

Relationships Between Flow, Water Temperature, And Exports In  
The San Joaquin River Delta And The Rate That Adult Merced  
River Hatchery Fall-Run Chinook Salmon With Coded-Wire-Tags  
Were Recovered In The Central Valley Escapement And The  
Ocean Fisheries

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## INTRODUCTION

A total of 158 releases of juvenile salmon marked with coded-wire tags (CWT) were released in the San Joaquin River between Mossdale and Dos Reis between 1982 and 2006. Smolt survival rates have been estimated for the Vernalis Adaptive Management Plan studies as a function of the number of recoveries with trawls at Chipps Island, Jersey Point, and/or Antioch as described in the Annual Technical Reports by the San Joaquin River Group Authority. The trawl based absolute survival estimates, which are called “Differential Recovery Rates” in the Annual Technical Reports, are computed as the combined trawl recovery rate for the upstream release group of CWT smolts (Mossdale or Dos Reis) divided by the combined trawl recovery rate for the downstream release group of CWT smolts at Jersey Point. Paired upstream and downstream releases have been made since 1989.

An index of smolt survival can also be made by estimating the total number of CWT salmon that returned to spawn in the inland escapement or were caught in the ocean fisheries divided by the number of juvenile salmon released. This index of survival, which is called the Adult Recovery Rate in this report, has two advantages over the trawl based absolute survival estimates used in the VAMP studies. First, paired releases are unnecessary and so this index provides more estimates, particularly from 1982 to 1988, when no physical Head of the Old River Barrier was installed and there was a large range in Delta export rates and flows at Vernalis. Second, the Adult Recovery Rate reflects survival to the adult life stage, not just juvenile survival from point A (e.g., Mossdale) to point B (e.g., Jersey Point). This would be important if smolts survived to Chipps Island, but were so diseased or otherwise in poor health that they died soon after. However, there is one major disadvantage in that Adult Survival Rate is affected by the survival of the salmon in the ocean as well as the conditions in the Delta. This disadvantage was minimized in the analyses reported here by excluding the estimates during years when ocean conditions were poor as indicated by an index of ocean conditions developed by Wells and others (2007).

## METHODS

The methods used to estimate the adult CWT inland and ocean recoveries are described in Mesick et al. (2009). The estimated CWT recoveries for the releases of smolt-sized Merced and Feather River Hatchery salmon that marked with coded-wire tags and released in the San Joaquin River between Mossdale and Dos Reis between 1982 and 2006 were used for these analyses. The Adult Survival Rate estimates were made by dividing the total number of CWT salmon that returned to spawn in the inland escapement and were caught in the ocean fisheries divided by the number of juvenile salmon released for each CWT code. Excel Pivot Tables were used to estimate the total number of recoveries for each CWT release from all inland and ocean sampling sites and all adult run years. The CWT Adult Recovery Rate estimates are presented in Table 1.

The effect of ocean conditions on the survival evaluations was minimized by excluding the estimates during years when ocean conditions were poor as indicated by an index of

ocean conditions developed by Wells and others (2008). The survival rates for the 158 CWT smolt releases were relatively low when the Well's ocean index was less than -0.4 (Figure 1). Therefore, smolt survival estimates that correspond to years when the Well's ocean index was less than -0.4 were excluded from evaluations of flows, exports, and water temperatures in the Delta.

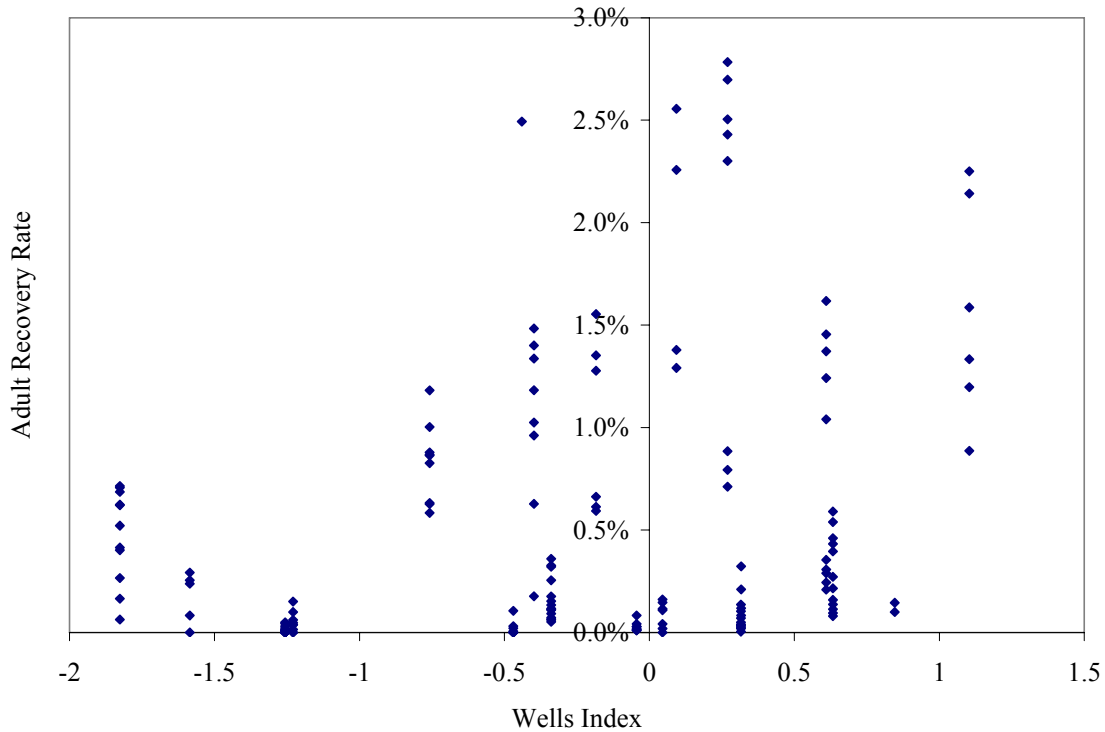


Figure 1. The relationship between the Adult Recovery Rate and the Wells and others (2008) ocean conditions index for juvenile CWT releases made in the San Joaquin River between Mossdale and Dos Reis from 1983 to 2004.

