

Traffic Flow Analysis

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Operations is Fun



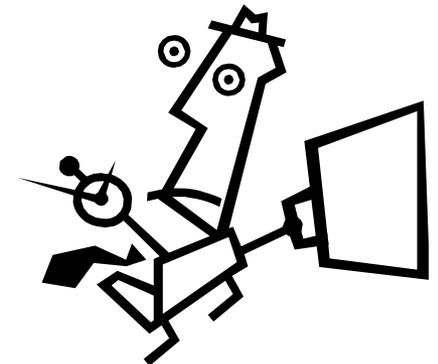
Operations is Fun

- But just as lack of good trackwork, bad equipment, lots of derailments can reduce the fun,
- So can bad traffic flow



Have you ever operated on a layout where:

- Every town is a switching puzzle?
- Sat in siding for two (real) hours waiting for traffic to clear to do switching?
- When you are cleared you have five (fast) minutes to work?
- Five trains are stacked up trying to get into the yard?



Old Ideals, New Ideas

- Paired Industries
- No more than one of something
- Point to Point (with yards at each end)
- Complete, self contained world
- On line to Off line
- Multiple copies (or big!)
- Might not even have a classification yard
- Interchanges
- Staging Tracks

Queues

- Not “Q”, but waiting lines
- Especially on a model railroad, “rolling stock” spends most of its time, well, not **rolling**!
- Distances are compressed, running times shortened.



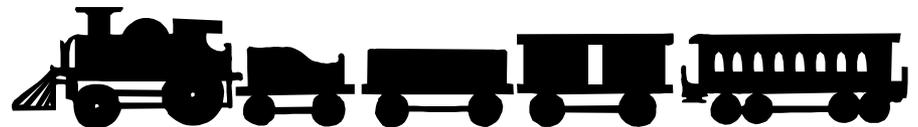


**Rolling stock
rolling !**

What our rolling stock really does

- waiting at an industry to be unloaded / loaded
- waiting at an interchange to be picked up
- waiting in a train on a staging track to enter
- waiting in the classification yard for the next train
- waiting on empty car tracks (home road cars)

- enroute on a train.



Rolling Stock not Rolling

- Out of 365 cars on the author's layout, at any given time, a maximum of four trains are in motion, average train length of 12 cars.
- 13% of rolling stock is rolling
- We need to manage the remaining 87% or we can't keep the traffic moving
- If the yard and other support tracks are choked full, we can't get rolling stock rolling

Basis for Siding Capacities

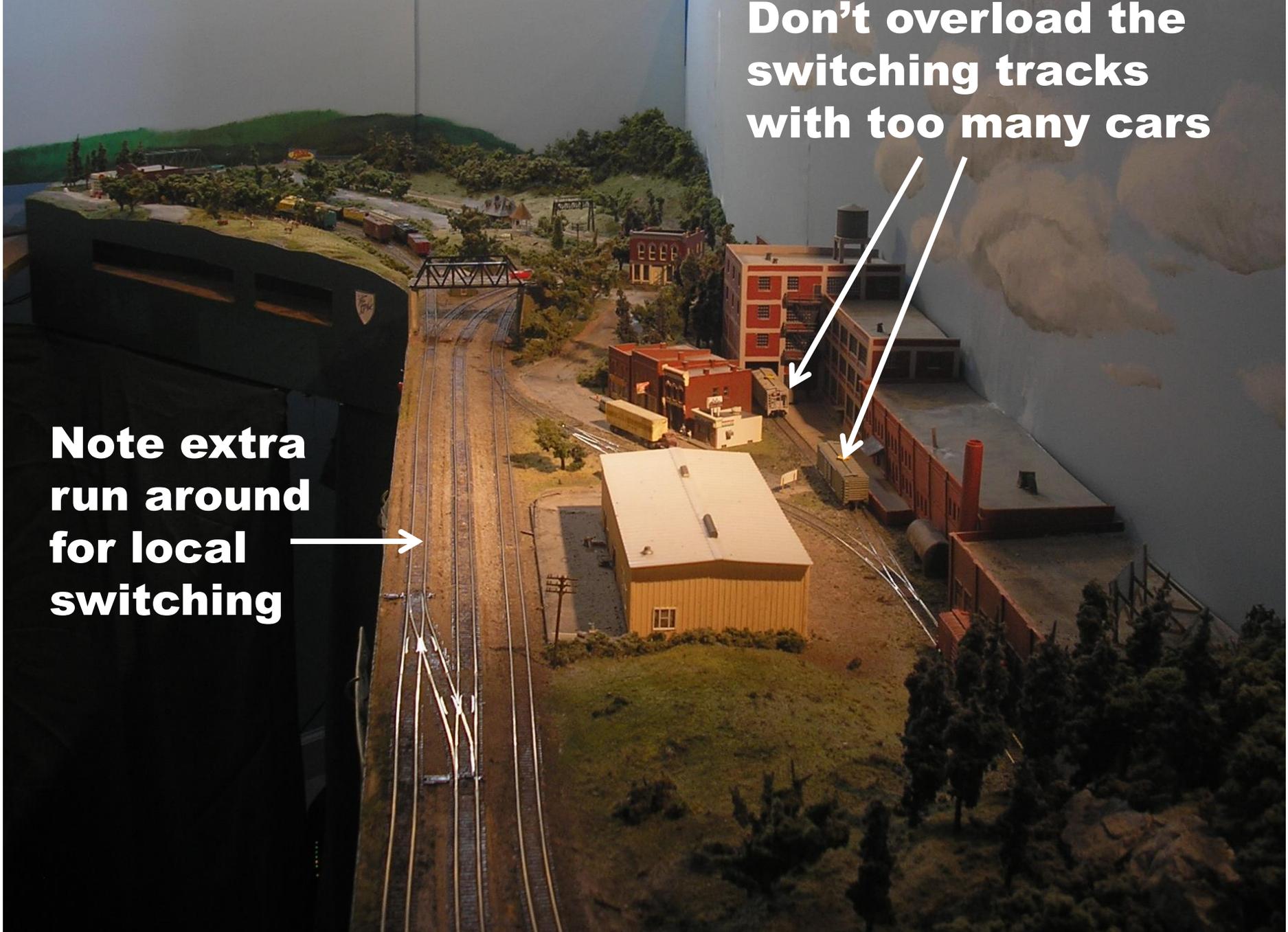
- Personal Experience
- When you have to do a lot of puzzle switching, it gets very difficult above 60% car loading
- If you are simply dropping a cut of cars in a siding, then 90% is no problem, the only issue is will you overflow the siding

