FIRST GREAT WESTERN:
GATING PROPOSAL FOR BATH SPA STATION TICKET HALL

1. Purpose
This document supports the Listed Building Consent Application for the ticket office improvements and installation of automatic ticket gates at Bath Spa station.

2. Scope
This document deals with the design, development, safety requirements and operation of the proposed automatic ticket gates for Bath Spa station.

3 Introduction
First Great Western has decided to install automatic ticket gates at Bath Spa to improve station security and customer care and protect revenue. Statistics from the British Transport Police show that once a station has been gated the level of crime is reduced indicating that ticketless travel and crime are linked. The gates to be installed at Bath are used extensively on both National Rail and at London Underground stations.

4. Gating Proposal
The proposal to introduce gates at Bath Spa station sites the gateline at the West end of the ticket hall immediately before the subway leading to platform 1 (see the diagrams). The gateline consists of five automatic ticket gates, four standard aisle gates and one wide aisle gate. The wide aisle gate is located at the North end of the gateline, i.e. on the forecourt wall side of the ticket hall. In this location any queues of customers on the paid side waiting to pass through the wide gate are unlikely to effect on the flows through the standard gates. The wide aisle gate is for the use of disabled and encumbered customers and will operate on a 'first come, first served' basis accepting customers either entering or exiting the platforms. In this document the area between the gateline and the stairs to platform 2 is referred to as the concourse.

Once the gateline is brought into service the doors from the concourse to the forecourt will be closed. As part of the enabling work the doors will be re-hung to open outwards and fitted with electric locks that will release in the following situations:

- upon activation of the fire alarm
- upon local activation by the gateline staff
- upon operation of the gateline emergency open device (EMO)
- failure of the mains electricity power supply

To ensure that the flows through the ticket hall to and from the gateline operate smoothly a 'one way' system will set up with the ticket hall doors, see diagram 2.

At present the Upper Crust food outlet located in the forecourt has a pair of doors leading to the concourse area. With the implementation of the gating scheme the doors in question will be taken out of use and locked shut. First Great Western's fire safety consultant advises that this is will not have any fire safety implications.

5. Automatic Ticket Gates

The gates to be used at Bath are the E2 type electric gates a derivative of the E1 gate, both types of gate are used extensively in the United Kingdom both on National Rail and London Underground stations. The E2 gate was designed to work with smart card technology such as the Oyster card as well as tickets with a magnetic strip. The gate has a number of safety features:

- the paddle, the moving part of the gate, is made of an aluminium honeycomb pad surrounded by energy absorbent material minimising the risk of injury should a customer be struck by a paddle
- should the paddles strike someone or something they will initially reverse to allow anything trapped to be retrieved, after this the paddles resume opening or closing but at a slower speed than when they first encountered the obstruction
- it is possible for a customer to push through a gate, against the paddles in the event of an emergency
- when instances of the above two situations occur the gate sounds an alarm to warn the gateline staff that a customer may be in difficulty, the alarm also sounds when a customer's ticket is rejected, when a child passes through a gate and when the gates open in an emergency
- all the gates open when the fire alarm is activated, when there is a mains power supply failure and the 'emergency open' switch is operated by the gateline staff, the gates remain open until they are manually reset, in the above circumstances the gates open under the power of batteries within each gate thus ensuring they open in the event of a mains power failure

To accommodate customers who are disabled or encumbered with luggage, bikes, pushchairs etc... a wide aisle gate is provided, walkway aisle width 910mm. The standard aisle gate has a walkway aisle width of 620mm. The walkway of a gate is swept by beams to ensure that only one customer passes through when one ticket has passed through the ticket reader. In the wide aisle gate the walkway beams are modified to permit bikes, children with an accompanying adult and pulled wheeled luggage to pass through the gate without the paddles closing in mid passage.

6. Development and Design

The design of the gateline is based on customer flows from station counts and the flow capacity of the gates, in the case of the E2 gate a figure of 30 customers per minute is used, assuming every customer has a valid ticket. The design

takes account of the features of station and must not diminish the overall safety of the station.