The estimates of flow and water temperature in the San Joaquin River at Mossdale were made by AD Consultants and others (2009). The estimates of the total combined Delta exports (SWP, CVP, and CCC) are from the California Department of Water Resources Dayflow model output available at <http://www.water.ca.gov/dayflow/output/>.

The relationships were segregated into two groups: releases made when there was no Head of the Old River Barrier (HORB) installed and releases made when there was a HORB installed. The HORB affected smolt survival by minimizing the number of smolts that migrated into the Old River toward the Federal and State pumping facilities and by keeping a majority of the San Joaquin flow in the mainstem channel.

## RESULTS

The relationships between the Adult Recovery Rates and flows at Mossdale (Figure 2), Delta export rates (Figures 3 and 4), and water temperature at Mossdale (Figure 5)

suggest that managing flows that exceed 1,350 cfs, exports that exceed 1,740 cfs, and water temperatures below 71 degrees Fahrenheit has little effect on salmon smolt survival when no physical HORB is installed. It is likely that without the HORB, flow cannot substantially reduce the impacts of the poor water quality in the Deepwater Ship Channel. In the Old River, export levels that exceed 1,740 cfs probably result in high rates of entrainment and indirect mortality associated with exports (e.g., predation near the intakes).

When the HORB was installed, the results of the survival analyses with the Adult Recovery Rates are similar to those with the juvenile Differential Recovery Rates described in the VAMP Annual Technical Reports. Both sets of estimates suggest that there is a positive association between Delta flow (Figure 2) and smolt survival (Figure 3) when the HORB was installed (Newman 2008). The Adult Recovery Rates when the HORB was installed were inversely correlated with water temperatures at Mossdale (Figure 5) as expected based on the EPA (2003) criteria.

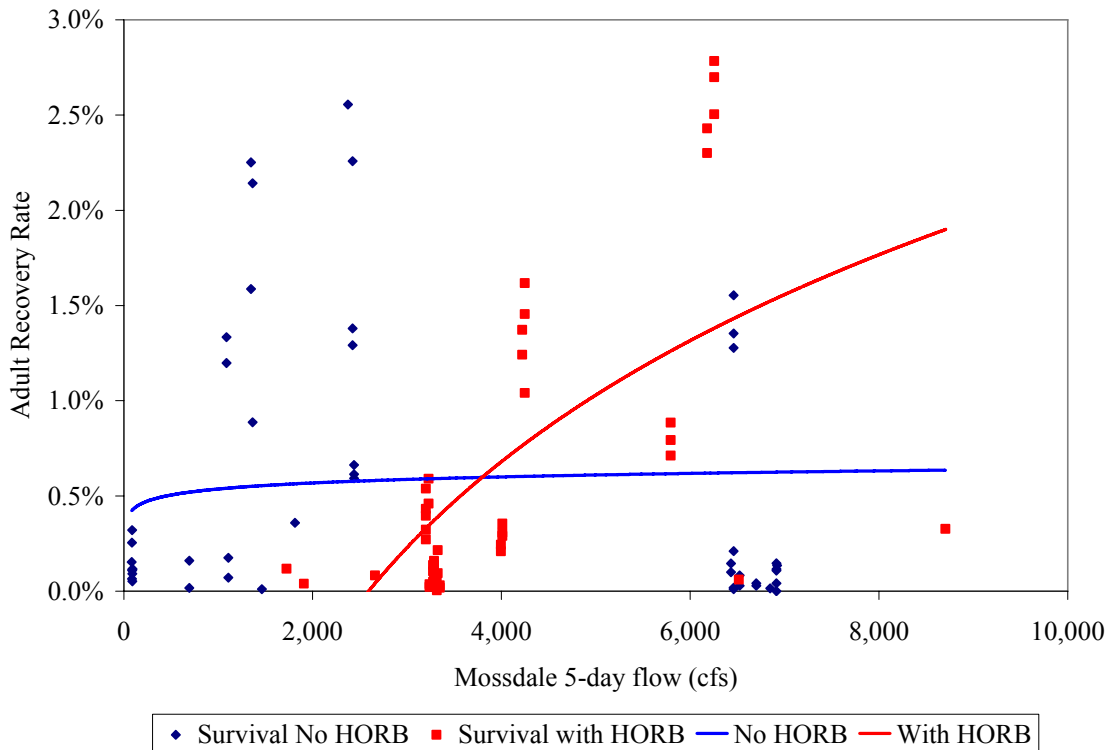


Figure 2. The relationship between the Adult Recovery Rate and the 5-day mean flow in the San Joaquin River at Mossdale (AD Consultants and others 2009) following the juvenile release date with and without the Head of the Old River Barrier (HORB). Excel trendlines (logarithmic regressions) are shown for the estimates with and without the HORB.