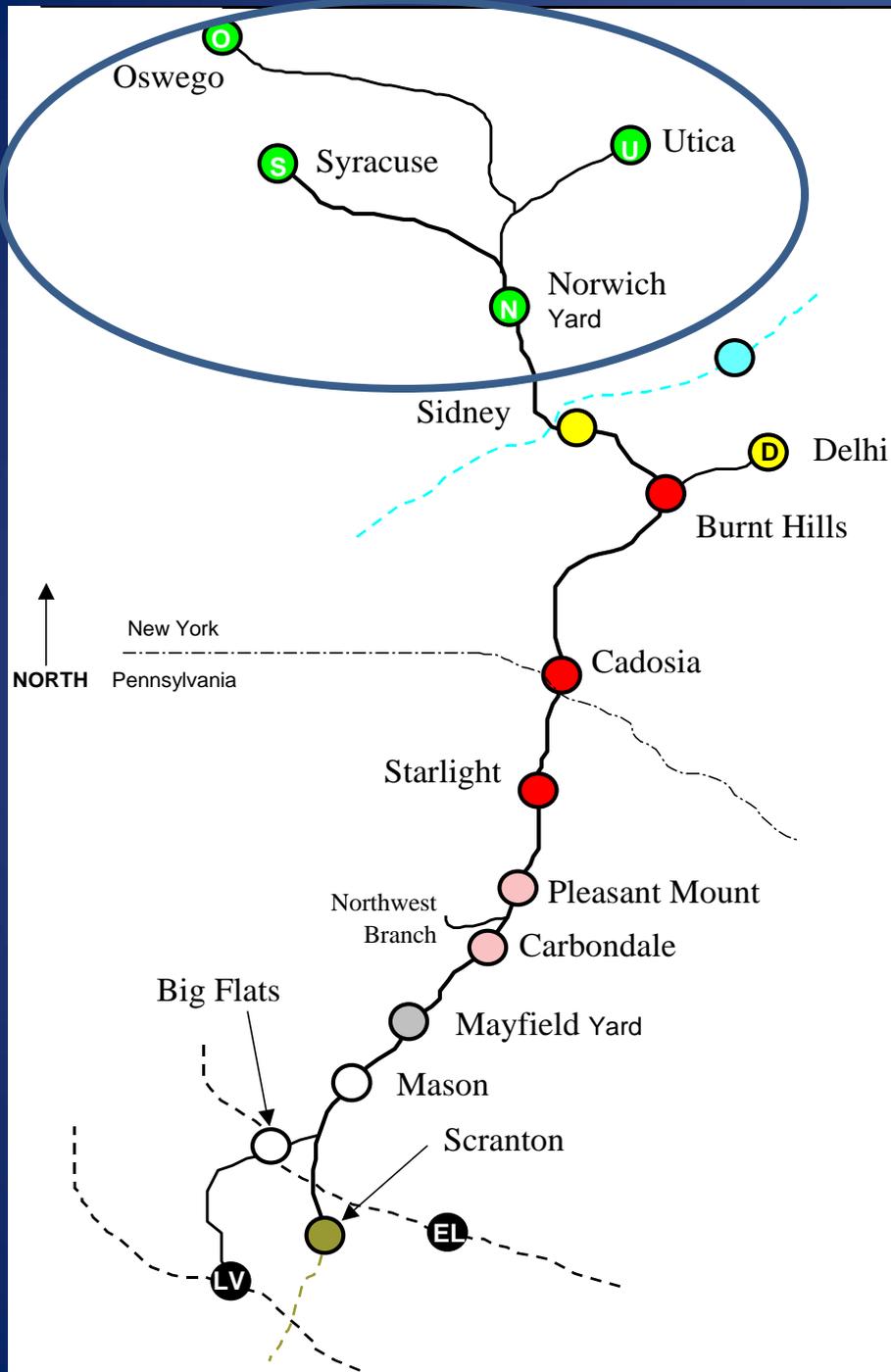
How many cars to have on the layout?