At Bath Spa counts were taken over three days, a Thursday, a Friday and a Saturday. On the three days the counts were taken from 0630 to 1930 hours (0700 to 1930 hours on the Saturday), this ensured that all types of customer were accounted for - commuter, business and leisure. Numbers of customers were recordeded for every 5 minute period for the duration of the counts. The counts data was fed into a computer spreadsheet which evaluated how many gates were required to deal with the numbers of customers counted. Some margin is built in for gate failure and unexpected crowds. The spreadsheet also modelled how the gates would deal with the flows as the model does permit able bodied customers to use the wide aisle gate when it is not in use by disabled and encumbered customers and those whose tickets are rejected by the gates or are incompatible. Disabled and encumbered customers were also counted over the three days and provision is included for customers with incompatible and rejected tickets.

The maximum flows measured during the three days of the counts were as follows:

Table 1

Maximum Pedestrian Flows and Gate Utilisation

	Flow PPM	5 Min Period	Gates	SAG Min Sec	WAG Min Sec	SAG %	WAG %
Day 1, 23 February 2006							
Morning Entry	55	0735 to 0740	2	0:39	1:09	13	23
Morning Exit	173	0835 to 0840	2	2:07	3:03	42	61
Evening Entry	107	1735 to 1740	2	1:18	2:21	26	47
Evening Exit	146	1805 to 1810	2	1:46	2:45	35	55
Max WAG utilisation occurred at 0835 to 0840 at 61%							
Day 2, 24 February 2006							
Morning Entry	82	0810 to 0815	2	1:09	3:27	23	69
Morning Exit	167	0810 to 0815	2	2:04	3:27	41	69
Evening Entry	104	1705 to 1710	2	1:17	2:24	26	48
	104	1735 to 1740	2	1:16	2:09	25	43
Evening Exit	181	1725 to 1730	2	2:12	3:15	44	65
Max WAG utilisation occurred at 0810 to 0815 at 69%							
Day 3, 25 February 2006							
Morning Entry	65	0925 to 0930	2	0:45	1:54	16	38
Morning Exit	100	1215 to 1220	2	2:09	3:21	43	67
Evening Entry	101	1525 to 1530	2	1:12	1:54	24	38
Evening Exit	169	1315 to 1320	2	1:35	1:33	32	51
Max WAG utilisation occurred at 1215 to 1220 at 67%							

Note on Table 1: columns 1, 2 and 3 are self-explanatory, column 4 is the number of gates in use in that direction of flow, columns 5 and 6 are the times taken for the flows to pass through the standard and wide aisle gates in minutes and seconds and columns 7 and 8 show the gate capacity used expressed as a percentage, i.e. columns 5 and 6 expressed as a percentage of a five minute period.
SAG=Standard Aisle Gate, WAG=Wide Aisle Gate, PPM Pedestrians per Minute

The design criterion for gate utilisation of a standard gate is 50 percent, i.e. a 5 minute flow will pass through the gateline in 2 minutes 30 seconds. For a wide aisle gate it is 65%, i.e. a 5 minute flow will pass through the gate in 3 minutes 15 seconds. This provides the margin for gate failure and any unexpected overcrowding. The gateline utilisation is benchmarked at 50% and 65% and any periods where this is exceeded are subject to a risk assessment. The utilisation of both the standard gates and the wide gate has been evaluated and the maximum flows are shown in Table 1 above. The maximum entry utilisation of the standard aisle gates occurred on Days 1 and 2 with a utilisation of 26%. This occurred on Day 1 between 1735 and 1740 hours and on Day 2 between 1705 and 1710 hours. The maximum exit utilisation occurred on Day 2 with a utilisation of 44% between 1725 and 1730. The maximum utilisation of the wide gate occurred on Day 2 with a utilisation of 69% between 0810 and 0815 hours. In the case of the standard gates the maximum entry and exit gate utilisations are within the design criteria of 50% utilisation. The maximum wide gate of 69% is slightly in excess of the design criteria of 65%. The reason for this is that on Day 2 the morning peak entry and exit flows coincided in the 5 minute period commencing at 0810 hours.

The gateline will operate throughout the day with two entry and two exit gates (see diagram 1). This arrangement will permit the gates to be configured as follows, working from the South side, one entry and one exit, these two gates will be signed for platform 1, then one entry and exit gate, these two gates being signed to platform 2. This configuration will reduce congestion on the paid side of the gateline as the flows to each platform will be segregated. In particular it will reduce any congestion caused by customers going from platform 1 to 2 and vice versa.