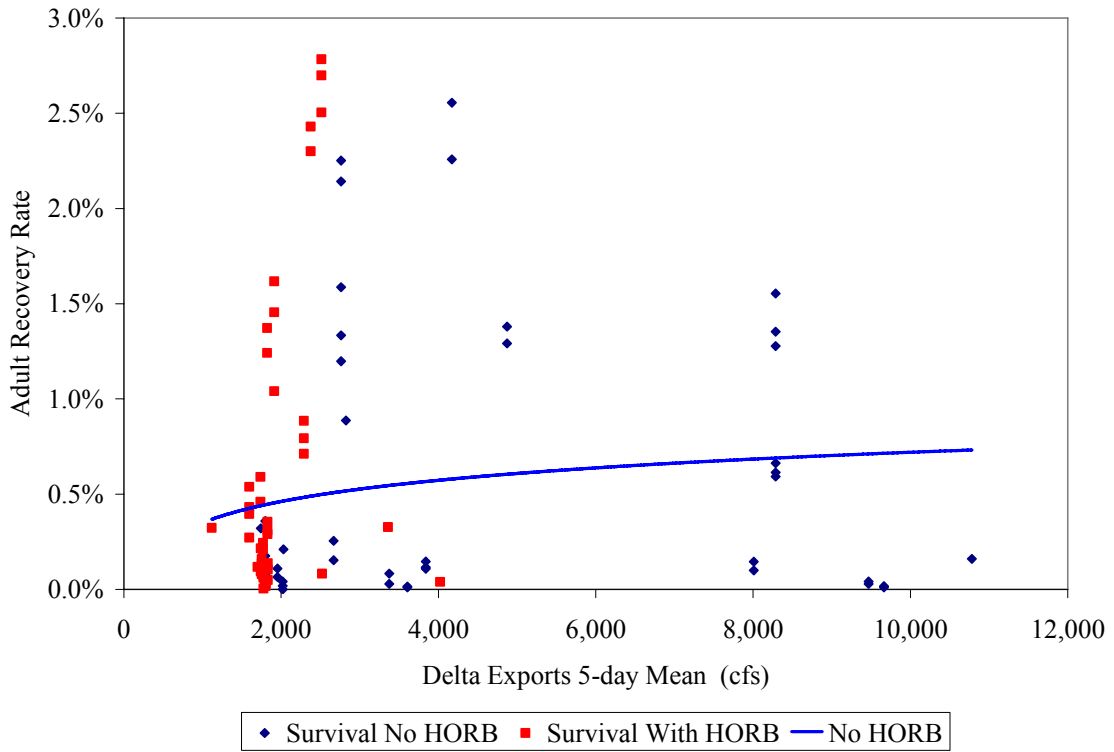


Figure 3. The relationship between the Adult Recovery Rate and the 5-day mean Delta Export Rate (DWR Dayflow) following the juvenile release date with and without the Head of the Old River Barrier (HORB). Excel trendline (logarithmic regression) is shown for the estimates without the HORB.

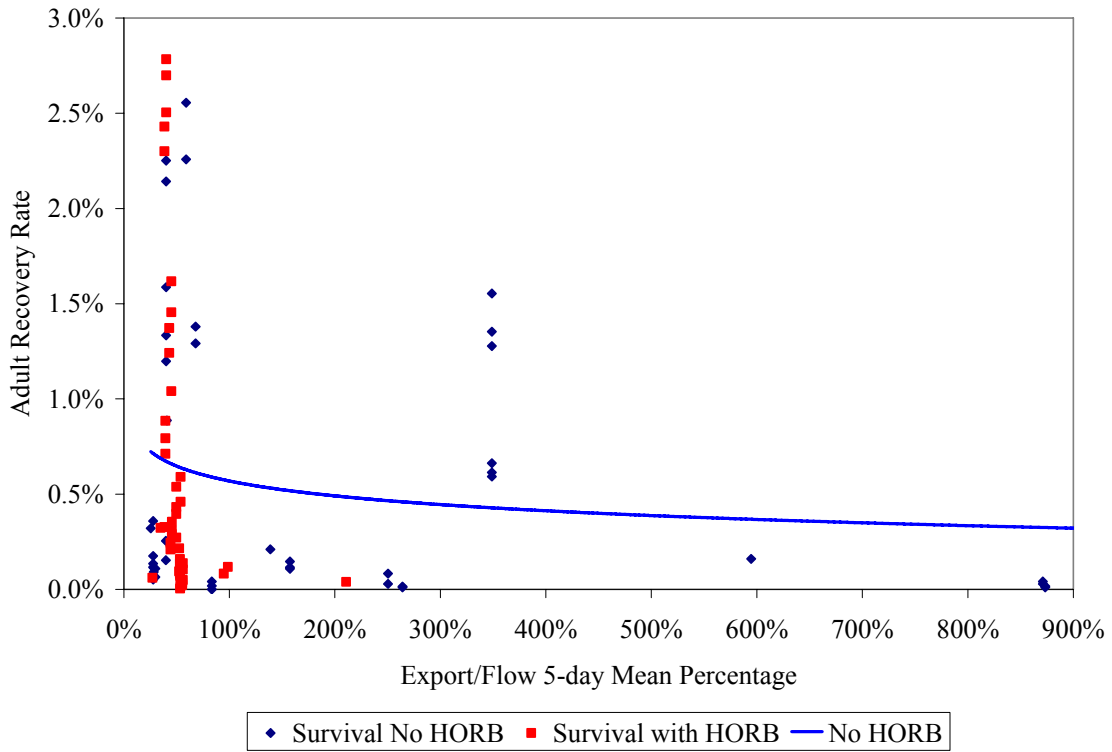


Figure 4. The relationship between the Adult Recovery Rate and the 5-day mean ratio of Delta Export Rates (DWR Dayflow) to the Mossdale Flow (AD Consultants and others 2009) following the juvenile release date with and without the Head of the Old River Barrier (HORB). Excel trendline (logarithmic regression) is shown for the estimates without the HORB.