1. Industrial Trackage - 40 to 60% loading.
2. Interchange - 80 to 90% loading
3. Staging 80 to 90% loading at session start
4. Classification Yard - 30 to 60% loading
5. Empty Car Storage - 80% loading
6. Enroute trains at session start - 80% loading

Don't overload the switching tracks with too many cars

Note extra run around for local switching





“The rest of the
world”
5 track, two train
length stub ended
staging



Classification Yards

- On the average, 50% of the cars for any given train will be waiting in the yard
- The Yard is the most likely choke point on a model railroad
- Do everything you can to make the yard crew's life easier

Variability

- Operations Researchers use the “Poisson Distribution” to describe the motion and counts of independent items
- Similar to single car movements on a railroad
- The standard deviation of a Poisson variable is the square root of the average (this is a measure of the variability)
- 95% of results will be within 2 standard deviations of the average

Variability – Prototype

- Let's say a prototype train is 121 cars long on an average day. This means 95% of the time, the train will be between $121 + 2 \times \sqrt{121}$ cars long and $121 - 2 \times \sqrt{121}$ cars long
- That is, 99 to 143 cars long, or
- Plus or minus 20%

As NS traffic surges, service put to the test



<http://www.nscorp.com/content/nscorp/en/bizns/archives/Summer2014/as-ns-traffic-surgesserviceputtothetest.html>

Variability – Model

- Let's say a model train is 16 cars long on an average operating session. This means 95% of the operating sessions, the train will be between $16 + 2 \times \sqrt{16}$ cars long and $16 - 2 \times \sqrt{16}$ cars long
- That is, 8 to 24 cars long, or
- Plus or minus 50% (vs 20% for prototype)
- The modeler must account for much more variation in flow than the prototype

Classification Yards

- A classification yard is NOT a destination, only a waiting area
- Check expected capacity needed based upon the 50% rule
- 90% of the time there will be less than $X + 1.28$ times the square root of X cars in the yard if X is the average loading of the yard.



Burnt Hills



Station
Terminal
Train
PLAC
FAC
SUN
SUN

Mayfield & York
Coal Distribution

Trains Originating
At Mayfield & York

Trains Originating
At Mayfield & York

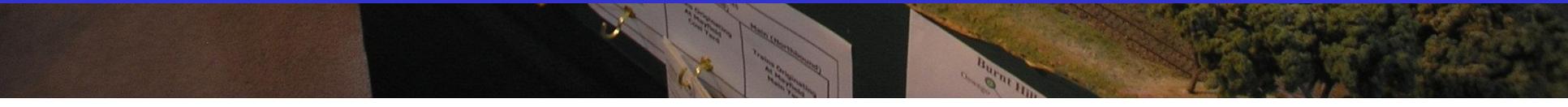


Informational text label on the right side of the display board.

This yard can be switched by two operators, one in the “pit” out of the way of the train crews.

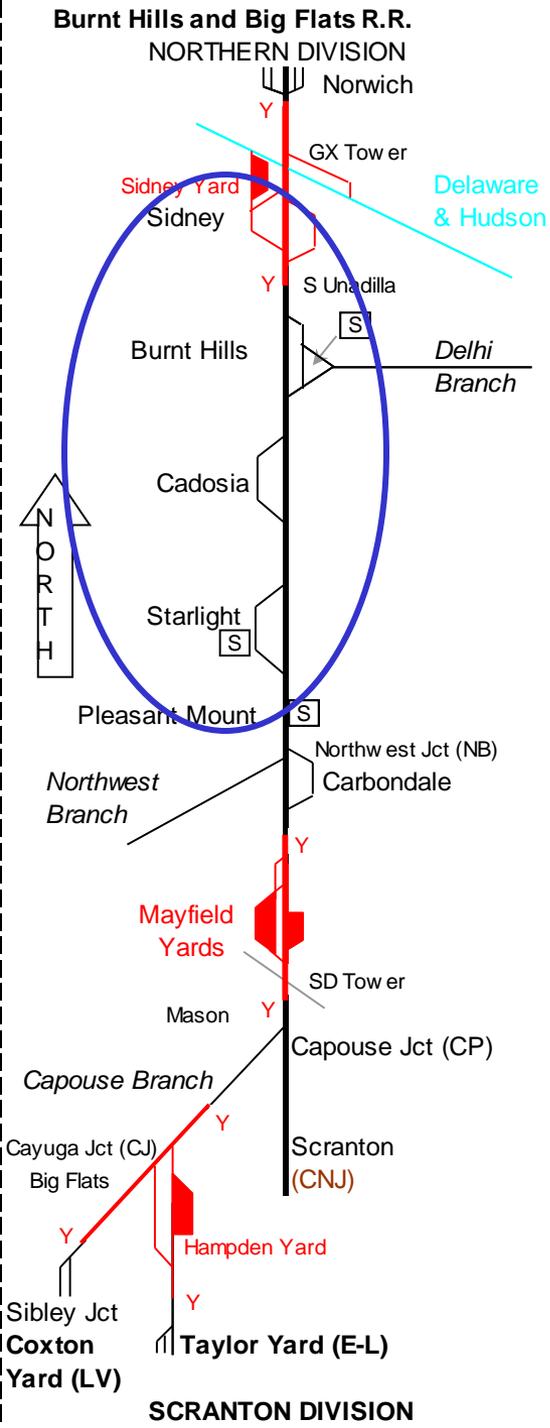


Note use of colors coded tracks to ease strain on yard crews.