7. Pedestrian Analysis

The flows in the concourse and the ticket hall areas are as follows (see diagram 2):

Table 2	
Primary and Secondary Pedestrian Flows	
Primary flows	
1	Forecourt main entrance to ticket hall and entry side of gateline
2	Ticket hall to entry side of gateline

3	Exit side of gateline to forecourt main exit
4	Entry side of gateline to subway to platform 1
5	Entry side of gateline to stairs to platform 2
6	Stairs from platform 2 to exit side of gateline
7	Subway from platform 1 to exit side of gateline
8	Main entrance to ticket vending machine
9	Ticket vending machines to entry side of gateline
Secondary flows	
10	Ticket hall and ticket vending machines to forecourt main exit
11	Exit side of gateline to ticket hall
12	Various flows associated with the use of the automatic telling machine
13	To and from the subway to platform 1and the stairs to platform 2

The following flow rates apply either based on the gate supplier's data or 'Fruin Level of Service E' (low):

Table 3	
Flow Rates	
Flow and location	Rate
from the ticket hall to the paid side	60 pedestrians/minute (Cubic)
from the paid area to the ticket hall	60 pedestrians/minute (Cubic)
from the stairs from platform 1	44 pedestrians/minute*(Fruin)
from the stairs from platform 1	88 pedestrians/minute (Fruin)
through the arch, one way flow	120 pedestrian/minute (Fruin)
through the arch, bi-directional flow	60 pedestrians/minute in each direction (Fruin)

*assumes pedestrians obey 'keep left' signage

Fruin 'Level of Service' flow rates can be found in 'Pedestrian Planning and Design' by JJ Fruin. 'Level of Service E' ranges from 65 to 82 pedestrians per metre width of walkway per minute (20 to 25 per foot width of walkway per minute) for walkways and 42 to 55 pedestrians per metre width of stair per minute (13 to17 pedestrians per foot width of stair per minute) for stairs. The work by Fruin is used as the basis for the computer flow modelling packages, Pedroute and Paxport.

The chief area of concern is the arch referred to in the last two flow rates. This is between the subway to platform 1 and the stairs to platform 2. It is only used by customers coming from or going to the stairs to platform 2.

The total flow capacity of the four standard gates under normal conditions is 120 pedestrians per minute. Throughout the day the gates will be configured to give flow rates of 60 pedestrians entering and 60 customers exiting. The theoretical maximum flow rate through the arch from the gateline to the stairs is 120 pedestrians per minute, i.e. the same as the gateline. It can be seen from the

above flow rates in Table 3 that if all the entering customers, 60 per minute were to go to platform 2 then this flow would still be within the capacity of the arch assuming only 44 pedestrians per minute would be descending the stairs. However the flow through the arch is unlikely to achieve 60 pedestrians per minute as the flow up the stairs will only be 44 per minute, this situation will cause queuing and possible congestion. The data from Table 1 indicates that the suggested flows are in reality unlikely to occur as queuing is not currently prevalent in this area. The worse case scenario is where 88 pedestrians descend the stairs whilst 60 pedestrians try to enter the concourse. This situation is most likely to occur during an evacuation or some other controlled situation when no customers would be entering the platforms. In any event such a situation can be regulated by opening the concourse doors to the forecourt.

Referring to Tables 1, the peak entry flow measured was 22 customers per minute (107/5) and the peak exit flow was 37 pedestrians per minute (181/5). The summation of the peak flows, 59 pedestrians per minute is well within the situations discussed above. If the measured peak flow rates were doubled, i.e. 118 pedestrians per minute, and it was assumed all customers came and went from platform 1 then this is still just short of the maximum capacity of the arch between the gateline and the stairs to platform 2.

In the ticket hall it will be necessary to set up a one way system with exiting customers leaving by the ticket hall by the door nearest to the ticket gates and customers entering the ticket hall by any of the other doors. The width of the ticket hall exit door is 1390mm giving a flow rate of 90 pedestrians per minute. However this is greater than the exit capacity of the gateline with two gates set to exit of 60 pedestrians per minute.

To reduce the risk of congestion in the concourse area First Great Western will actively encourage encumbered customers to use the platform step free exits to the car parks.

