APPENDIX T

Groundwater Impact Evaluation Technical Memorandum

Rio Del Oro
Development Project

Groundwater Impact Evaluation

Technical Memorandum

Prepared for:

EDAW

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TABLE OF CONTENTS

This Technical Memorandum presents the results of the evaluation of three proposed Rio Del Oro development alternatives. Also evaluated were the impacts of removing mine tailings (grading) from the project site. Rio Del Oro is a proposed mixed-use development within Rancho Cordova, California. The site has been used for mining activities and for propellant testing by the aerospace industry. The site is currently zoned industrial, and rezoning of the site is being sought. Figure 1 shows the project location (figures are included at the end of the text).

A Notice of Preparation was filed by the City of Rancho Cordova announcing the development of an Environmental Impact Report (EIR) for the Rio del Oro community project. EDAW was retained to develop the EIR. A component of the EIR is the evaluation of the impacts on deep percolation, as indicated by changes in depth to groundwater, due to the implementation of the project in the largely undeveloped area. Analysis is required to determine if the development of the project will change deep percolation rates and depth to groundwater.

EDAW retained Water Resources & Information Management Engineering, Inc. (WRIME) to evaluate how deep percolation and depth to groundwater would be affected due to the development of the Rio del Oro project. The tool selected to evaluate the Rio Del Oro project was the Sacramento County Integrated Groundwater and Surface water Model (SACIGSM).

The SACIGSM was originally developed in 1993 (Montgomery Watson, 1993) to analyze groundwater and surface water operations, basin yield, and impacts of various water supply plans on the groundwater and surface water resources in Sacramento County. As part of the effort for hydrologic analysis to support the update of the *Zone 40 Water Supply Master Plan*, the model was refined to reflect Zone 40 planning units, as well as additional detailed land use and water use data (WRIME, 2004; WRIME, 2005). The Rio Del Oro development is within the Zone 40, allowing this analysis to utilize the previous work effort.

DISCLAIMER

The SACIGSM is a regional groundwater and surface water model that simulates the water resources system on daily time-steps and uses widely spaced grid nodes and relatively large grid elements. Due to the scale of model simulation time-step and the size of the model grid, the model is limited in its ability to provide specific information regarding localized groundwater flow, drawdown, and infiltration rate; and other information that does not lend itself to be determined at a small scale. As such, the results of this study should only be considered in a regional context.

The SACIGSM was used to simulate impacts of the Rio Del Oro Project Alternatives. These alternatives differ in the degree of land set aside for wetlands and the density of urbanization. The impacts of removing placer mine tailings from the Rio Del Oro Project Site were also evaluated. A 25-year hydrologic period was used in the simulations of the alternatives. The impacts of the alternatives were evaluated at the end of simulation period. This represents the responses in the groundwater system over long-term, hydrologic conditions.

2.1 BASELINE

The Baseline used in evaluating the Rio Del Oro Project Alternatives is the SACIGSM Baseline 2000. The Baseline 2000 was developed for the *Zone 40 Water Supply Master Plan*. The Baseline 2000 is consistent with the assumptions used to define the Rio Del Oro No-Action Alternative. The Baseline 2000 land use at Rio Del Oro is primarily undeveloped land. The 1970 through 1995 hydrologic period is incorporated in the Baseline 2000. This hydrologic period is a reasonably balanced hydrologic sequence that includes periods of drought (1976-77, 1987-1992) and recovery (1983, 1993-1995).

The Sacramento County General Plan shows the Rio Del Oro area as a fully-developed urban area. As such, 2030 Baseline Condition, which is representative of the Sacramento County General Plan, incorporates the Rio Del Oro development. However, the various detailed land use conditions are not considered in the General Plan and are subject of this EIR.

Actual groundwater level data was used to calibrate, or ground truth, the model in and around the Rio Del Oro project area. The parameters determined through calibration were used to develop the Baseline 2000 and were used to simulate the groundwater conditions in the Rio Del Oro project area.

2.2 ALTERNATIVES ASSUMPTIONS

The developments at Rio Del Oro are projected to occur over time during the next 20-25 years. However, in order to evaluate the impact, a worst-case scenario was analyzed by assuming that the project was fully-developed at the start of the 25-year analysis period. The fully developed project conditions are consistent with the build-out conditions considered in the Sacramento County General Plan.

Surface water is provided to meet the demands at Rio Del Oro. Baseline model includes groundwater pumping associated with remediation around the Rio Del Oro area. SCWA is planning to use the remediated groundwater for consumptive purposes. SCWA is expected to be the water purveyor for the Rio Del Oro area and a portion of the Rio Del Oro water supply will include remediated groundwater. Part of the water that is used at the development site will be applied outdoors. The water used outdoors can subsequently percolate and recharge the groundwater system; while water used indoors is returned to the regional wastewater treatment plant. In addition, it is expected that the grading of the site for development will not significantly disturb the current infiltration potential of the soils in the project area. As such, the percolation of applied water for turf irrigation, greenbelts, and parks would not be affected significantly due to grading. This assumption is based on site visits, cursory evaluation of the soil conditions and review of mining and excavation plans for the site (Teichert Aggregates, 2004), the master drainage study (Wood Rodgers, 2003), and professional judgment; and has not been independently verified through analysis of borings and core samples.

A model parameter is specified to reflect the relative imperviousness of Rio Del Oro. This parameter is used in the calculation of recharge to the groundwater system. This parameter was modified to reflect the different land use scenarios in the Rio Del Oro alternatives.

2.3 PROPOSED ACTION ALTERNATIVE

In this alternative, Rio Del Oro would be developed as a mixed-use master-planned community that includes a range of housing types, employment centers, and recreation opportunities. Table 1 summarizes the land use data that is incorporated in the Rio Del Oro Draft Environmental Impact Report (EDAW, 2005). Table 1 also includes unit water demand data that is incorporated from the water system infrastructure plan that was developed by Sacramento County Water Agency for Rio Del Oro and surrounding areas (Sacramento County Water Agency, 2004). The table shows an estimated water demand for each project alternative, by land use type.

