April 13, 1992
 > Client Department Contact: R. Hughes Phone: (718) 330-3877
 > TA Responsibility Center: 2803 Proposed Start: 1/01/93 Proposed Completion: _____
 > _____
 > _____

> SCHEDULED FOR MTA AUDIT COMMITTEE
 > _____ Month _____ Year _____
 > (ISD Use Only!)
 > FUNDING: X Operating Year 1993 Reimbursable _____ Non Reimbursable X
 > _____ Capital Project Number _____
 > _____
 > _____

APPROVALS REQUIRED	Y/N	APPROVAL SIGNATURE	DATE	PRIORITIZE
Requestor (Dept Head)	_____	_____	_____	_____
V.P. - ISD	_____	_____	_____	_____
Sr. V.P. - Oper Support	_____	_____	_____	_____
MTA Director - ISTP	_____	_____	_____	_____
Other _____	_____	_____	_____	_____

(ISD Use Only!)

PROJECT NAME: Track Information Planning System**Purpose and Scope:**

To implement a Track Information Planning System (TIPS) at Track's Jay Street headquarters and field offices. This system will improve the planning and control of track construction and maintenance jobs. It will also pave the way for the Authority's eventual move away from minicomputers to client-server architectures.

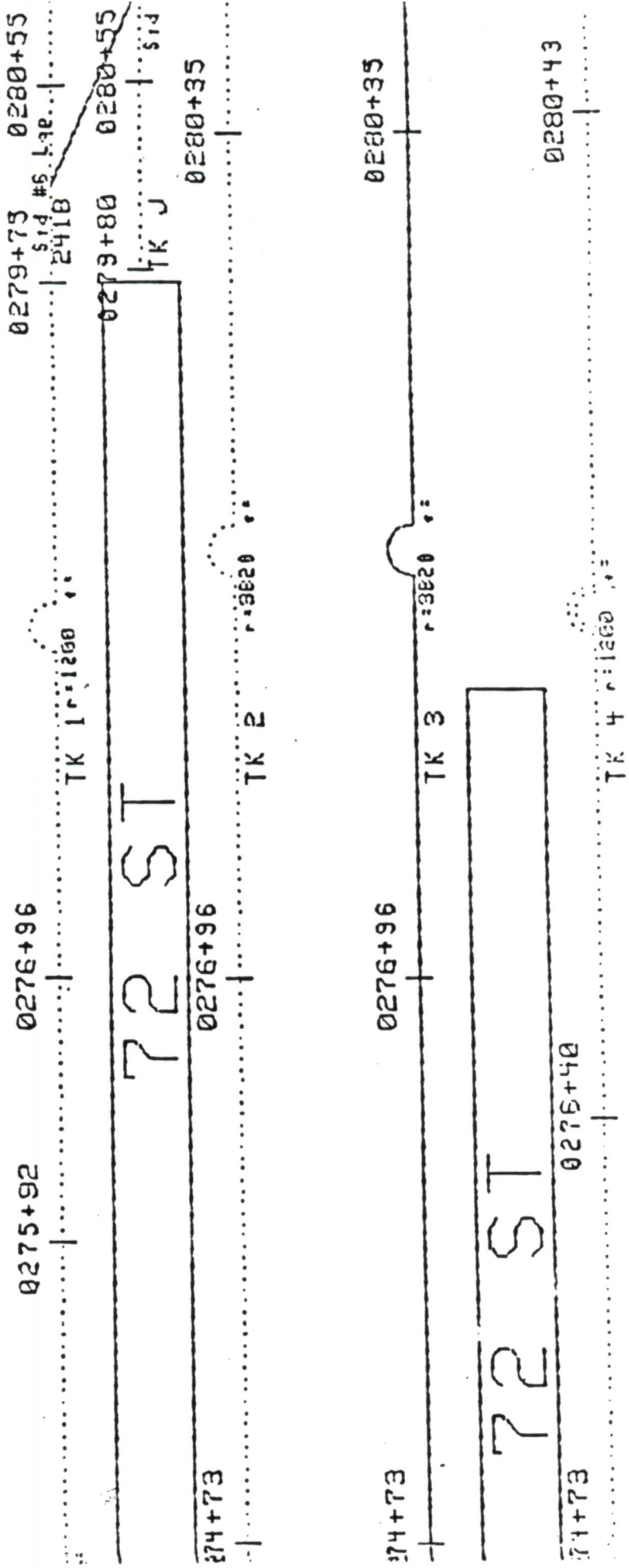
Goals:

- o To enable Track offices both at Jay Street and in the field to monitor all aspects of a track project and to update the information they control. So, for example, the material ordering office could check to see which switch design drawings were completed by the engineers so that parts could be ordered.
- o To give each office access to current data on track inventory, condition, and predicted life cycles. This data would be available for display, for ad hoc analyses, or for computer generated track drawings, as shown in Figures A and B.
- o To link Track offices to the Authority wide electronic mail system. Email currently gets only minor usage in the Division of Track because only offices at Jay Street are on the network. Email's speed, flexibility, and ability to confirm deliveries promise to make it a powerful communication tool for Track.
- o To prepare for the eventual retirement of the IBM System 38 and Wang VS minicomputers. Track uses two major applications on System 38D and one smaller application on Rapid Transit's VS-7310. This project sets up the hardware and communications to replace 80% of the System 38 terminals and 100% of the VS terminals. Future projects would be needed to migrate the software for these applications.

IRT-B

BOWAY-7 AVE LINE

North --->



SOLID LINE INDICATES: Components ; Reconstruction 01/1524 TO 12/2099

PROJECT NAME: Track Information Planning System

>Project Team Organization:
(Insert Organization chart, if available)

>Project Manager: R. Hughes
Title: Manager, Planning and Information Systems

>Project Organization:

>Project Manager
Reports to: T. Sammon, Director of Planning
Reports to: H. Klaus, Engineering Officer
Reports to: F. Smith, Chief Engineer, Div. of Track
Reports to: T. F. Prendergast, Senior Vice President, Rapid Transit

>LAN Administrators:

>370 Jay Street J. Tawil
>Hoyt-Schermerhorn S. Rumala
>38th Street Yard P. Shah
>14th St/6th Ave K. Charles
>Linden Shop J. Chackochen (Work Train System)

>The system will be implemented by the project manager and staff. This team
>team has over 15 person-years experience developing TIPS and is installing two
>Novell LANs this year similar to those proposed.

PROJECT NAME: Track Information Planning System

Project Description:

This project will link 85 existing PCs and four new ones together in a set of Local Area Networks (LANs) at 370 Jay Street and three remote locations to be bridged together with high speed communications. Figure C shows the proposed network configuration. Figure C also shows an additional LAN at Linden Shop as part of the 1992 Work Train Manifest System, which will be bridged to the other LANs as part of the proposed project.

A primary function of the LAN network is to support the TIPS application. TIPS is a custom written PC database system that has been under development since 1983 and in general use in Track since 1987 (on standalone PCs). The features of TIPS are described in the "Background" section. TIPS is being rewritten to work as a client-server application. Presently, all parts of the program dealing with track switches are working in the new environment. The other portions of TIPS are being converted, but as they are not yet ready, they will not be used for project justification. The network will also be used for standard DOS applications like Lotus 123 and Harvard Graphics. Users will have the additional capability of being able to share their workfiles. For example, two budget analysts may be working on different columns of the same spreadsheet without conflict.

Another function of the network will be to provide access to other computers. Gateways will be added to connect to the MTA's IBM mainframe and to the System 38. Although the System 38 will eventually be phased out, two important applications are expected to remain for the next several years. The investment in System 38 gateway hardware pays for itself in the elimination of data lines to the four field LAN sites.

Electronic mail will be the last function to be added to the network. At the present time, there is no email package which satisfactorily interfaces with the Authority's Wang Office system, but compatibility is coming later this year according to the trade journals. Not taking this as accurate, we will give the industry another two years after their predicted date to come up with an acceptable product.