8. Safety Validation

The introduction of automatic ticket gates at a station requires safety validation in accordance with a railway industry standard. The standard requires the type of gate used to meet certain technical and operational requirements. It also requires that the proposal can adequately deal with the customer flows and does not cause overcrowding and congestion. The standard requires that the introduction of the gates does not affect the means of escape in an emergency or the time taken to evacuate the station. Additionally it requires that the gateline makes adequate provision for disabled and encumbered customers by having sufficient wide aisle gates. Also the gateline must not introduce any new cross flows of customers and pinch points. It also requires that the emergency plans for the station are reviewed.

9. Gateline Monitoring and Management

The gateline cannot be in use unless the required number of staff are available to monitor and manage the gates. Should sufficient staff not be available then the gates must be locked open. Staff who manage and monitor the gateline must be familiar with the following:

- operation of the gates
- revenue protection procedures, e.g. issue of excess fares using portable ticket issuing equipment
- customer care procedures
- procedures for the early recognition and dealing with overcrowding situations, at Bath these will include use of the gates and forecourt exit doors to relieve overcrowding and congestion
- evacuation procedures
- operation of the remote controls for the platform gates

10. Step Free Access

Step free access from the platforms at Bath Spa is by gates leading to the East and West car parks. In view of the risks for encumbered customers associated with the stairs leading from platform 1 and 2 and the desirability to avoid encumbered customers using the concourse area, particularly in the peak periods First Great Western will actively encourage encumbered customers to leave the station by the car parks. Both platform exits will be fitted with gates that will have electric locks that can be remotely operated from the gateline. Each gate will also have a help point. When the platform gates are unstaffed the help point will enable customers to communicate with the gateline staff who will be able to remotely release the lock on the gate to permit bona fide users to enter the platforms. This arrangement will prevent the gates being used by travellers who wish to avoid paying a fare.

11. Customer Unfamiliarity

Bath Spa has a high number of customers who are tourists who are likely to be unfamiliar with the automatic ticket gates. For this reason the gateline operating staff must be vigilant to ensure that customers requiring assistance are dealt with expeditiously to avoid delaying other customers.

12. Station Evacuation

In event that the station is required to be evacuated it is likely that most of the customers on the platforms would leave by the car park gates, assuming neither is blocked by the incident requiring the station to be evacuated.

13. Bringing the Gateline into Service

In the period before the gateline is brought into service First Great Western will launch a poster and leaflet campaign to advise their customers as to when the

gates will be brought into use. The posters and handouts will also explain how to use the gates and which tickets will not work in the gates. Additionally on train announcements will be made in the period leading up to the introduction of the gates. The presence of gates will form part of the normal on train approach announcement for Bath Spa. In the weeks immediately after the introduction of the gates additional revenue protection staff will be at the Bath gateline to assist customers and ensure the smooth operation of the gates.

The introduction of the gates at Bath will take place in two stages, first the doors to the forecourt will be closed and customers will pass through the gates which will be locked open, once customers are familiar with this arrangement then the gates will be made operational.