Table 1. Land Use and Water Demand Summary

Land Use	Unit water demand (acre-feet/acre)[1]	Area (acres)[2]			Water Demand (acre-feet)		
		Proposed Action	*High Density*	*Impact Minimi-zation*	*Proposed Action*	*High Density*	*Impact Minimi-zation*
Single Family Residential	2.89	1,597	1,567	1,036	4,615	4,529	2,994
Medium Density Residential	3.7	237	249	241	877	921	892
High Density Residential	4.12	86	104	173.5	354	428	715
Village Commercial	2.75	20	20	15	55	55	41
Local Town Center	1.04	22	22	22	23	23	23
Regional Town Center	1.04	111	111	87	115	115	90
Business Park	2.75	86	86	105.5	237	237	290
Industrial Park	2.71	282	282	258.5	764	764	701
Public / Quasi Pubic	1.04	9.5	9.5	24	10	10	25
School Campus	1.04	78	78	77.5	81	81	81
Middle School	1.04	20	20	20	21	21	21
Elementary School	1.04	54	54	44.5	56	56	46
Community Park	3.46	107	107	106	370	370	367
Neighborhood Parks	3.46	63	63	61	218	218	211
Storm Water Detention	0	39	39	36	0	0	0
Wetland Preserve	0	507	507	992	0	0	0
Drainage Parkway	3.46	143	143	147	495	495	509
Private Recreation	3.46	54	54	50	187	187	173
Open Space/ Preserve	0	36	36	10	0	0	0
Landscape Corridors	1.04	44	44	44	46	46	46
Greenbelts	1.04	50	50	50	52	52	52
Major Roads	0	183	183	225.5	0	0	0
TOTAL		**3,829**	**3,829**	**3,826**	**8,576**	**8,608**	**7,276**

1. Rio Del Oro Draft Environmental Impact Report
2. Sacramento County Water Agency Zone 40 Water System Infrastructure Plan for the Sunrise Corridor / Mather / Sunrise Douglas Service Areas

The SACIGSM uses four categories to characterize land use for Rio Del Oro: urban, agricultural (irrigated parks and open space), native vegetation, and riparian vegetation. Table 2 summarizes the land use data included in the SACIGSM to simulate this alternative.

Table 2. Land and Water Use Data Incorporated in the SACIGSM

Alternative	Land Use (acres)					Water Use (af)
	Urban	*Agriculture (irrigated area)*	*Native Vegetation*	*Riparian Vegetation*	*Total*	
Baseline 2000	183	1,207	2,247	192	3,828.5	2,694
Proposed Action	2,785.5	500	36	507	3,828.5	8,576
High Density	2,785.5	500	36	507	3,828.5	8,608
Impact Minimization	2,330	494	10	994.5	3,828.5	7,276

2.4 HIGH DENSITY DEVELOPMENT ALTERNATIVE

In this alternative, Rio Del Oro is designed similar to the Proposed Action Alternative, but the number of medium- and high-density residential units is greater and there are fewer single-family residential units. The land and water use data associated with the alternative is summarized in Table 2. It should be noted that the High-Density Alternative, as designed, has the highest water demand of any of the alternatives. This is due to the fact that a greater number of medium- and high-density housing units are planned for development in this alternative compared to the other alternatives. Medium- and high-density housing have a greater water demand per unit of area than single-family housing, thus the higher overall water demand.

2.5 IMPACT MINIMIZATION ALTERNATIVE

In this alternative, the project site would be configured so that the level of residential, commercial, and industrial development would decrease from the Proposed Action. An additional 485 acres would be designated as part of the wetland preserve. The total amount of residential development would be reduced by approximately 380 acres; however, the residential unit density would increase. The land and water use data associated with the alternative is summarized in Table 2.

The following are results of the hydrologic modeling associated with the Rio Del Oro Project Alternatives and the impacts of grading the Project Site.

Depth to groundwater contour maps and hydrographs were developed to evaluate the impacts of grading the site and impacts of development. The contour maps were produced by calculating the difference in depth to groundwater between each Project Alternative and the Baseline 2000. The difference contours represent long-term changes in the groundwater system at the end of the simulation period. Depth to groundwater hydrographs were prepared at two locations in and around the project site. Figure 1 shows the hydrograph locations.

3.1 IMPACTS OF SITE DEVELOPMENT

The SACIGSM Baseline 2000 was modified to reflect the Development Alternatives. The impacts of the alternatives are described below.

Figures 2 through 4 show the difference in groundwater depths due to the development of the Rio Del Oro. The figures show that depths to groundwater would decrease by 6, 2, and 6 feet from Baseline 2000 groundwater depths for Proposed Action, High Density Development and Impact Minimization Alternatives, respectively. Figures 5 and 6 show the depth to groundwater for each hydrograph location over the planning horizon. The hydrographs show that the depth to groundwater for the Project Alternatives are less than the Baseline 2000. The difference in groundwater levels between the Proposed Alternatives and Baseline 2000 appears to have stabilized by simulation year 19 or 20. An evaluation of the depth to groundwater in the area, the seasonal fluctuation of depth to groundwater, and the potential future uses of groundwater in the area for local and/or regional municipal and/or industrial demands indicates that the estimated changes in the depth to groundwater due to the proposed development are not significant.

The reduced depth to groundwater under each development alternative are primarily due to the introduction of surface water supplies relative to the no development in the Baseline 2000. The difference in groundwater elevations between the various development alternatives is due to the density of land use and water supply rates. In the alternative where there is greater outdoor water use (Project Alternative and Impact Minimization), the long-term depth to water is lower than those with less outdoor water use. As shown in Figure 6, the Project Alternative and Impact Minimization alternatives produce similar results since both alternatives recharge the groundwater system with similar volumes of water.