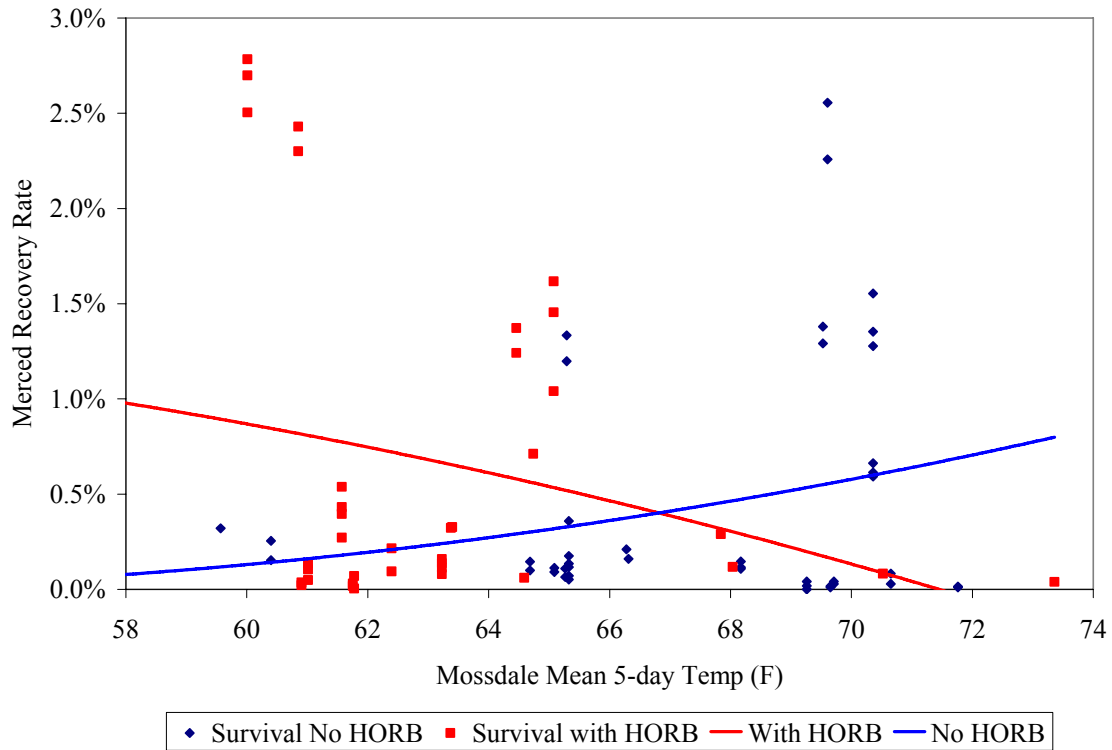


Figure 4. The relationship between the Adult Recovery Rate and the 5-day mean water temperature (Fahrenheit) at Mossdale (AD Consultants and others 2009) following the juvenile release date with and without the Head of the Old River Barrier (HORB). Excel trendlines (2nd order polynomial regressions) are shown for the estimates with and without the HORB.

## REFERENCES

AD Consultants, Resource Management Associates, Inc., and Watercourse Engineering, Inc. 2009. San Joaquin River Basin water temperature modeling and analysis. Prepared for CALFED, ERP-06D-S20. Moraga, California. October 2009.

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Newman, K.B. 2008. An evaluation of four Sacramento-San Joaquin River Delta juvenile salmon survival studies. Report prepared for the CalFed Science Program, Project number SCI-06-G06-299.

Wells, B.K., J.C. Field, J.A. Thayer, C.B. Grimes, S. J. Bograd, W.J. Sydeman, F. B. Schwing, and R. Hewitt. 2008. Untangling the relationships among climate, prey and top predators in an ocean ecosystem. *Marine Ecology Progress Series* 364:15-29.



Table 1. The Adult Recovery Rate estimates for all Merced River Hatchery (MRH) and Feather River Hatchery (FRH) coded-wire-tag (CWT) releases in the San Joaquin River between Mossdale and Dos Reis from 1982 to 2005.

<u>REARING LOCATION</u>	<u>CWT CODE</u>	<u>RELEASE LOCATION</u>	<u>Total Released</u>	<u>DATE RELEASED</u>	<u>Adult Recovery Rate</u>	<u>Wells Ocean Index</u>	<u>Mossdale 5-day Mean Flows</u>	<u>Mossdale 5-day Mean Temp</u>	<u>Exports 5-day Mean</u>	<u>Export/Mossdale Flow</u>	<u>HORB</u>
MRH	062545	DOS REIS ROAD	50,190	4/29/97	1.1827%	-0.3983	5,900	62.0	2,639	0.4473	Yes
MRH	062546	DOS REIS ROAD	54,810	4/29/97	0.9618%	-0.3983	5,900	62.0	2,639	0.4473	Yes
MRH	062548	DOS REIS ROAD	51,294	5/8/97	0.6277%	-0.3983	6,052	65.7	2,833	0.4681	Yes
MRH	062550	DOS REIS ROAD	51,671	5/27/97	0.1770%	-0.3983	3,448	71.7	6,875	1.9937	Yes
MRH	0601060914	DURHAM FERRY	25,016	4/28/00	0.8841%	0.2699	5,794	17.6	2,289	0.3951	Yes
MRH	0601060915	DURHAM FERRY	28,296	4/28/00	0.7933%	0.2699	5,794	17.6	2,289	0.3951	Yes
MRH	0601110814	DURHAM FERRY	25,218	4/28/00	0.7120%	0.2699	5,794	64.7	2,289	0.3951	Yes
MRH	060401	DURHAM FERRY	25,987	4/17/00	2.6981%	0.2699	6,255	60.0	2,512	0.4016	Yes
MRH	060402	DURHAM FERRY	25,939	4/17/00	2.7836%	0.2699	6,255	60.0	2,512	0.4016	Yes
MRH	064401	MOSSDALE	26,399	4/18/00	2.4301%	0.2699	6,180	60.9	2,376	0.3845	Yes
MRH	064402	MOSSDALE	25,977	4/18/00	2.3006%	0.2699	6,180	60.9	2,376	0.3845	Yes
MRH	064563	DURHAM FERRY	26,482	4/17/00	2.5045%	0.2699	6,255	60.0	2,512	0.4016	Yes
MRH	064429	DURHAM FERRY	25,802	4/30/01	1.0402%	0.6102	4,248	65.1	1,912	0.4501	Yes
MRH	064430	DURHAM FERRY	25,105	4/30/01	1.6178%	0.6102	4,248	65.1	1,912	0.4501	Yes
MRH	064431	DURHAM FERRY	24,725	4/30/01	1.4553%	0.6102	4,248	65.1	1,912	0.4501	Yes
MRH	064432	MOSSDALE	25,838	5/1/01	1.2419%	0.6102	4,221	64.5	1,822	0.4316	Yes
MRH	064433	MOSSDALE	26,107	5/1/01	1.3717%	0.6102	4,221	64.5	1,822	0.4316	Yes
MRH	064436	DURHAM FERRY	25,428	5/7/01	0.2894%	0.6102	4,010	67.8	1,826	0.4554	Yes
MRH	064437	DURHAM FERRY	25,298	5/7/01	0.3545%	0.6102	4,010	17.6	1,826	0.4554	Yes
MRH	064438	DURHAM FERRY	25,454	5/7/01	0.3075%	0.6102	4,010	17.6	1,826	0.4554	Yes
MRH	064439	MOSSDALE	25,542	5/8/01	0.2097%	0.6102	3,996	17.6	1,770	0.4429	Yes
MRH	064440	MOSSDALE	25,695	5/8/01	0.2441%	0.6102	3,996	17.6	1,770	0.4429	Yes