A half dozen field locations are too small to warrant their own LANs and high speed communications to Jay Street. Remote communications at 9600 baud will be available for these sites, but not all the functionality or speed of the network will be available. We consider this an interim solution, and hope to remedy it by the time Track moves off the System 38. Several steps were taken to minimize the investment in this area while still providing a vital link to these offices. Line charges are avoided by making use of existing fax lines at each site. And the remote communications central site hardware will make use of equipment purchased for the Work Train Manifest System.

All LAN purchases in this proposal will conform to ISD's specifications, i.e., Novell 386 token ring using shielded twisted pair cable.

NEW INFORMATION SYSTEM INITIATIVE

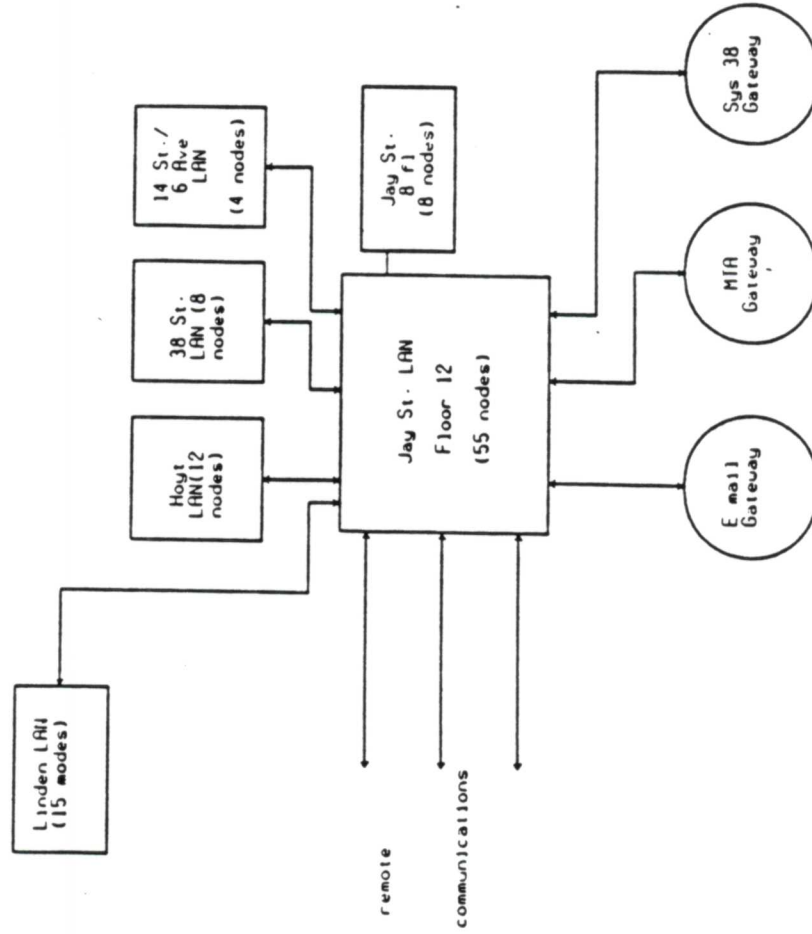
ISP NUMBER _____ PAGE: 4A
(ISD Use Only!)

PROJECT NAME: _____ Track Information Planning System

Project Description: (continued)

One full time position is allocated for implemented of this project over its 2.5 year life span. Actually, it is envisioned that 3-4 persons will contribute, with a combined time commitment adding up to one full time position. No quota has been allocated for LAN administration. This does not mean we think this job will not require staff time, but rather that the added burden of LAN administration will be equally offset by greater staff productivity in other areas which the LANs will make possible.

FIGURE C - TIPS NETWORK CONFIGURATION



PROJECT NAME: Track Information Planning System**Background (including industry experience):**

Track construction/maintenance planning is a process that requires a complex interaction between many offices, some of which are in remote field locations. Figure D illustrates this by showing the steps from inception to final closeout for typical track jobs such as switch renewal, panel installation, welded rail, and ballasted to concrete roadbed (Type I-II) conversion. Although the participating offices all have PCs, communication between locations is limited to the traditional technologies of phone, interoffice mail, and more recently, fax. If a network linked these PCs, making shared databases and electronic mail possible, the planning process would be strengthened.