Depth to groundwater difference contours are centered in and around the Rio Del Oro project site because there are no other changes to the land and water conditions in the areas outside Rio Del Oro. The difference contours represent the impacts of the proposed alternatives on the groundwater system. The contours with the greatest negative values are focused on the areas with the greatest change in depth to water.

It is concluded that the development of the proposed site will not have significant hydrologic impacts on the groundwater conditions in the area.

3.2 IMPACTS OF CHANGES IN SOIL INFILTRATION POTENTIAL

The hydrologic impacts of grading the project site can be evaluated by analysis of changes to the hydrologic soil conditions at the site. The hydrologic soil type governs the infiltration potential of soils and as such, recharge to the groundwater system. The most recent Natural Resource Conservation Service (NRCS) soil survey of Sacramento County indicates that the predominant soil types for the project area have the greatest infiltration potential, as ranked and categorized by the NRCS. The SACIGSM Baseline 2000 model scenario reflects this condition.

Based on site visits, review of the mining and excavation plans for the site (Teichert Aggregates, 2004) and the master drainage study (Wood Rodgers, 2003) for the site, and professional judgment and experience, it is not expected that the grading of the proposed development area will alter the hydrologic soil conditions in the area significantly.

However, in order to estimate the range of impacts on groundwater levels of the worst-case changes to the hydrologic soil conditions, the SACIGSM Baseline 2000 was modified to reflect extreme changes in the hydrologic soil type, so that they have the lowest infiltration potential. Figure 7 shows the impact of such extreme case on depth to groundwater in the development area. Figures 8 and 9 show simulated depth to groundwater for existing soil type and low infiltration potential soil type for locations 1 and 2, respectively.

Figure 7 shows that depth to groundwater could increase by approximately 12 feet, if grading the project site causes extreme changes to the hydrologic soil type. Figures 8 and 9 show that the depth to groundwater at Location 1 is approximately 3 feet greater than Baseline 2000 depth to groundwater. The difference appears to stabilize after about year 18. Figure 9 shows that at location 2 depth to groundwater is approximately 8 to 10 feet greater in low infiltration soil conditions compared to Baseline 2000. As indicated before, based on site visits and visual inspection of the soil conditions as well as previous investigations, it is not expected that grading of the site would change the infiltration capacity of the soil. In addition, because this area is not intended for heavy use of groundwater for municipal and/or industrial use, and the development of the area is expected to decrease the depth to groundwater by 2 to 6 feet, the impacts of extreme changes to infiltration capacity on groundwater levels is considered not to be significant on the local and/or regional groundwater conditions.

The SACIGSM has been used to evaluate the potential impacts of the Rio Del Oro project. The alternatives were evaluated by modifying the Baseline 2000 model to represent the details of each Project Alternative. The Baseline 2000 model was also modified so that impacts of grading the project site could be evaluated independent of the Project Alternatives. The following is summarized from the analyses conducted.

1. The Project Alternatives include plans for developing 2,800 to 3,300 acres of the 3,800-acre project site with an average annual water demand of 7,300 to 8,800 acre-feet. Imported surface water treated to drinking water standards is the source of supply.
2. Depth to groundwater is expected to decrease by 2 to 6 feet within the Rio Del Oro boundary with the development of the project.
3. The reduced depths to groundwater under each development alternative are primarily due to the introduction of surface water supplies relative to the no development in the Baseline 2000. The difference in the depth to groundwater between the various development alternatives is due to the density of land use and water supply rates.
4. The analyses of development Alternatives indicate that there are no significant hydrologic impacts due to changes in the land use in the development site.
5. The predominant soil types at the development project site have the highest potential for infiltration, according to the NRCS. It is not expected that the mining and excavation of the site will affect the infiltration capacity of the soils in the development area.
6. A modeling analysis of impacts on the depth to groundwater was conducted where it was assumed that an extreme disturbance of hydrologic soil conditions is made. The results indicate that the extreme changes to infiltration capacity could potentially cause increase the depth of groundwater by up to 12 feet.
7. Given that the potential uses of groundwater for M&I in the area is limited, and the development of the site would potentially cause an increase in groundwater levels, the potential impacts of extreme changes to soil infiltration capacity is considered not to be significant.

EDAW 2005. *Draft Environmental Impact Report for Rio Del Oro Project, Rancho Cordova, California.* June 2005.

Montgomery Watson 1993. *County Groundwater Model – Model Development and Basin Groundwater Yield.* Sacramento County Water Agency. June 1993.