<u>REARING LOCATION</u>	<u>CWT CODE</u>	<u>RELEASE LOCATION</u>	<u>Total Released</u>	<u>DATE RELEASED</u>	<u>Adult Recovery Rate</u>	<u>Wells Ocean Index</u>	<u>Mosssdale 5-day Mean Flows</u>	<u>Mosssdale 5-day Mean Temp</u>	<u>Exports 5-day Mean</u>	<u>Export/Mosssdale Flow</u>	<u>HORB</u>
MRH	064457	MOSSDALE	25,637	4/19/02	0.5900%	0.6325	3,228	17.6	1,738	0.5384	Yes
MRH	064458	MOSSDALE	26,050	4/19/02	0.4601%	0.6325	3,228	17.6	1,738	0.5384	Yes
MRH	064470	DURHAM FERRY	25,831	4/25/02	0.1370%	0.6325	3,287	63.2	1,753	0.5333	Yes
MRH	064471	DURHAM FERRY	25,128	4/18/02	0.2717%	0.6325	3,200	61.6	1,595	0.4984	Yes
MRH	064472	DURHAM FERRY	26,447	4/18/02	0.5386%	0.6325	3,200	61.6	1,595	0.4984	Yes
MRH	064473	DURHAM FERRY	25,078	4/18/02	0.4324%	0.6325	3,200	61.6	1,595	0.4984	Yes
MRH	064474	DURHAM FERRY	25,997	4/18/02	0.3959%	0.6325	3,200	61.6	1,595	0.4984	Yes
MRH	064475	DURHAM FERRY	25,809	4/25/02	0.1589%	0.6325	3,287	63.2	1,753	0.5333	Yes
MRH	064476	DURHAM FERRY	25,939	4/25/02	0.0796%	0.6325	3,287	63.2	1,753	0.5333	Yes
MRH	064477	DURHAM FERRY	25,518	4/25/02	0.1137%	0.6325	3,287	63.2	1,753	0.5333	Yes
MRH	064478	MOSSDALE	26,076	4/26/02	0.2156%	0.6325	3,325	62.4	1,743	0.5242	Yes
MRH	064479	MOSSDALE	25,716	4/26/02	0.0944%	0.6325	3,325	62.4	1,743	0.5242	Yes
MRH	060282	DURHAM FERRY	25,862	4/21/03	0.1039%	0.3156	3,276	61.0	1,833	0.5595	Yes
MRH	060283	DURHAM FERRY	27,415	4/21/03	0.0491%	0.3156	3,276	61.0	1,833	0.5595	Yes
MRH	062742	DURHAM FERRY	25,457	4/21/03	0.1367%	0.3156	3,276	61.0	1,833	0.5595	Yes
MRH	062743	MOSSDALE	26,970	4/22/03	0.0228%	0.3156	3,239	60.9	1,795	0.5541	Yes
MRH	062745	DURHAM FERRY	26,122	5/28/03	0.0397%	0.3156	1,909	73.4	4,022	2.1071	Yes
MRH	062746	DURHAM FERRY	26,652	4/28/03	0.0184%	0.3156	3,349	61.8	1,805	0.5389	Yes
MRH	062747	DURHAM FERRY	26,062	4/28/03	0.0303%	0.3156	3,349	61.8	1,805	0.5389	Yes
MRH	062748	MOSSDALE	26,409	4/22/03	0.0360%	0.3156	3,239	60.9	1,795	0.5541	Yes
MRH	062749	MOSSDALE	26,031	4/29/03	0.0703%	0.3156	3,316	61.8	1,775	0.5352	Yes
MRH	062750	MOSSDALE	26,064	4/29/03	0.0038%	0.3156	3,316	61.8	1,775	0.5352	Yes
MRH	062752	DURHAM FERRY	26,338	4/22/04	0.1061%	-0.4691	3,126	63.4	1,696	0.5426	Yes
MRH	062753	DURHAM FERRY	26,321	4/22/04	0.0000%	-0.4691	3,126	63.4	1,696	0.5426	Yes