The TA has been developing PC based track planning analysis tools starting in 1983 with the Track Engineering Database (TED). Since then, track degradation analysis and track chart (CAD) modules have been added. Figure E shows how these programs and others fit into the history of track computer systems development at the TA. TIPS (TED) has been in general use since 1987 on standalone PCs. Important features include:

- o use of a standard track naming convention that allows the user to identify any location on the railroad to within one foot and which is consistent with nomenclature used in the field and by other departments.
- o Lengths of track are broken into devices based on track geometry.
- o flexible query, reporting and sorting functions
- o track charts and line maps produced with CAD technology (Figures A & B)
- o interface with TEMPP program to predict track component life cycles and calculate estimated replacement needs

In 1990, an effort was started to adapt Track's computer systems to a network client-server environment. To date, the software needed for planning switch renewals is complete and was tested using the Wang IWSORE pseudo LAN. The system awaits only a production network on which it can run. The parts of the system for non-switch track planning are in development and can be expected later.

FIGURE D - TRACK PROJECT WORK FLOW

LEAD TIME

2 years (switches)

3-6 months (non-switch)

18 months

2 months

5 weeks

2-4 weeks

OFFICE RESPONSIBLE

Field Support

Supply

Cost Accounting

Program Forecasting

Interdepartmental G.O. meeting

Linden Shop (various offices)