What Trains To Run

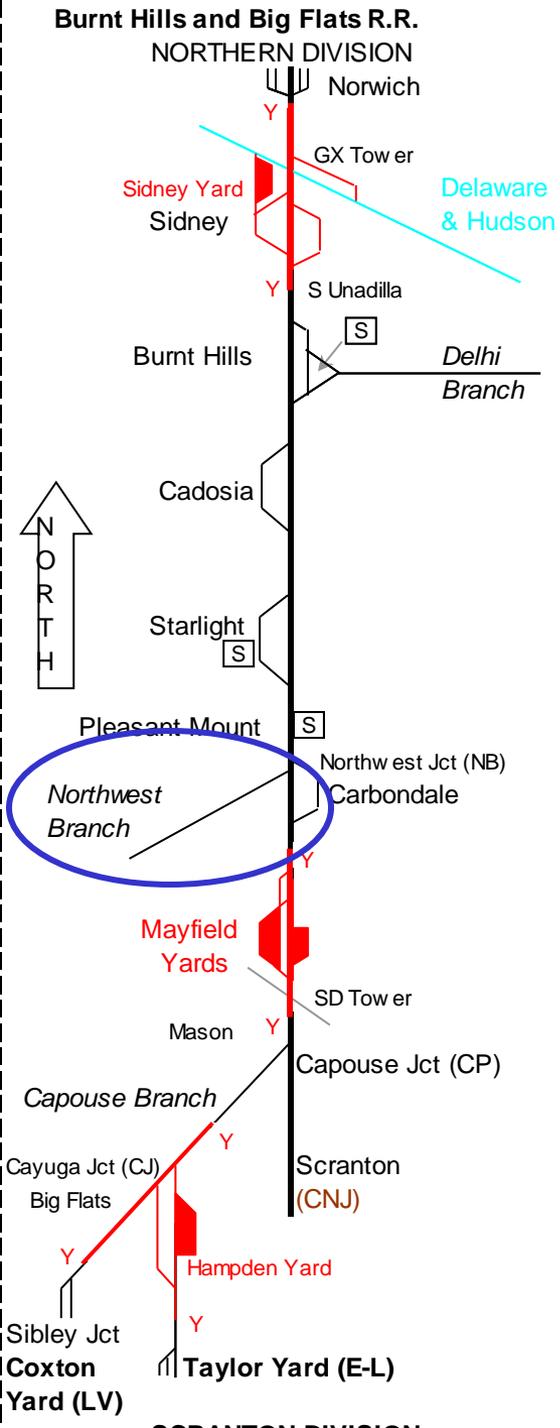
- Make a schematic
- Record car capacities
- Apply suggested capacity rates
- Determine local train lengths
 - The author uses 7 to 12
- Group sidings/towns into groups twice the size of the local train length



- One local train handles Starlight, Cadosia, Burnt Hills, and South Unadilla

Pleasant Mount	5 cars
Starlight	2 cars
Cadosia	13 cars
Burnt Hills	18 cars
Power Plant (Coal)	10 cars
S.Unadilla (Gravel)	2 cars

- There are a total of 45 cars of capacity covered. This is enough for two 12 car trains per “day”.
- Picks up local block at Sidney Yard but does not switch industries at Sidney



- One local train handles the Northwest Branch

Northwest Breaker	18 cars
Richmondale Breaker	20 cars
NW Branch Loader	3 cars
NW Branch Team. Wood	5 cars

- There are a total of 46 cars of capacity covered on the branch. This is enough for two 12 car trains per “day”.