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MRH	062754	DURHAM FERRY	25,920	4/22/04	0.0311%	-0.4691	3,126	63.4	1,696	0.5426	Yes
MRH	062755	DURHAM FERRY	25,993	4/22/04	0.0000%	-0.4691	3,126	63.4	1,696	0.5426	Yes
MRH	064582	MOSSDALE	25,749	4/23/04	0.0000%	-0.4691	3,168	64.7	1,790	0.5650	Yes
MRH	064583	MOSSDALE	25,703	4/23/04	0.0059%	-0.4691	3,168	64.7	1,790	0.5650	Yes
MRH	064670	MOSSDALE	26,238	4/23/04	0.0209%	-0.4691	3,168	64.7	1,790	0.5650	Yes
FRH	0601140303	STEWART ROAD-FRH	53,997	4/24/92	0.0609%	-1.2290	1,221	68.8	1,375	1.1265	Yes
FRH	0601140304	STEWART ROAD-FRH	52,628	4/24/92	0.0380%	-1.2290	1,221	68.8	1,375	1.1265	Yes
FRH	063131	STEWART ROAD-FRH	54,363	5/4/92	0.0000%	-1.2290	1,243	72.3	3,151	2.5344	Yes
FRH	063132	STEWART ROAD-FRH	52,164	5/4/92	0.0000%	-1.2290	1,243	72.3	3,151	2.5344	Yes
FRH	063134	STEWART ROAD-FRH	54,036	5/12/92	0.0144%	-1.2290	848	73.9	2,117	2.4962	Yes
FRH	063133	STEWART ROAD-FRH	53,880	5/12/92	0.0000%	-1.5854	848	73.9	2,117	2.4962	Yes
FRH	0601140404	STEWART ROAD-FRH	55,448	4/26/94	0.3229%	0.3167	3,201	63.4	1,119	0.3496	Yes
FRH	063141	STEWART ROAD-FRH	53,121	5/2/94	0.1183%	0.3167	1,724	68.0	1,702	0.9871	Yes
FRH	063143	STEWART ROAD-FRH	54,537	5/9/94	0.0827%	0.3167	2,661	70.5	2,522	0.9478	Yes
FRH	0601060204	DOS REIS ROAD-FRH	51,271	5/16/96	0.3267%	-0.3387	8,704	63.4	3,359	0.3859	Yes
FRH	0601060206	DOS REIS ROAD-FRH	51,730	5/9/96	0.0611%	-0.3387	6,516	64.6	1,776	0.2726	Yes
FRH	0601060302	STEWART ROAD-FRH	26,784	4/28/97	1.4009%	-0.3983	6,018	62.2	2,531	0.4206	Yes
FRH	0601060303	STEWART ROAD-FRH	28,334	4/28/97	1.3364%	-0.3983	6,018	62.2	2,531	0.4206	Yes
FRH	0601060304	DOS REIS ROAD-FRH	27,059	4/29/97	1.4835%	-0.3983	5,900	62.0	2,639	0.4473	Yes
FRH	0601060305	DOS REIS ROAD-FRH	26,695	4/29/97	1.0251%	-0.3983	5,900	62.0	2,639	0.4473	Yes
MRH	064628	SAN JOAQ.R,BELOW OLD	50,765	4/24/82	2.4937%	-0.4400	27,939	63.6	10,070	0.3604	No
MRH	064658	DOS REIS ROAD	226,554	5/29/86	2.5555%	0.0930	7,066	69.6	4,170	0.5901	No
MRH	064659	STEWART ROAD	52,905	5/30/86	1.3794%	0.0930	7,158	69.5	4,873	0.6808	No
MRH	B61101	DOS REIS ROAD	51,226	5/29/86	2.2579%	0.0930	7,066	69.6	4,170	0.5901	No

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MRH	B61102	STEWART ROAD	54,310	5/30/86	1.2912%	0.0930	7,158	69.5	4,873	0.6808	No
MRH	064503	STEWART ROAD	37,024	4/27/87	0.5928%	-0.1845	2,375	70.4	8,288	3.4891	No
MRH	064504	STEWART ROAD	34,814	4/27/87	0.6134%	-0.1845	2,375	70.4	8,288	3.4891	No
MRH	064505	STEWART ROAD	36,438	4/27/87	0.6623%	-0.1845	2,375	70.4	8,288	3.4891	No
MRH	064506	DOS REIS ROAD	36,420	4/27/87	1.2776%	-0.1845	2,375	70.4	8,288	3.4891	No
MRH	064507	DOS REIS ROAD	37,251	4/27/87	1.3525%	-0.1845	2,375	70.4	8,288	3.4891	No
MRH	064508	DOS REIS ROAD	35,412	4/27/87	1.5538%	-0.1845	2,375	70.4	8,288	3.4891	No
MRH	0601110104	STEWART ROAD	27,181	5/3/89	0.0185%	0.0452	2,424	69.3	2,020	0.8333	No
MRH	0601110105	STEWART ROAD	26,582	5/3/89	0.0000%	0.0452	2,424	69.3	2,020	0.8333	No
MRH	0601110106	STEWART ROAD	26,850	5/3/89	0.0410%	0.0452	2,424	69.3	2,020	0.8333	No
MRH	0601110107	DOS REIS ROAD	26,108	5/2/89	0.1088%	0.0452	2,438	68.2	3,838	1.5743	No
MRH	0601110108	DOS REIS ROAD	26,672	5/2/89	0.1460%	0.0452	2,438	68.2	3,838	1.5743	No
MRH	0601110113	DOS REIS ROAD	26,383	5/2/89	0.1156%	0.0452	2,438	68.2	3,838	1.5743	No
MRH	0601110412	DOS REIS ROAD	25,633	5/1/96	0.1345%	-0.3387	6,459	65.3	1,798	0.2784	No
MRH	0601110413	DOS REIS ROAD	29,192	5/1/96	0.3589%	-0.3387	6,459	65.3	1,798	0.2784	No
MRH	0601110414	DOS REIS ROAD	18,533	5/1/96	0.0716%	-0.3387	6,459	65.3	1,798	0.2784	No
MRH	0601110415	DOS REIS ROAD	36,037	5/1/96	0.1757%	-0.3387	6,459	65.3	1,798	0.2784	No
MRH	0601110806	DOS REIS ROAD	26,752	4/17/98	0.7070%	-1.8267	24,752	17.6	1,302	0.0526	No
MRH	0601110807	DOS REIS ROAD	26,906	4/17/98	0.6234%	-1.8267	24,752	17.6	1,302	0.0526	No
MRH	0601110808	DOS REIS ROAD	25,300	4/17/98	0.6858%	-1.8267	24,752	17.6	1,302	0.0526	No
MRH	0601110809	MOSSDALE	26,465	4/16/98	0.5217%	-1.8267	24,923	17.6	928	0.0372	No
MRH	0601110810	MOSSDALE	25,264	4/16/98	0.4015%	-1.8267	24,923	17.6	928	0.0372	No
MRH	0601110811	MOSSDALE	25,926	4/16/98	0.7143%	-1.8267	24,923	17.6	928	0.0372	No
MRH	062642	MOSSDALE	25,194	4/19/99	1.3337%	1.1031	6,914	65.3	2,763	0.3996	No