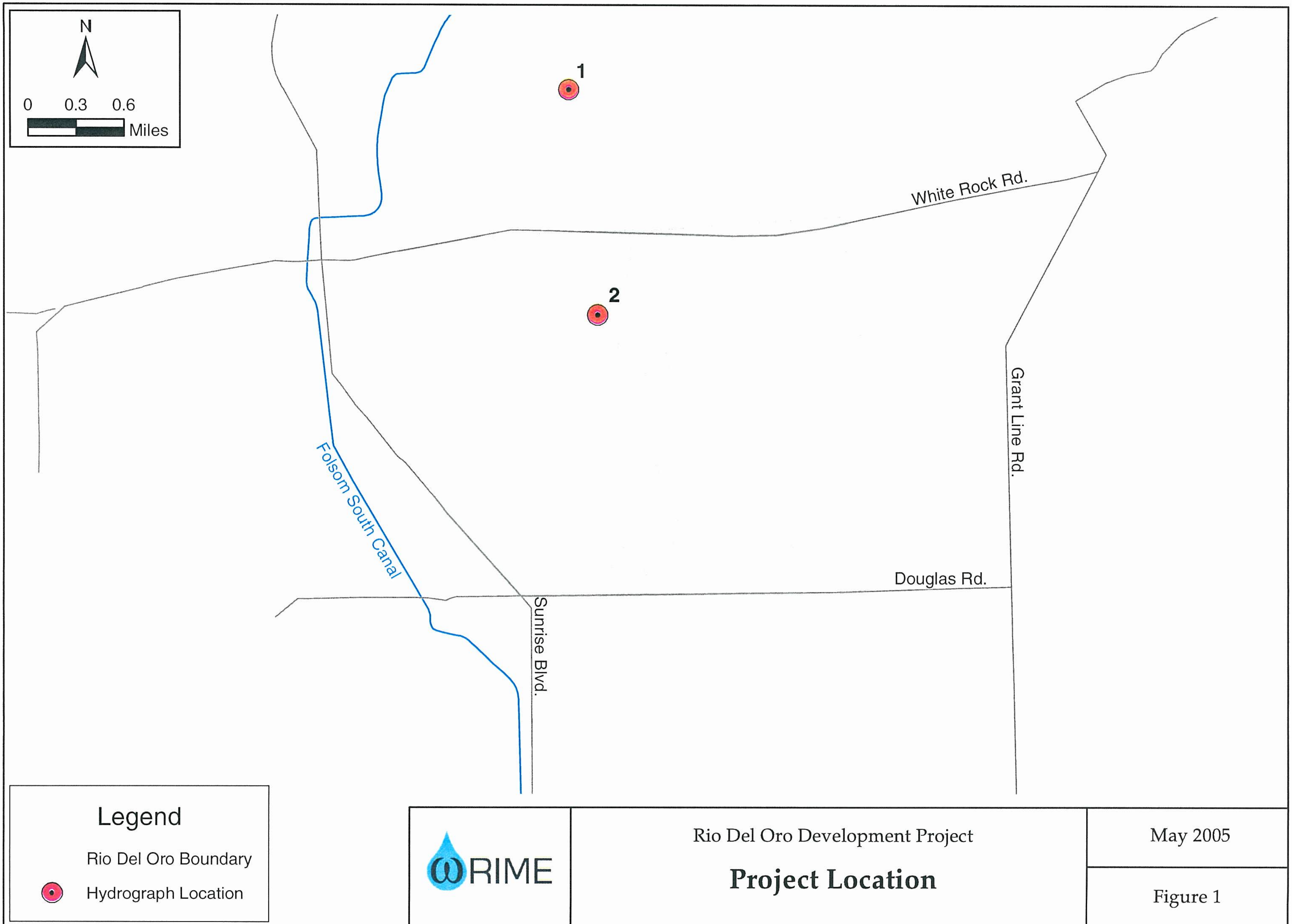
Sacramento County Water Agency 2004. *Sacramento County Water Agency Zone 40 Water System Infrastructure Plan (WSIP) for the Sunrise Corridor/Mather/Sunrise Douglas Service Areas.* April 2004.

Teichert Aggregates 2004. *Mining and Reclamation Plans for Grantline West – City of Rancho Cordova, CA.* December 2004.

Wood Rodgers 2003. *Master Drainage Study – Rio Del Oro – Rancho Cordova, California.* August 2003.

WRIME 2004. *Hydrologic and Modeling Analysis for Zone 40 Water Supply Master Plan.* Sacramento County Department of Environmental Review and Assessment. December 2004.

WRIME 2005. DRAFT - *Cosumnes River Hydrologic Evaluation.* Sacramento County of Environmental Review and Assessment. March 2005.



Rio Del Oro Development Project

Project Location

May 2005

Figure 1

Note: contour units is feet, difference is calculated as alternative minus no action, layer 1 depth to groundwater, end of simulation for 1970-1995 hydrologic period