14. Bath Rugby Days

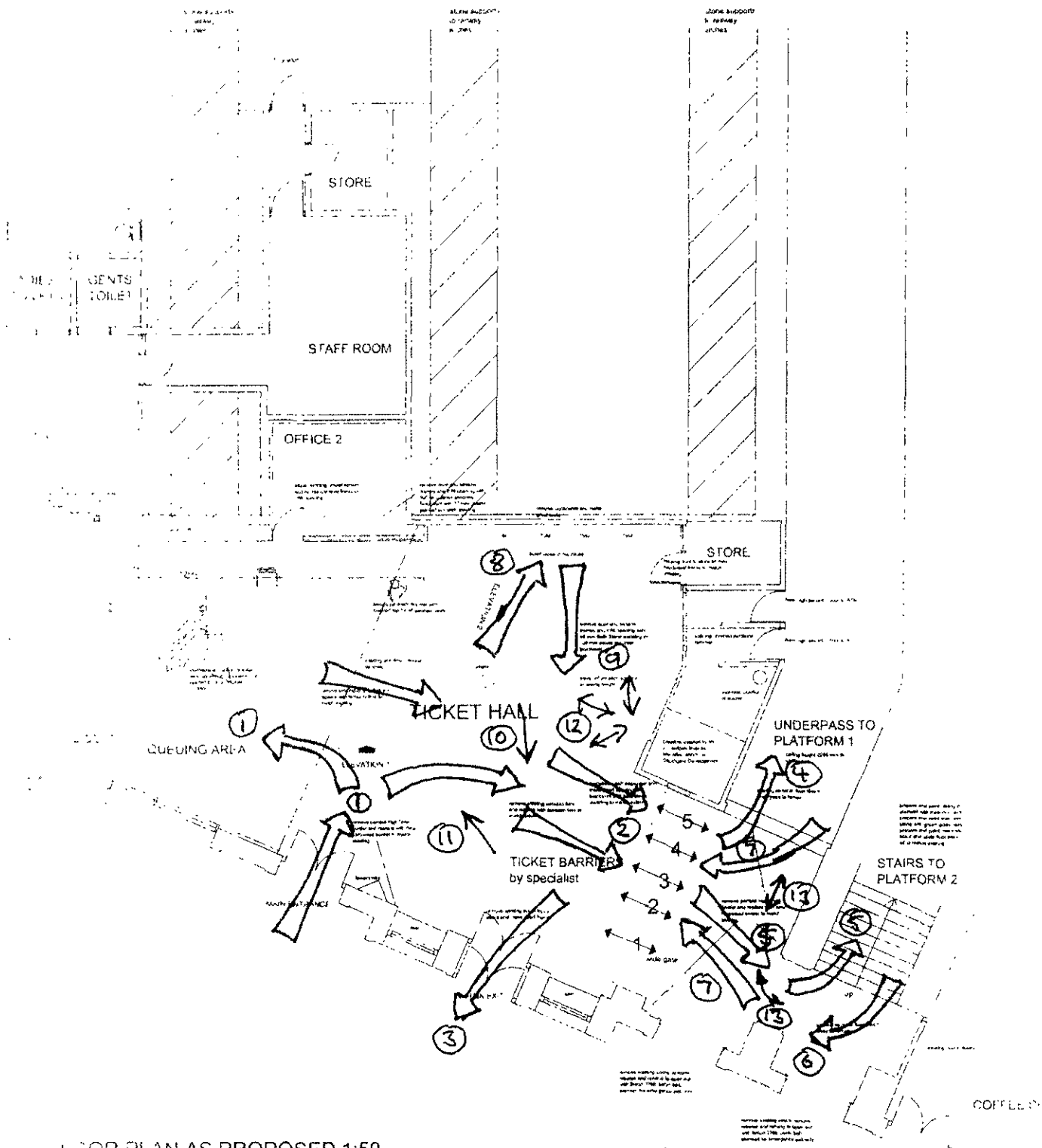
To deal with Bath Rugby Days and similar events First Great Western will introduce crowd control plans at Bath Spa.

14. Gateline Review Period

After the gateline is brought into service its performance will be monitored over the first six months of its operation. Reviews will be carried out 8 and 26 weeks. The flows in the concourse will be identified as an item requiring special monitoring during the review period. Should the operation of the gateline not conform to the requirements of its safety validation then the reviews provide the opportunity for any problems to be addressed.

15. Conclusion

The above demonstrates that the introduction of automatic ticket gates at Bath Spa station will be in accordance with the railway industry standard and that the local conditions and pedestrian flows have been considered in the design and development of the proposal. The proposal will not diminish the overall safety of the station. The gateline staff will be trained to recognise flow situations that have the potential to cause overcrowding in the concourse area and will be able to divert exiting customers into the forecourt to relieve those situations should they develop. In addition First Great Western will positively encourage encumbered customers to use the gates leading to the car parks. The operation of the gateline is reviewed after 8 and 26 weeks of operation.