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MRH	062643	MOSSDALE	25,204	4/19/99	1.1974%	1.1031	6,914	65.3	2,763	0.3996	No
MRH	062644	MOSSDALE	25,921	4/19/99	1.5863%	1.1031	6,914	17.6	2,763	0.3996	No
MRH	062645	DOS REIS ROAD	25,267	4/19/99	2.2512%	1.1031	6,914	17.6	2,763	0.3996	No
MRH	062646	DOS REIS ROAD	25,092	4/19/99	2.1422%	1.1031	6,914	17.6	2,763	0.3996	No
MRH	064723	MOSSDALE	25,531	5/19/06	0.0273%	-1.4369	24,556	66.6	6,734	0.2742	No
MRH	064606	MOSSDALE	25,746	4/20/99	0.8866%	1.1031	6,920	17.6	2,823	0.4079	No
MRH	064584	DURHAM FERRY	25,230	5/9/05	0.0213%	-1.2566	8,866	60.8	2,443	0.2756	No
MRH	064585	DURHAM FERRY	25,229	5/9/05	0.0000%	-1.2566	8,866	60.8	2,443	0.2756	No
MRH	064586	DURHAM FERRY	25,231	5/9/05	0.0098%	-1.2566	8,866	60.8	2,443	0.2756	No
MRH	064587	DURHAM FERRY	25,229	5/9/05	0.0000%	-1.2566	8,866	60.8	2,443	0.2756	No
MRH	064589	DOS REIS ROAD	25,052	5/10/05	0.0436%	-1.2566	8,982	61.5	2,628	0.2926	No
MRH	064590	DOS REIS ROAD	25,506	5/10/05	0.0000%	-1.2566	8,982	61.5	2,628	0.2926	No
MRH	064591	DOS REIS ROAD	24,946	5/3/05	0.0000%	-1.2566	8,192	61.2	2,446	0.2986	No
MRH	064672	DURHAM FERRY	25,174	5/2/05	0.0490%	-1.2566	8,140	61.6	2,412	0.2963	No
MRH	064673	DURHAM FERRY	25,176	5/2/05	0.0130%	-1.2566	8,140	61.6	2,412	0.2963	No
MRH	064674	DURHAM FERRY	25,192	5/2/05	0.0121%	-1.2566	8,140	61.6	2,412	0.2963	No
MRH	064675	DURHAM FERRY	25,170	5/2/05	0.0000%	-1.2566	8,140	61.6	2,412	0.2963	No
MRH	064697	DOS REIS ROAD	25,186	5/3/05	0.0000%	-1.2566	8,192	61.2	2,446	0.2986	No
MRH	064698	DOS REIS ROAD	26,090	5/3/05	0.0309%	-1.2566	8,192	61.2	2,446	0.2986	No
MRH	064699	DOS REIS ROAD	25,417	5/10/05	0.0043%	-1.2566	8,982	61.5	2,628	0.2926	No
FRH	063114	DOS REIS ROAD-FRH	53,122	4/20/89	0.1605%	0.0452	1,813	66.3	10,781	5.9456	No
FRH	0601140105	STEWART ROAD-FRH	54,545	4/17/90	0.0174%	-0.0443	1,107	69.7	9,663	8.7328	No
FRH	0601140106	STEWART ROAD-FRH	53,641	4/17/90	0.0108%	-0.0443	1,107	69.7	9,663	8.7328	No
FRH	0601140107	DOS REIS ROAD-FRH	53,367	4/16/90	0.0412%	-0.0443	1,087	69.7	9,468	8.7106	No