Track Construction Div.
-or-
Track Maintenance Div.
-or-
Contractor

Inspection Standards

Chief Engineer's office

Cost Accounting

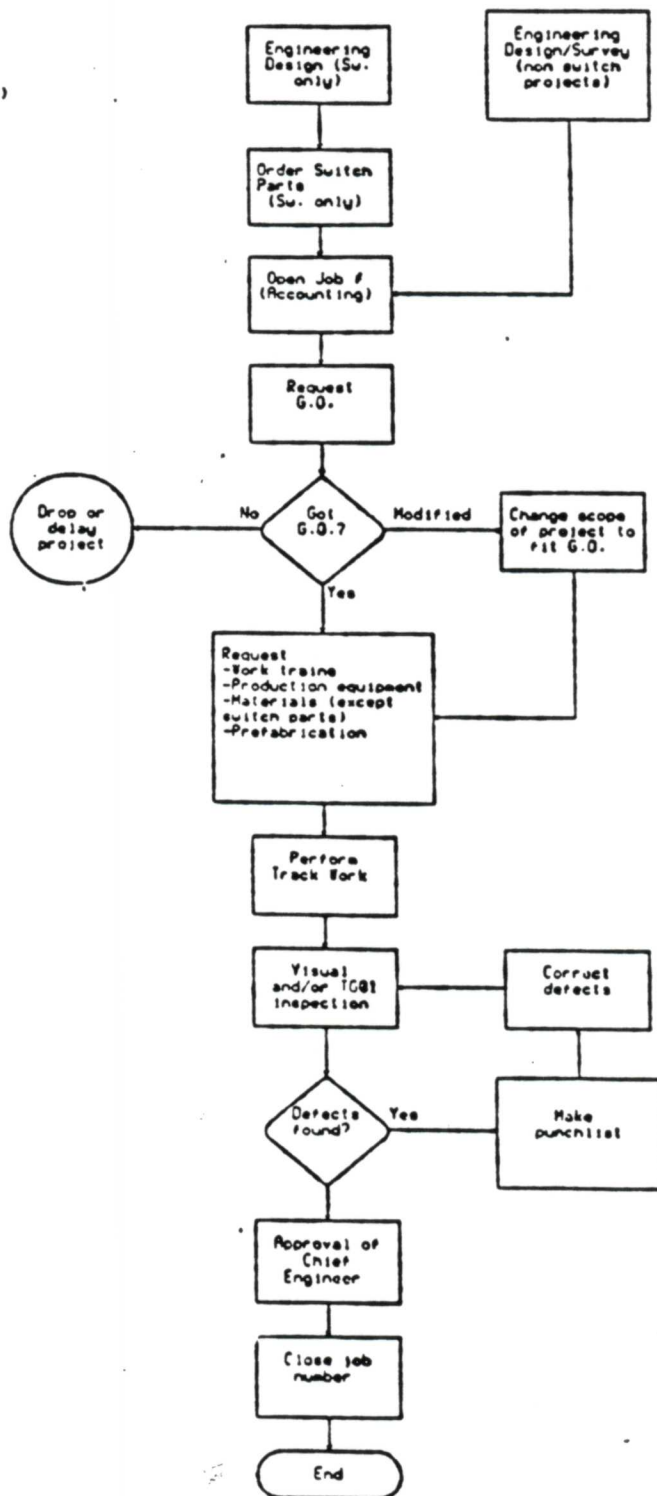


FIGURE D

TRACK COMPUTER SYSTEMS HISTORY

1975

1980

1985

1990

1995

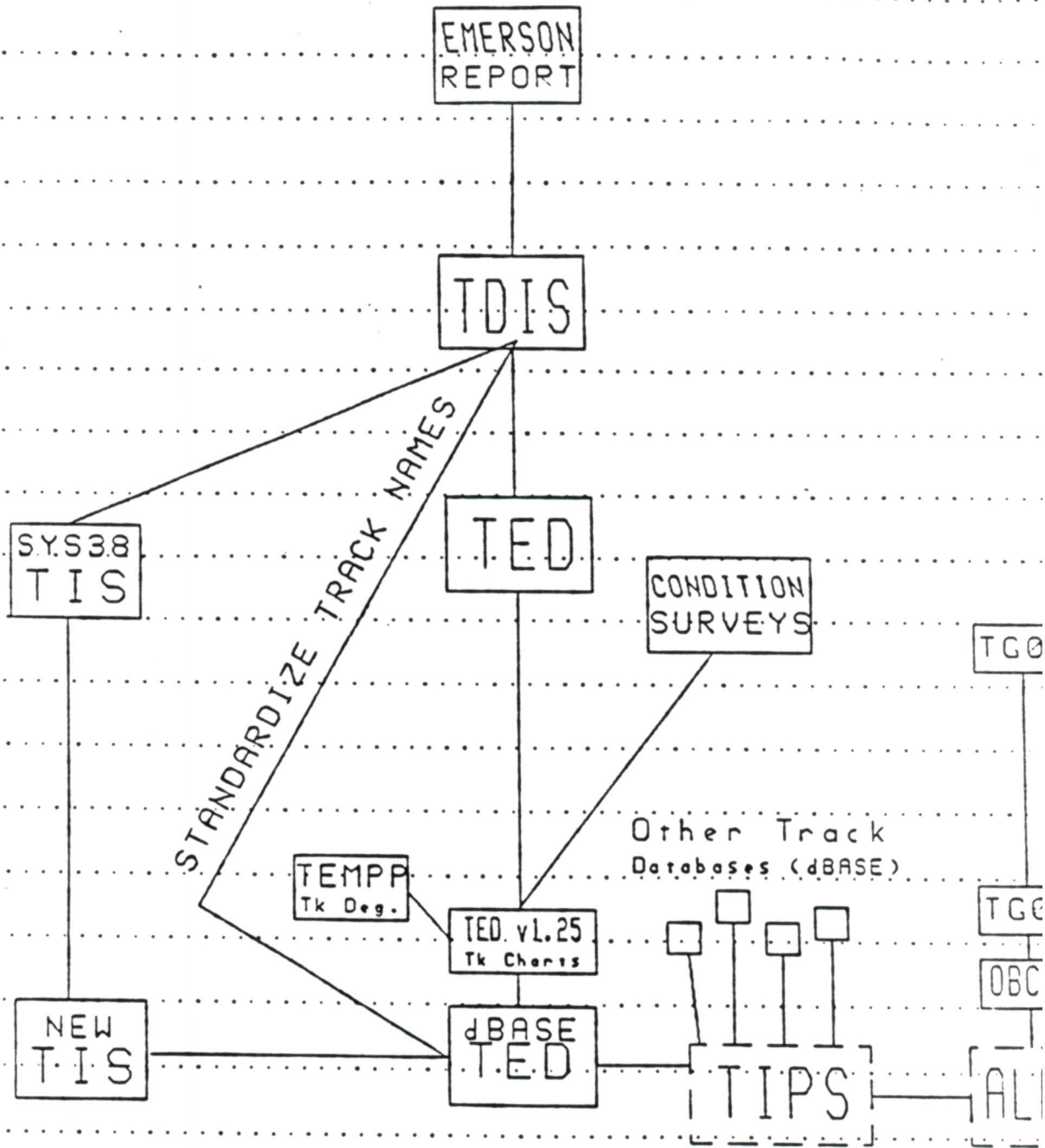


FIGURE E

NEW INFORMATION SYSTEM INITIATIVE

PROJECT NAME: Track Information Planning System

Quantifiable Benefits
 \$000s

Identify Quantifiable Benefits which can be committed and measured by the categories identified below over a five year time horizon.

	1998	1999	2000	2001	2002	Five Yr Total
COST REDUCTION (identify specific areas of cost reduction)						
<u>Increased switch life</u> (based on 2 fewer switch renewals per year)	1269	1333	1399	1469	1543	7013
<u>Removal of 5 S/38 lines</u>	9	9	10	10	11	(*)73

COST AVOIDANCE (identify specific areas of cost avoidance)

Headcount (cumulative)
 \$ Value

Headcount (cumulative)
 \$ Value

PRODUCTIVITY (identify specific areas of productivity gains)

Headcount (cumulative)
 \$ Value

Headcount (cumulative)
 \$ Value

REVENUE GENERATION (identify specific areas of revenue generation)

\$ Value

\$ Value

NEW INFORMATION SYSTEM INITIATIVE

PROJECT NAME: Track Information Planning System

Explanation of Quantifiable Benefits:

The major benefit to be gained by implementing TIPS is to increase the effective life cycle of track. Track life is the amount of time from the day a piece of track is built until the day it is replaced, and depends upon the track's location, amount of traffic it receives, the kind of maintenance it gets over the years, and other factors. Because of scheduling constraints and the inexactness of the planning process, many track components get replaced before