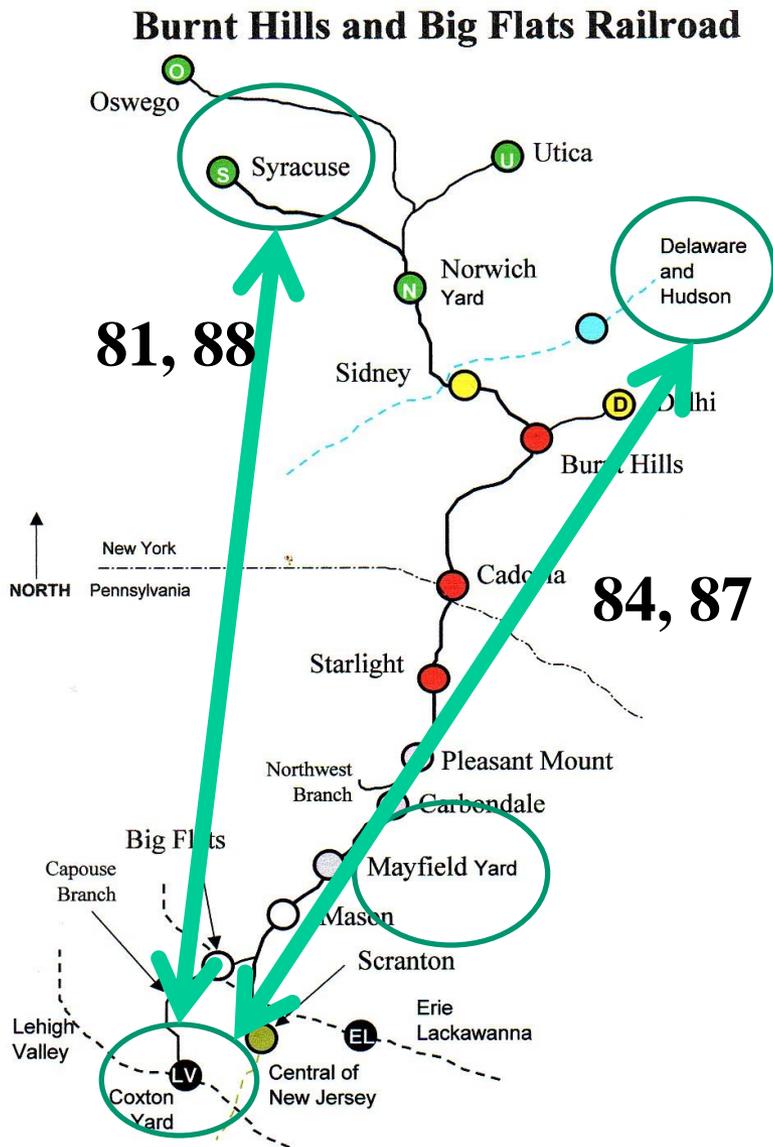
Locals

- Once you have a group of sidings to service, operate train from staging or classification yard
- Return to origination (turn) or continue on to staging or another yard
- Consider leaving blocks of cars for pickup by through trains
- You may want the local to block cars prior to return to yard

Through Trains

- If you like long through trains, consider only dropping off and picking up blocks of cars along the way between staging yards rather than classifying the whole train.
- You can make it easier on the yard by having a strategy (connections) for the through trains
- Author uses 12 to 16 cars for train length

BH&BF First Class Trains



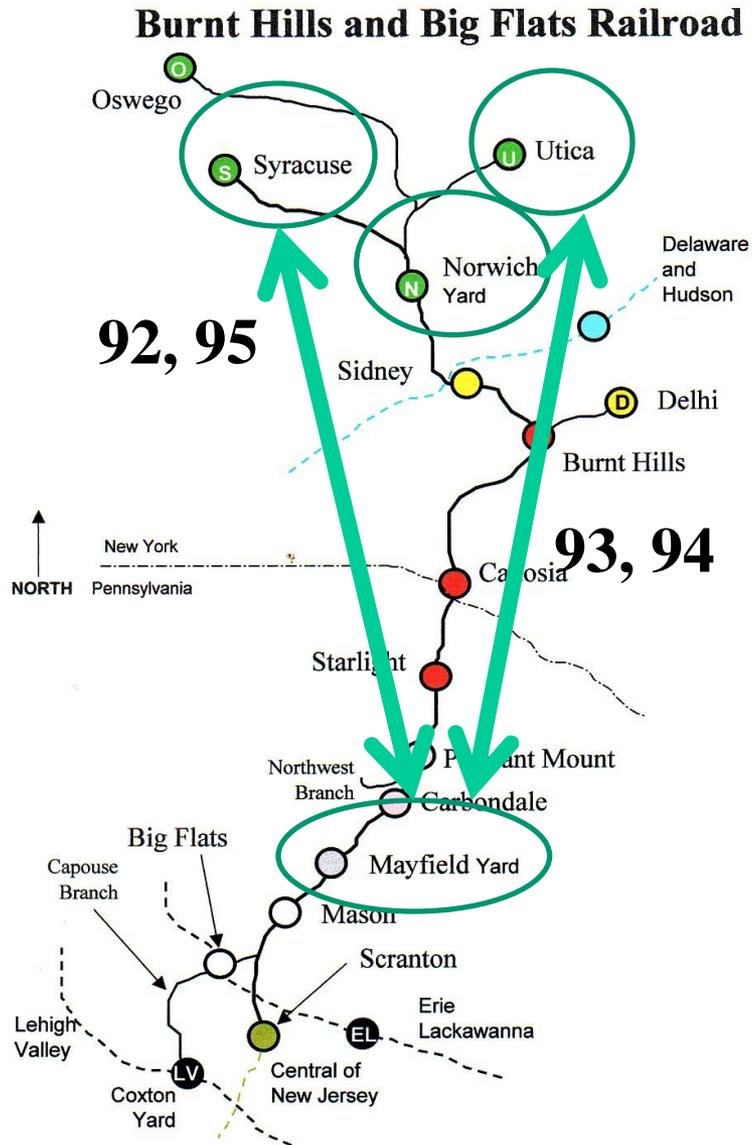
- **81 & 88**

- Lehigh Valley run thru to Syracuse (staging to staging)
- Yard service at Mayfield and Norwich

- **NE-84 & NE-87**

- LV to D&H run thru (staging to staging)
- Based upon prototype
- Yard service at Mayfield