Legend

Rio Del Oro Boundary

Groundwater Difference Contour

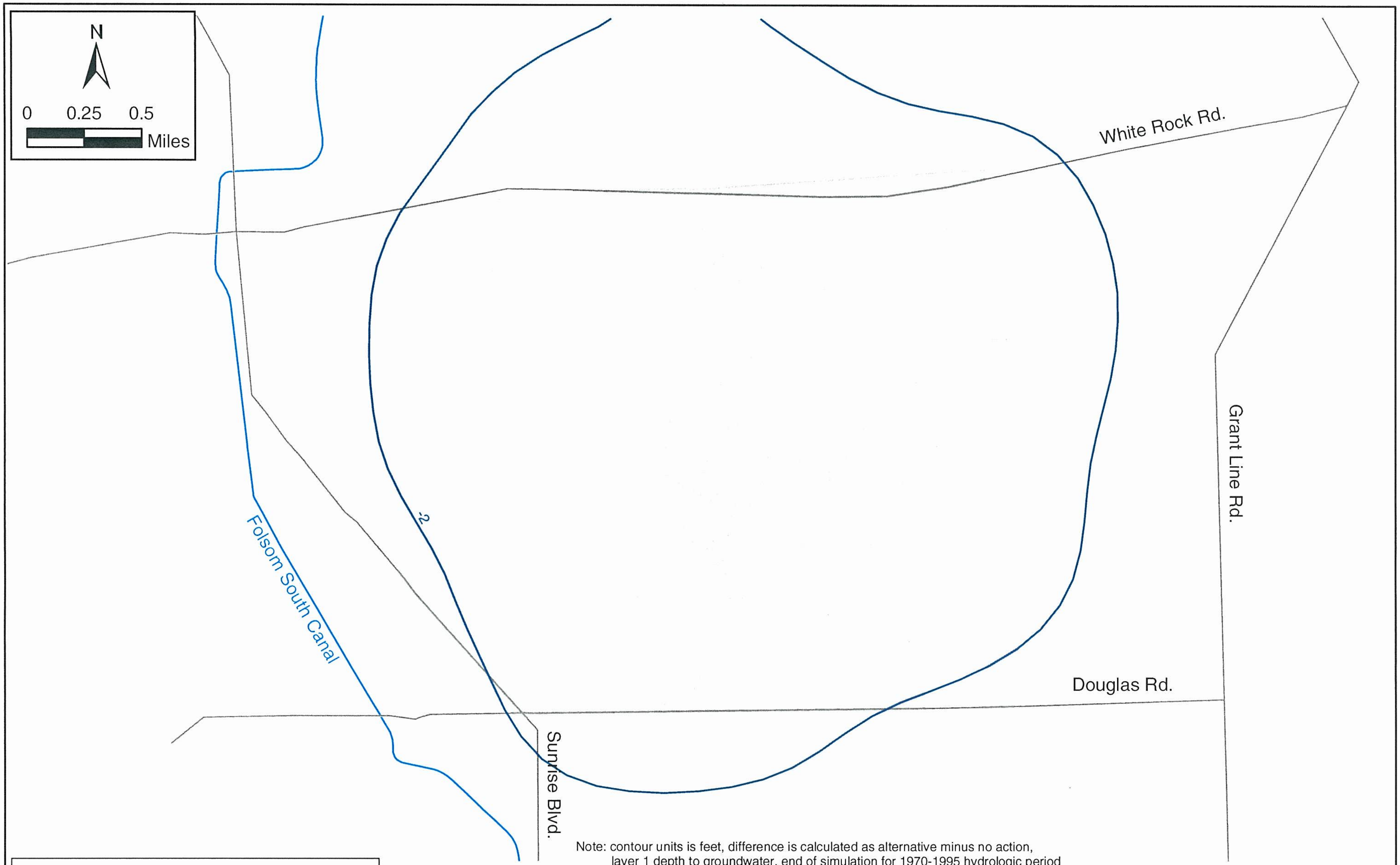
RIME

Rio Del Oro Development Project

Impacts on Depth to Groundwater of the Proposed Action Alternative

May 2005

Figure 2



Note: contour units is feet, difference is calculated as alternative minus no action, layer 1 depth to groundwater, end of simulation for 1970-1995 hydrologic period