they are fully worn, so the effective life cycle is less than what it could be. TIPS will improve the way the Track Division identifies segments for complete renewal or other maintenance actions. Given the size of the annual budget for track renewal, even a modest average increase in effective track life would produce substantial benefits.

TIPS has been completed and satisfactorily tested for switch renewal as of this time. Consequently, benefits will be quantified for increases in effective switch life only. Presently, the Authority is working down a backlog of overage mainline switches which will be eliminated in 1997. Therefore, the benefits of TIPS will first come into play with the mainline switches that come due for renewal after 1997. The average cost for renewing one mainline switch in 1991 was \$451,000. This figure includes labor, materials, and support costs (such as the cost of diverting service). The average switch life used by Track for estimating budget needs is 30 years. We believe that with TIPS, that average can be extended to 31 years. This means two fewer switches would need to be renewed each year after 1997 in order to maintain a state of good repair. This is how the figures under the "cost reduction" heading are calculated. Each number is derived by multiplying the switch renewal cost by two and adding inflation. Note that the years above the benefit figures start with 1998. We have expanded the overall project life to 10 years, from 1993 to 2002.

A minor benefit is the elimination of five System 38 data lines, costing \$108 each in monthly rental. Note that although these cost reductions are shown on page 6 only for the years 1998 to 2002, the savings below are also taken into account.