BH&BF Second Class Trains



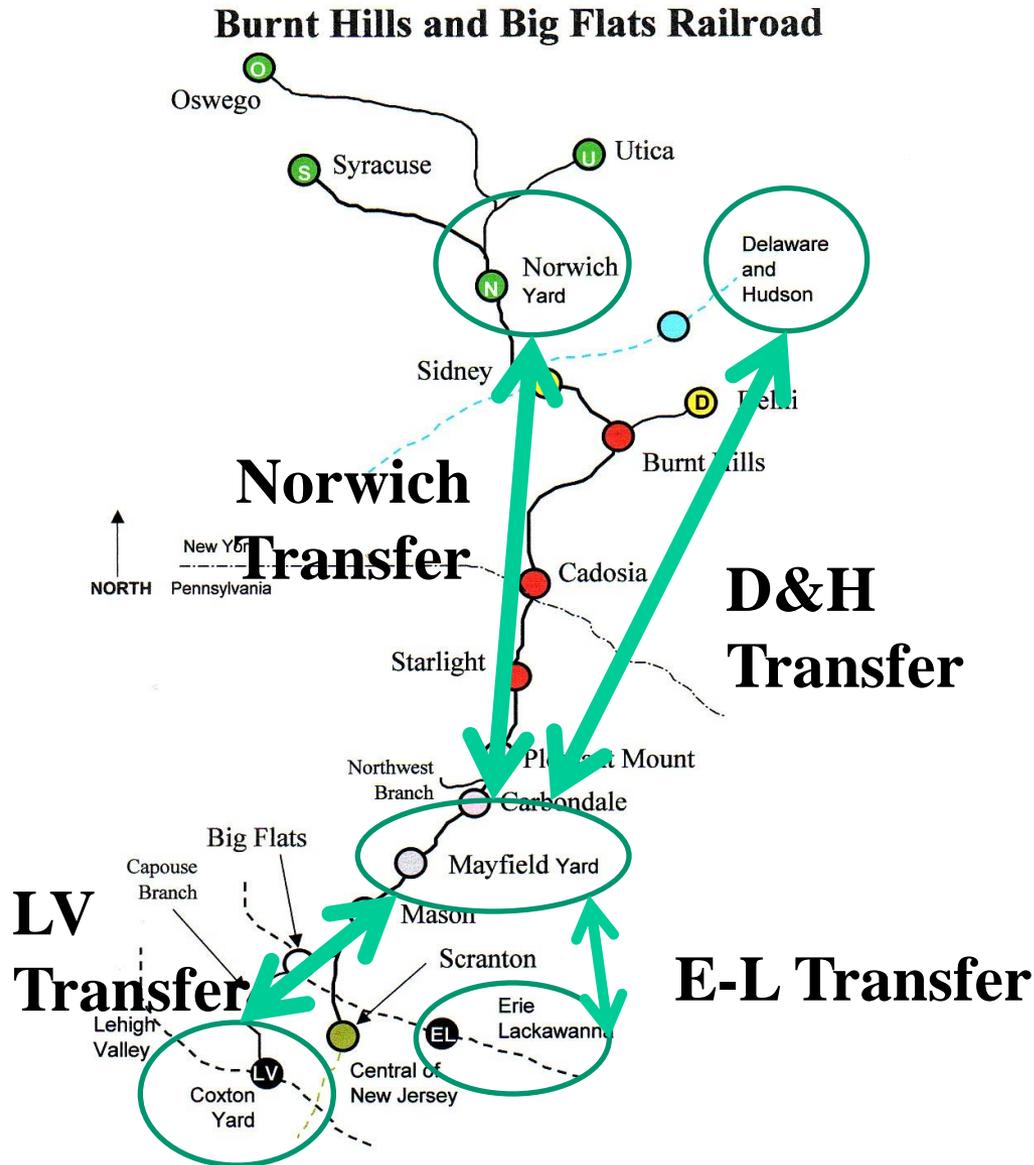
- **92 & 95**

- Between Mayfield and Syracuse (staging)
- Yard service at Norwich

- **93 & 94**

- Between Mayfield and Utica (staging)
- Yard service at Norwich

Interchanges and Staging (Norwich)



Putting it Together

- From your tabulation of car capacities:
- Apply the ratios to determine how many cars the layout will support
- Determine which trains will be run (locals and through)
- Balance the classification yard
- Run through trains if more traffic needed

Sample Calculations

Traffic Levels	Capacity	Cars	1st Shift	2nd Shift	Total	Trains	#	Yard Queue
Southern Interchanges		80%			134			
LV Coxtton Yard	NE / SL Thru	9	7	7		NE / SL	2	0.0
LV Coxtton Yard	NE / SL Blocks	5	4	4		NE / SL	2	2.0
LV Coxtton Yard	2 - 10 car train	20	16	16		LV Transfer	4	4.0
E-L Hampden Yd	24 cars	24	19			BF Local	4	2.4
	1 Passenger 1 8 car train							
E-L Taylor Yard	1 12 car train	20	16	16		EL Transfer	4	4.0
CNJ Scranton	3 12 car tracks	36	29			Scranton Local	4	3.6

- This is for the south end of the BH&BF
- LV Coxtton and E-L Hampden are staging
- E-L Taylor and CNJ are modeled interchanges
- These tracks are loaded to 80% capacity