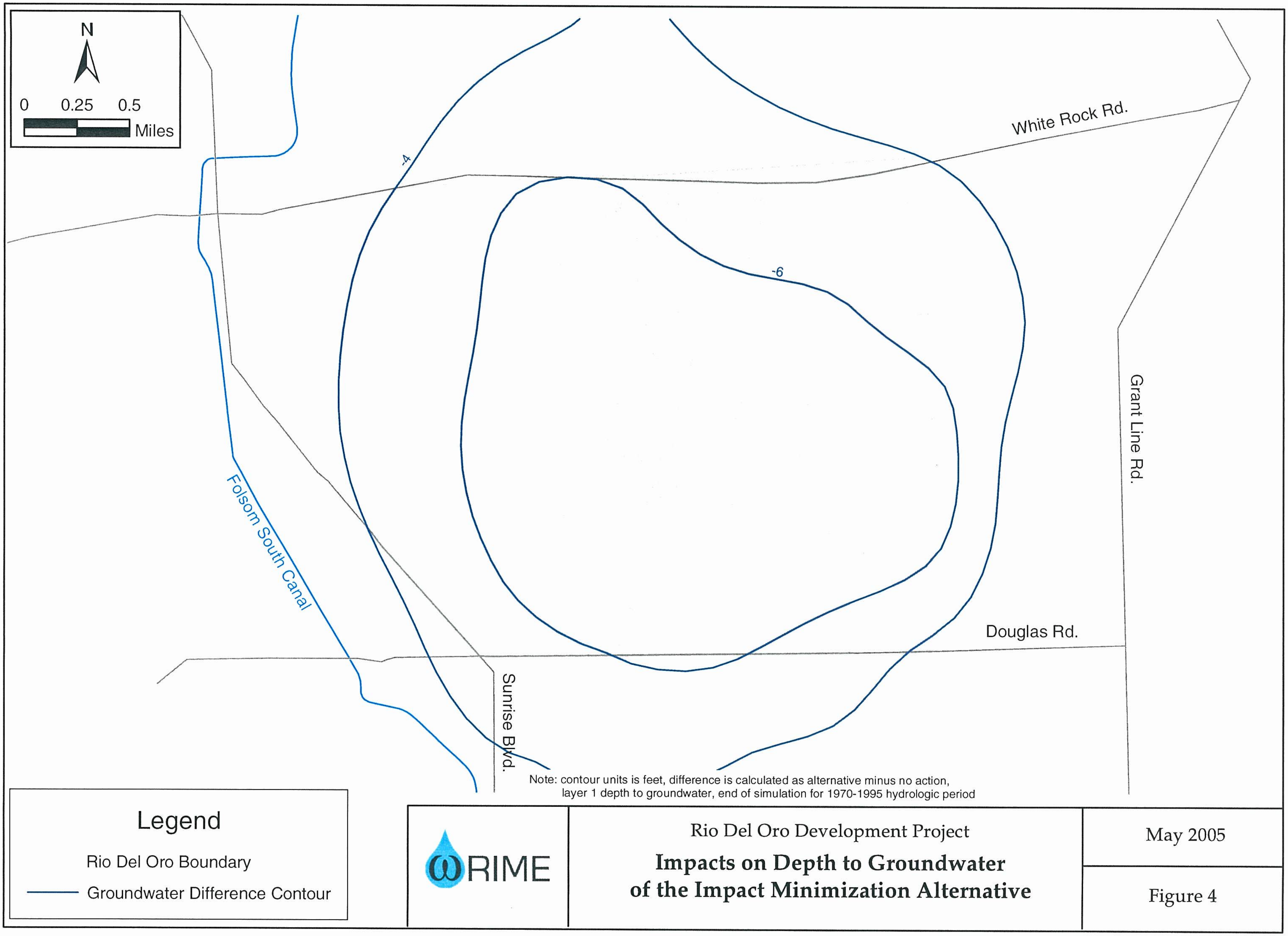
RIME

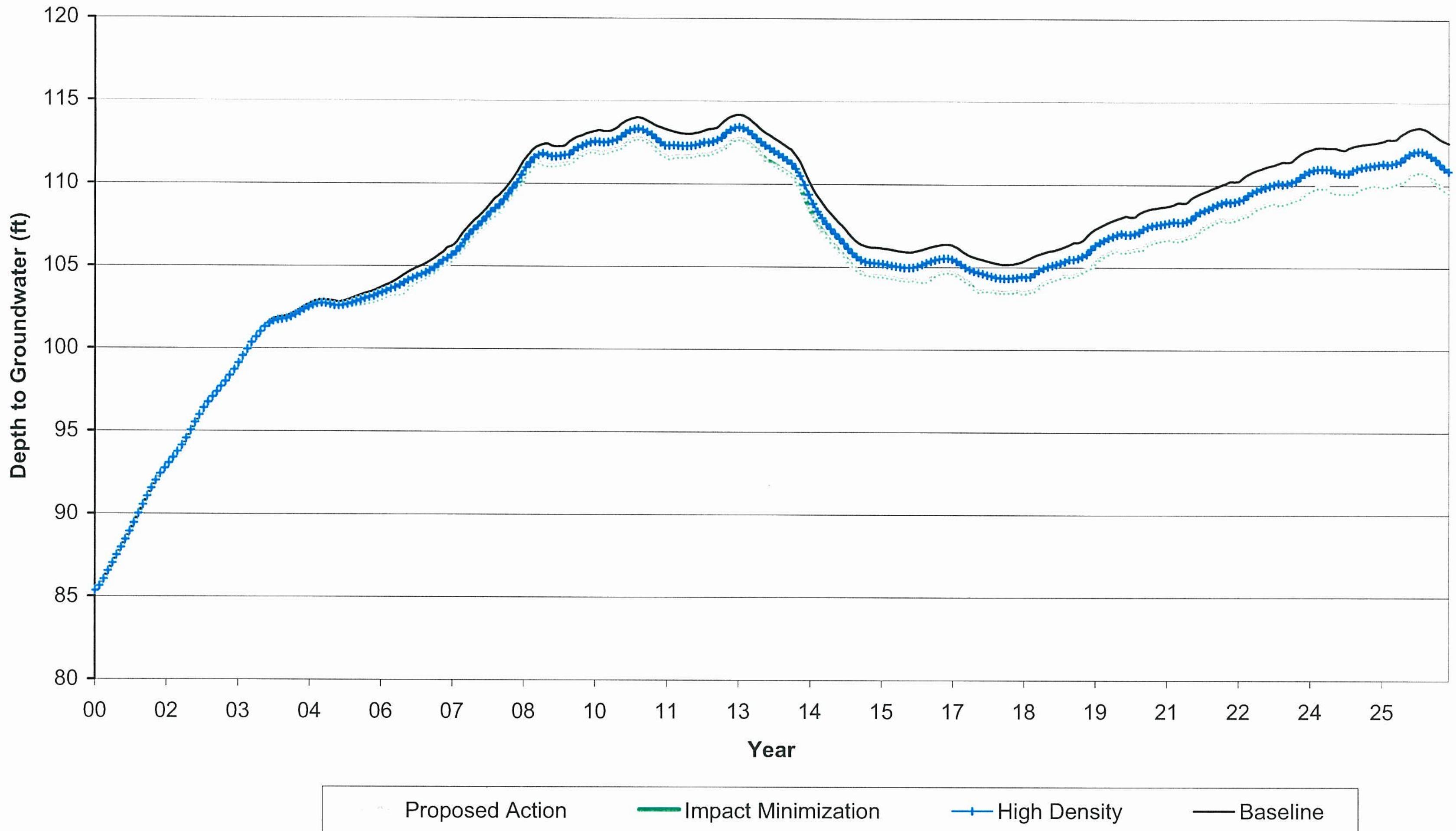
Rio Del Oro Development Project

Impacts on Depth to Groundwater of the High Density Alternative

May 2005

Figure 3


N
0 0.25 0.5
Miles
White Rock Rd.
Grant Line Rd.
Douglas Rd.
Sunrise Blvd.
Folsom South Canal
-4
-6
Note: contour units is feet, difference is calculated as alternative minus no action,
layer 1 depth to groundwater, end of simulation for 1970-1995 hydrologic period
Legend
Rio Del Oro Boundary
Groundwater Difference Contour
RIME
Rio Del Oro Development Project
Impacts on Depth to Groundwater
of the Impact Minimization Alternative
May 2005
Figure 4



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Rio Del Oro Groundwater Evaluation

Depth to Groundwater Hydrograph for Baseline and Project Alternatives at Location 1