1995	\$8000
1996	\$8000
1997	\$8000

NEW INFORMATION SYSTEM INITIATIVE

PROJECT NAME: Track Information Planning System

**Costs
\$000s**

Identify All Costs Associated with the
 New Initiative over a Five Year time Horizon

	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997-</u> <u>2002</u>	<u>Ten Yr</u> <u>Total</u>
Agency Staff						
Headcount	1	1	.5			2.5
\$ Value	61	61	30.5			152.5
Hardware (identify):						
Servers, cabling, NICs, MAUs, comm. eq., PCs, monitors	92.8	125.6	2.	0	0	220.4
Hardware Maintenance	0	0	9	9	64.2	82.2
Software (identify):						
Network, Lotus, HG, DC, Wd Perf, Email	29.5	5	51	0	0	85.5
Software Maintenance						
Data Center impact (identify):						
Data Communications (identify):						
Install 4 x 56 KB lines	0	5.5	0	0	0	5.5
Data Communications Maintenance	0	0	10.6	22.2	158.6	191.4
Consultants/Professional Services						
Other:						
Novell Training	6	6	0	0	0	12
Total Costs	189.3	203.1	103.1	31.2	222.8	749.5

PROJECT NAME: Track Information Planning System

Summary
 \$000s

Cost/Benefit

>	<u>TOTAL</u>	<u>COST RED.</u>	
>	Total Benefits \$ 7086		
>	Total Cost	749.5	
>	Net Benefit	\$ 6336.5	
>	(Cost)		

Using <u>7.8</u> % Cost of Capital	
<u>5</u> % Inflation Rate	<u>COST RED.</u>
<u>TOTAL</u>	
NPV \$ <u>3294</u>	
IRR <u>55%</u>	
Breakeven <u>67</u> months	

Other Benefits (Qualitative)

- o Benefits have been quantified only for switch renewal planning because that is the only area in which the application is already complete and tested. However, modules are under development for other types of work which should extend the effective life cycles for non-switch track components.
- o The establishment of the TIPS network puts Track in a position to move away from the IBM System 38 and Wang VS platforms toward the two-tier client server architecture espoused in ISD's Five Year Plan. After the TIP: network is in place, Track's two System 38 applications, Trackwalker Inspection System (TIS) and Automatic Timekeeping System (ATS), can both be migrated to the network with elimination of the 38's communication lines and operation costs justifying the software conversion that will be required.

PROJECT NAME: Track Information Planning System

Additional Considerations

Project Risk

Because technological risk can be the Achilles's heel of a project involving new software and/or networking, several risk minimizing steps were taken.

- o Software development was completed and tested prior to the submission of this proposal. Users have had several years of experience with the software on standalone PCs.
- o The project team has had over 15 person-years experience developing the application and has had Novell classroom training and installation experience.
- o Technological obsolescence is as serious a threat as technological failure nowadays. LAN technology is stable, appears in no danger of becoming obsolete soon. LANs represent the bulk of this project. WAN technology is not yet mature, so only a low-cost, temporary investment has been made. If a better WAN solution comes along within five years as is anticipated, only a small part of the investment will have been jeopardized.

Project Alternatives

- o Do nothing This is not recommended because none of the benefits will accrue, and because Track would be pushed into a position of having to pursue other non-standard computer solutions.
- o Partial Funding If only partial funding were available, one or two of the satellite LANs would be postponed and/or fewer nodes would be connected to the Jay Street LAN. However, these actions could increase total costs in the long run, because retrofitting the system is more expensive than initial installation. A partial system will be unable to fulfill its mission because it will only allow incomplete communication. Experience with our present email network shows that an incomplete system will not get much use.
- o Reordered Funding By stretching out the procurement of components, some costs could be delayed. But this would also lengthen system installation, thereby increasing the labor cost.

PROJECT NAME: Track Information Planning System

Procurement Schedule

Identify each Procurement associated with this New Initiative.