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FRH	0601140108	DOS REIS ROAD-FRH	54,179	4/16/90	0.0286%	-0.0443	1,087	69.7	9,468	8.7106	No
FRH	0601140110	DOS REIS ROAD-FRH	54,050	5/2/90	0.0290%	-0.0443	1,348	70.7	3,374	2.5035	No
FRH	0601140111	DOS REIS ROAD-FRH	54,745	5/2/90	0.0826%	-0.0443	1,348	70.7	3,374	2.5035	No
FRH	0601140112	STEWART ROAD-FRH	54,334	5/3/90	0.0149%	-0.0443	1,364	71.8	3,604	2.6423	No
FRH	0601140113	STEWART ROAD-FRH	54,006	5/3/90	0.0103%	-0.0443	1,364	71.8	3,604	2.6423	No
FRH	0601140114	DOS REIS ROAD-FRH	55,408	4/15/91	0.0994%	0.8465	694	64.7	8,009	11.5343	No
FRH	0601140115	DOS REIS ROAD-FRH	54,081	4/15/91	0.1455%	0.8465	694	64.7	8,009	11.5343	No
FRH	0601140212	STEWART ROAD-FRH	72,798	4/7/92	0.1507%	-1.2290	1,586	66.6	5,852	3.6904	No
FRH	0601140213	STEWART ROAD-FRH	54,087	4/7/92	0.1001%	-1.2290	1,586	66.6	5,852	3.6904	No
FRH	0601140214	STEWART ROAD-FRH	55,644	4/13/92	0.0472%	-1.2290	1,383	66.4	1,429	1.0332	No
FRH	0601140215	STEWART ROAD-FRH	51,830	4/13/92	0.0376%	-1.2290	1,383	66.4	1,429	1.0332	No
FRH	0601140306	STEWART ROAD-FRH	53,499	4/6/93	0.0833%	-1.5854	3,016	65.1	7,048	2.3370	No
FRH	0601140312	STEWART ROAD-FRH	56,650	4/28/93	0.2546%	-1.5854	4,392	63.8	1,756	0.3998	No
FRH	063135	STEWART ROAD-FRH	52,729	5/4/93	0.2925%	-1.5854	4,568	62.8	1,850	0.4050	No
FRH	063138	STEWART ROAD-FRH	54,357	5/12/93	0.2384%	-1.5854	3,566	63.6	1,823	0.5112	No
FRH	0601140315	STEWART ROAD-FRH	53,665	4/11/94	0.2100%	0.3167	1,462	66.3	2,030	1.3882	No
FRH	0601140412	DOS REIS ROAD-FRH	52,313	4/17/95	1.0025%	-0.7578	18,871	57.8	3,790	0.2008	No
FRH	0601140414	STEWART ROAD-FRH	51,511	4/17/95	0.8679%	-0.7578	18,871	57.8	3,790	0.2008	No
FRH	0601140501	STEWART ROAD-FRH	51,886	4/17/95	0.8638%	-0.7578	18,871	57.8	3,790	0.2008	No
FRH	0601140504	STEWART ROAD-FRH	53,444	5/17/95	0.8267%	-0.7578	23,030	67.1	3,514	0.1526	No
FRH	063147	DOS REIS ROAD-FRH	52,676	5/5/95	1.1813%	-0.7578	20,981	62.8	3,904	0.1861	No
FRH	063148	STEWART ROAD-FRH	53,342	5/17/95	0.6320%	-0.7578	23,030	67.1	3,514	0.1526	No
FRH	063149	DOS REIS ROAD-FRH	52,935	5/5/95	0.8782%	-0.7578	20,981	62.8	3,904	0.1861	No
FRH	063150	STEWART ROAD-FRH	52,719	5/5/95	0.6268%	-0.7578	20,981	62.8	3,904	0.1861	No

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FRH	063151	STEWART ROAD-FRH	52,689	5/5/95	0.5834%	-0.7578	20,981	62.8	3,904	0.1861	No
FRH	0601060114	STEWART ROAD-FRH	51,620	4/15/96	0.1534%	-0.3387	6,701	60.4	2,668	0.3981	No
FRH	0601060115	STEWART ROAD-FRH	52,780	4/15/96	0.2546%	-0.3387	6,701	60.4	2,668	0.3981	No
FRH	0601060201	STEWART ROAD-FRH	52,570	4/30/96	0.0651%	-0.3387	6,525	65.3	1,953	0.2993	No
FRH	0601060205	STEWART ROAD-FRH	51,744	4/30/96	0.1094%	-0.3387	6,525	65.3	1,953	0.2993	No
FRH	0601140505	SAN JOAQ.R,BELOW OLD-FRH	51,660	4/17/96	0.3206%	-0.3387	6,847	59.6	1,743	0.2546	No
FRH	0601060110	DOS REIS ROAD-FRH	51,347	5/1/96	0.0519%	-0.3387	6,459	65.3	1,798	0.2784	No
FRH	0601060111	SAN JOAQ.R,BELOW OLD-FRH	51,100	5/2/96	0.0917%	-0.3387	6,433	65.1	1,821	0.2831	No
FRH	0601060112	SAN JOAQ.R,BELOW OLD-FRH	52,010	5/2/96	0.1127%	-0.3387	6,433	65.1	1,821	0.2831	No
FRH	0601060203	DOS REIS ROAD-FRH	51,951	5/1/96	0.1163%	-0.3387	6,459	65.3	1,798	0.2784	No
FRH	0601060505	MOSSDALE-FRH	15,796	4/23/98	0.1006%	0.6102	20,562	65.8	2,233	0.1086	No
FRH	0601060506	MOSSDALE-FRH	18,670	4/23/98	0.0630%	-1.8267	20,562	65.8	2,233	0.1086	No
FRH	0601140606	DOS REIS ROAD-FRH	24,377	4/24/98	0.1651%	-1.8267	20,104	65.7	2,240	0.1114	No
FRH	0601140607	DOS REIS ROAD-FRH	24,787	4/24/98	0.2653%	-1.8267	20,104	65.7	2,240	0.1114	No
FRH	0601060414	MOSSDALE-FRH	21,714	5/6/98	0.6211%	-1.8267	16,506	65.7	2,161	0.1309	No
FRH	0601060415	MOSSDALE-FRH	21,486	5/6/98	0.4147%	-1.8267	16,506	65.7	2,161	0.1309	No