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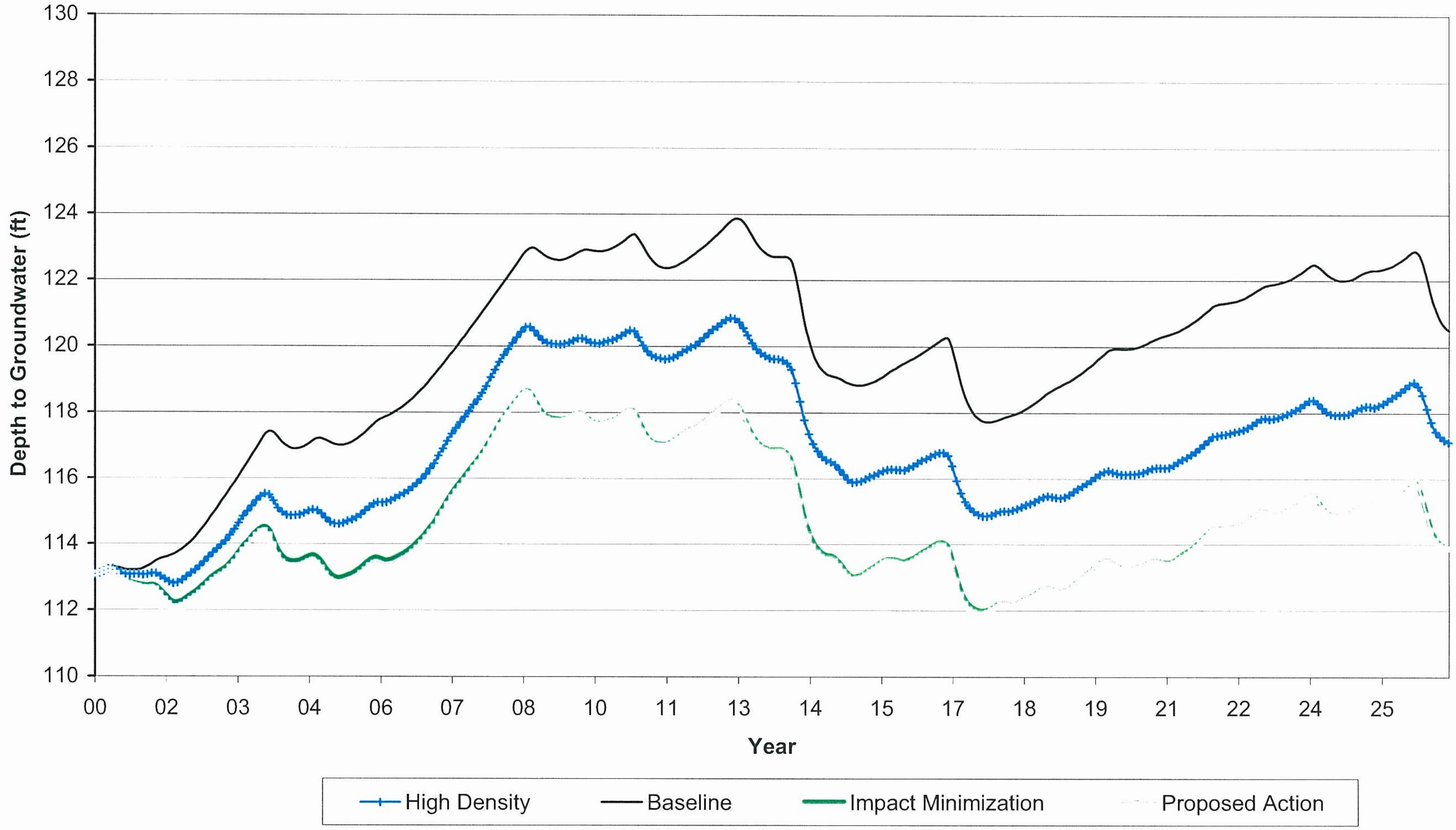
FIGURE 5



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Rio Del Oro Groundwater Evaluation

Depth to Groundwater Hydrograph for Baseline and Project Alternatives at Location 2

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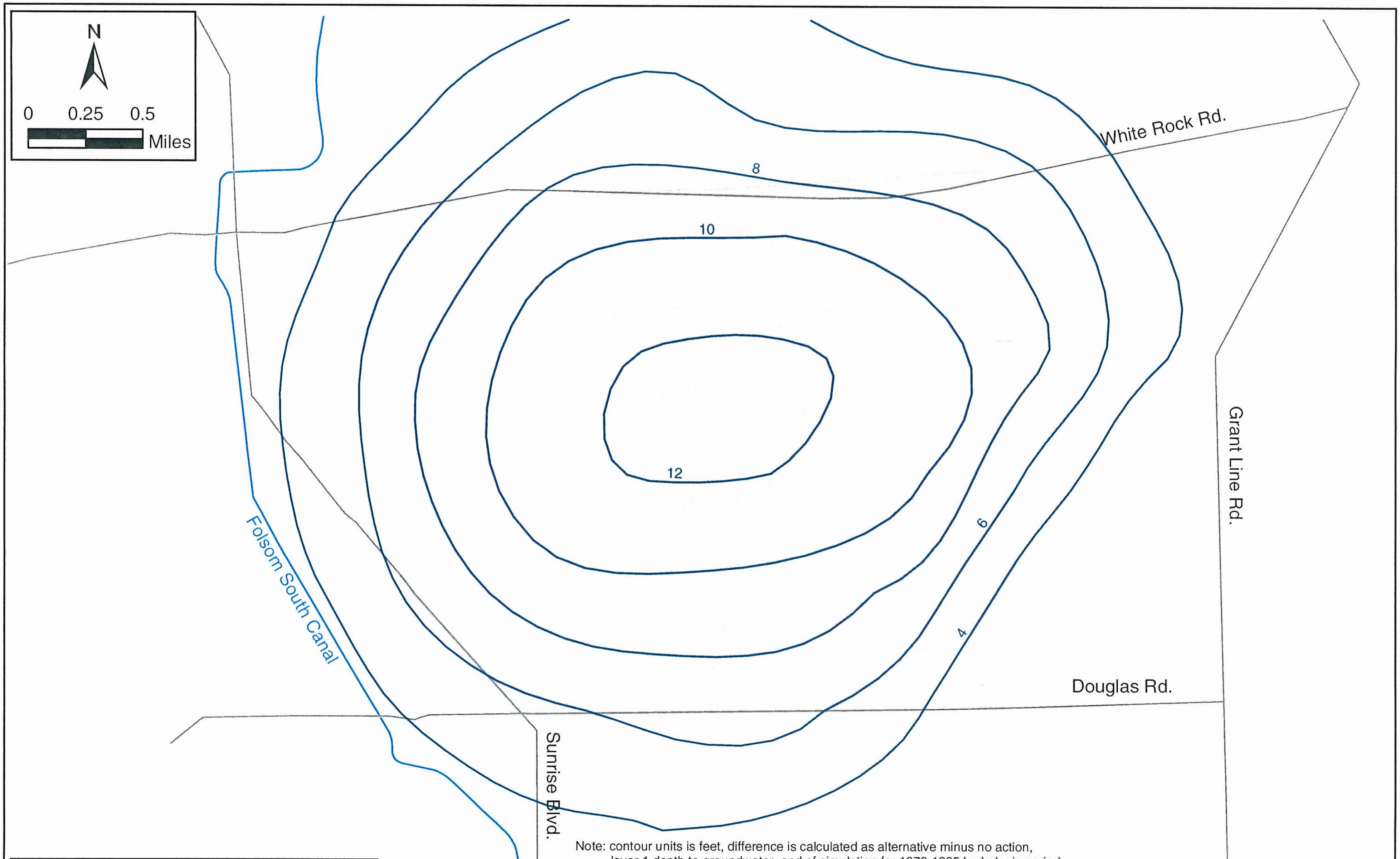
FIGURE 6