Procurement	Vendor (If Known)	Estimated Cost	Expected Month of Board Action
486 File server & 660 MB hard disk		\$10,000	
386 File server & 200 MB hard disk (3)		\$10,500	
Multiport Access unit (16)		\$ 9,600	
Token Ring Network Interface Card (95)		\$57,000	
Novell Netware (4)		\$13,500	
LAN Communications Equipment (var.)		\$65,820	
Uninterruptible Power Supply (5)		\$ 4,000	
LAN Application Software		\$21,000	
Personal Computer (4)		\$10,000	
Large CAD monitor (10)		\$10,000	
Email System for 102 Users		\$51,000	

NEW INFORMATION SYSTEM INITIATIVE: Track Info. Planning System

ISP NUMBER: _____ PAGE 12

PROJECT REVIEW CHECKLIST

ISP No. _____
Project Name: _____

INSTRUCTIONS:

PROJECT REVIEW CHECKLIST: read each item carefully and check those that are appropriate for your request. The Project Manager should sign and date this form.

Technology and System Issues

- Impact on Technical Environment
- Readiness of Technology Base
- Currency of Technology Base
- Fit to Agency's Strategy
- Complexity of Application or Technology
- Capacity Planning, Design Issues (including Data Center impact)
- Use of Industry Standards and Protocols
- Strategy Reviewed
- Software Strategy Reviewed
- Hardware Strategy Reviewed
- Agency Experience with the Technology or Application

Investment Analysis

- Alternatives Weighed and Analyzed (in-house, package, consulting, service,...) analyzed
- Thoroughness of Quantifiable Cost/Benefits Analysis
- Effectiveness of Cost/Benefit in stated time frames
- Appropriate Payback in consideration of quantitative benefits
- Shareable System or Coordinated Effort Reviewed
- GSA Pricing
- Use of Appropriated Cost of Capital, Inflation Rates
- Uses Existing Equipment and Software where appropriate
- Lease vs Buy Considered

Budget Issues

- Fully budgeted in ISP
- Approved by Agency IS/IT/Project Committee
- Changes from ISP (record)
- If Capital funded, approval attained from MTA Capital Staff
- Funding Source (Operating Budget, Capital Budget, UMTA,...)
- Disposition of Equipment to be replaced or retired
- Appropriateness of Maintenance

- Project Management and Control**
- Clearly Defined Areas of Responsibility
 - Adhere to Systems Development Life Cycle methodology
 - Results to Feasibility Analysis
 - Clearly Defined and Documented Requirements
 - Thoroughness & effectiveness of Project Plan including project checkpoints and critical path
 - Plans for Appropriate System Documentation
 - Plans for Adequate Training
 - Clearly Defined and Organized Scope
 - Clearly Defined Deliverables and Results

Risk and Success Issues

- Risk Assessed by Agency
- Availability of Required Skills to Maintain
- User Ownership and Executive Commitment
- User Commitment to Employing Technology Application
- Appropriate involvement of Agency MIS organization

Procurement Related

- Licensing and Negotiation Issues
- Competitiveness of Procurement Approach
- Alternative Sources of Supply
- Appropriateness of Third Party Maintenance Alternative
- Contract Termination Issues
- All Agency Guidelines Followed
- Procurement Schedules

Coordination

- Coordination with other Agencies considered fully
- Coordination with other Departments
 - Capital
 - Other

Project Presentation Issues: Audit Committee
 Tracking and monitoring requirements

Project Mgr. Signature: Boak Hughes

(ISD Use Only!)

PROJECT NAME: Track Information Planning System

Project Year	Budget Impact Summary (in thousands \$)			
	1993	1994	1995	1996
Requestor's Costs:	\$ 189.0	\$ 203.0	\$ 101.4	\$ 9.0
Information Services Division Costs:	\$ 0	\$ 5.5	\$ 10.6	\$ 22.2
TOTALS:	\$ 189.0	\$ 208.5	\$ 112.0	\$ 31.2

Requested Project Budget (Life Cycle of Project):
(in thousands \$)

User:	T.A. (Quota)	Labor	Material/Other	
			Expenses	Total
	(2.5)	\$ 152.5	\$ 400.1	\$ 552.6
ISD:	(0)	\$ 0	\$ 196.9	\$ 196.9
Total:	(2.5)	\$ 152.5	\$ 597.0	\$ 749.5