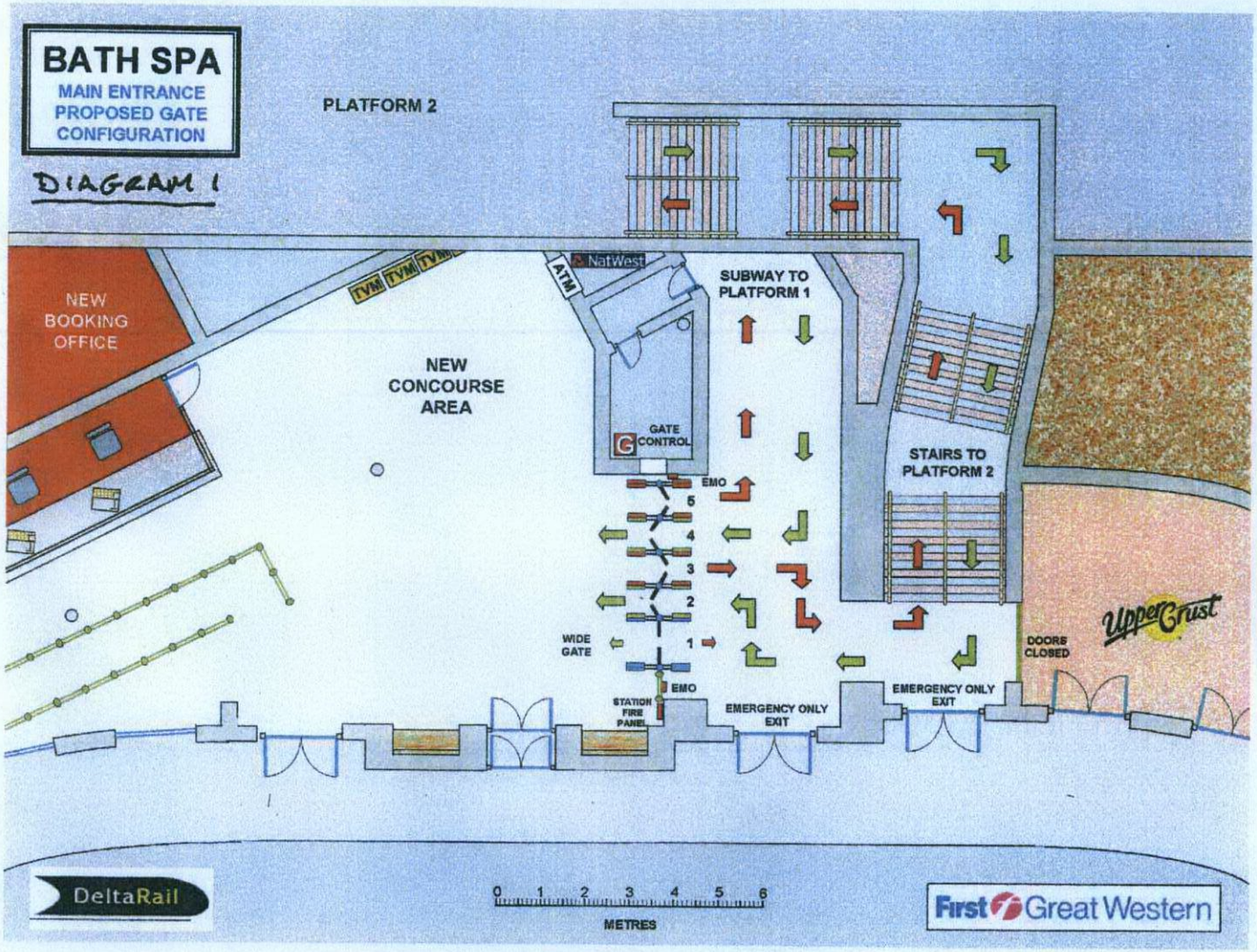


FLOOR PLAN AS PROPOSED 1:50

DIAGRAM 2

PRIMARY FLOWS

SECONDARY FLOWS


BATH SPA
MAIN ENTRANCE
PROPOSED GATE
CONFIGURATION
DIAGRAM 1
PLATFORM 2
NEW
BOOKING
OFFICE
TVM
TVM
TVM
ATM
NatWest
SUBWAY TO
PLATFORM 1
NEW
CONCOURSE
AREA
GATE
CONTROL
G
EMO
STAIRS TO
PLATFORM 2
6
4
3
2
1
WIDE
GATE
EMO
STATION
FIRE
PANEL
EMERGENCY ONLY
EXIT
EMERGENCY ONLY
EXIT
DOORS
CLOSED
Upper Crust
DeltaRail
0 1 2 3 4 5 6
METRES
First Great Western