Crew Instructions

Burnt Hills & Big Flats Railroad **Sidney Local North**

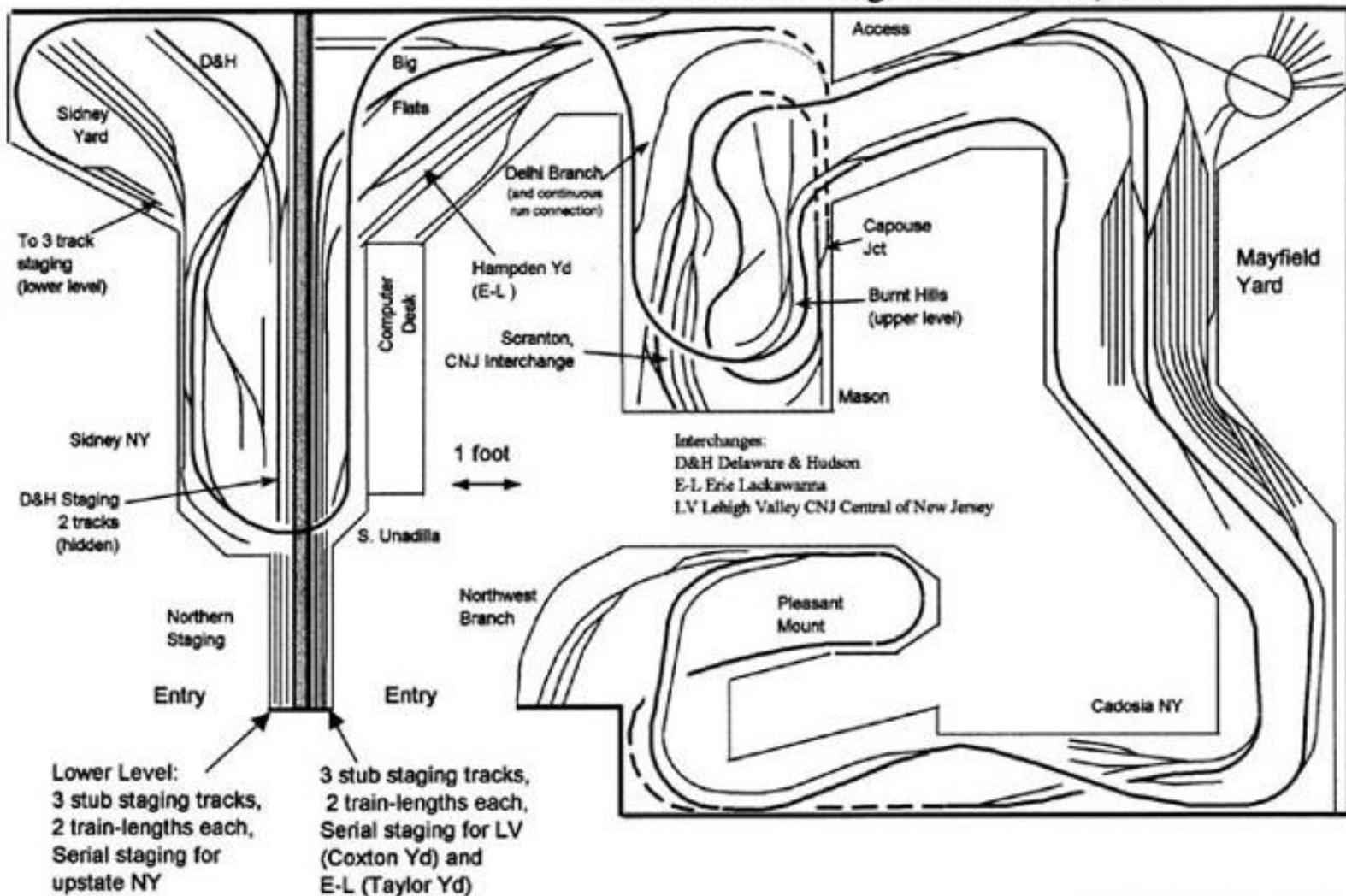
Max Train Length: 7 cars

Origination: Mayfield Main Yard

Obtain orders to run Extra Mayfield-Norwich

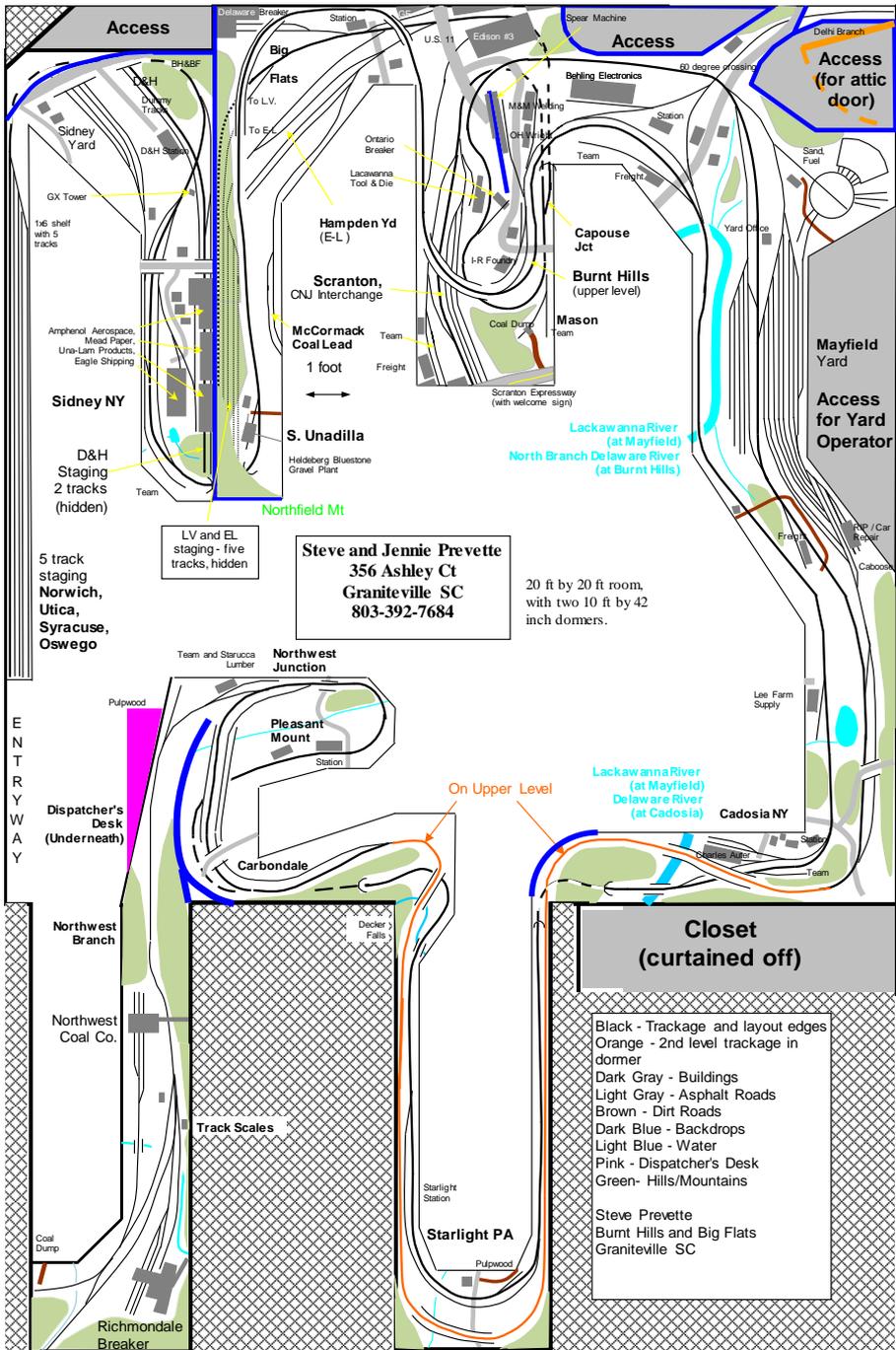
1. Leave Mayfield Main Yard Northbound.
2. Pass through Carbondale.
3. Pass through Starlight.
4. Pass through Cadosia.
5. Pass through Burnt Hills.
6. At Sidney, setout **YELLOW D** and **N** cars to Sidney Yard. Deliver other **YELLOW** cars from train and Sidney Yard to Sidney industries.
7. Pickup **YELLOW N**, **GREEN**, and **BLUE** cars from Sidney industries and deliver to Sidney Yard
8. Makeup train heading northbound with **YELLOW N** cars. Fill out to train length limit with **GREEN N** cars.
9. Depart Sidney Northbound.
10. Proceed to Norwich and terminate on track specified on Clearance Form.

Burnt Hills and Big Flats Railroad, 2002



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Burnt Hills & Big Flats
Track plan 2015
As it appeared in
“Great Model Railroads 2015”

A detailed model railway layout is shown, featuring a central yard filled with numerous freight cars in various colors (yellow, blue, green, orange, and black). The yard is surrounded by multiple tracks and a complex network of switches. To the right, a river flows through the landscape, with a small bridge crossing it. In the background, a town with several buildings is visible, including one labeled "Cadosia". The entire scene is set within a large, light-colored enclosure, possibly a display case or a dedicated room for the model. The text "Keep your Rolling Stock Rolling!" is overlaid in the center of the image.

“Keep your Rolling Stock Rolling!”

Appendix – Unclog the Yard

- Operating philosophy – don't make up trains. Break down trains. Hunting for cars from various tracks to make a train is very inefficient. Pull a track (or incoming train) and completely classify it.
- Have through trains bypass the yard, or only pause to setout and pickup a limited number of cars.
- Make sure engine movements and caboose movements are efficient

- Rule of Thumb – if trains are running randomly, on the average, one half of all of the cars for every train will be in the yard.
- If you need to save yard capacity, don't run trains randomly – set up the sequence of trains such that if a train drops of cars, they are intended for the next couple of trains. Pickups should also be planned so that they pickup from a recent arrival.
- Run multiple “copies” of the same train. This will reduce the number of cars waiting for the train.
- Run unit trains
- Pass blocks of cars from one train to another that do not require sorting

- Station a second crew to handle local industries, hostile, or even secondary classification
- Double end yard tracks
- Have crews block cars before they arrive at the yard. Pre-block trains that start in staging
- Give road crews a place to pickup and setout blocks to locals away from the main yard Start the session with the yard well organized
- Give locals a place to organize their trains away from the main yard.