Note: contour units is feet, difference is calculated as alternative minus no action, layer 1 depth to groundwater, end of simulation for 1970-1995 hydrologic period

Legend

Rio Del Oro Boundary

Groundwater Difference Contour

RIME

Rio Del Oro Development Project

Depth to Groundwater Impacts due to Change in Hydrologic Soil Type to Low Infiltration Potential

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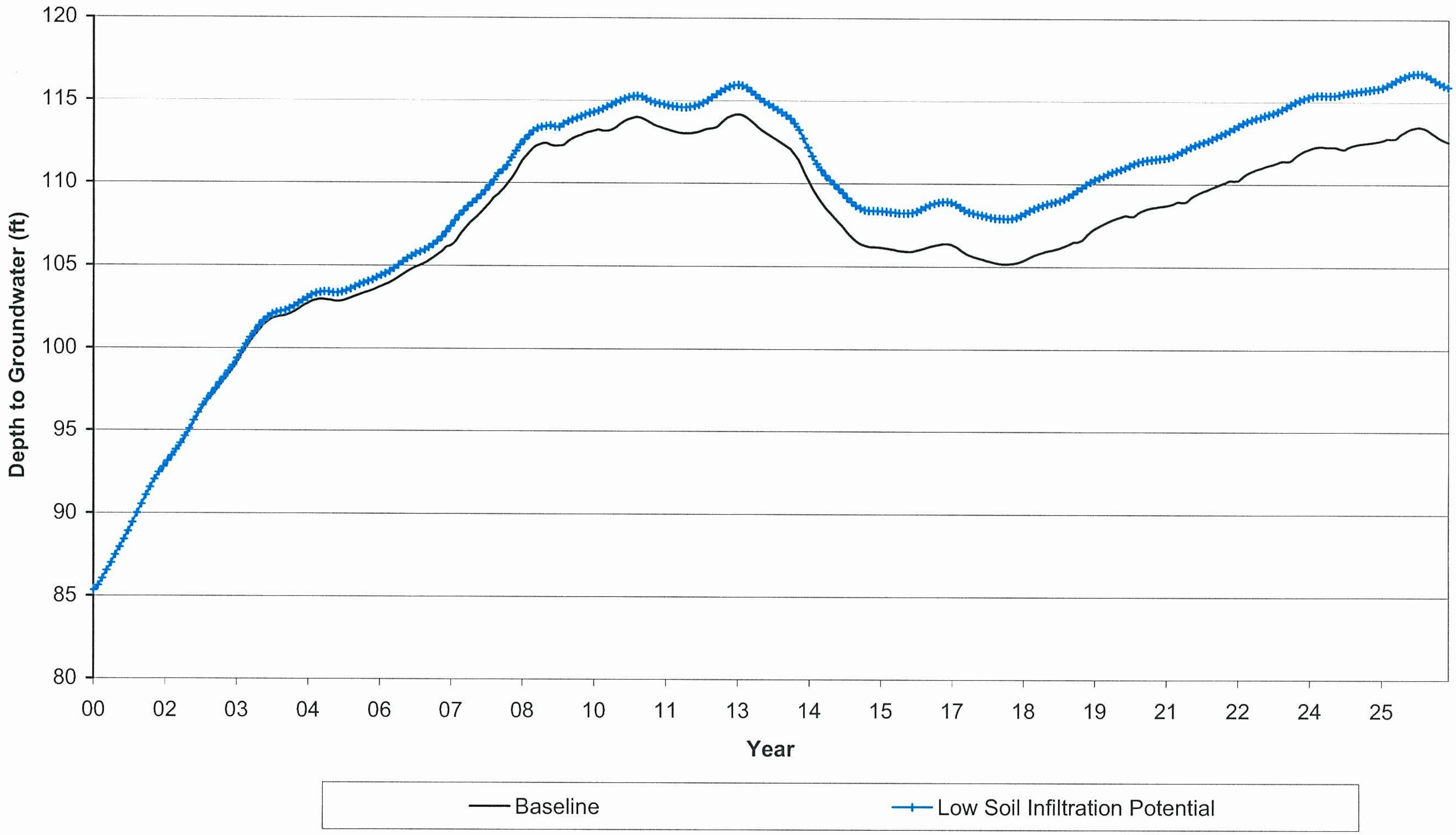
Figure 7



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Rio Del Oro Groundwater Evaluation

Depth to Groundwater Hydrograph for Baseline and Low Soil Infiltration Potential at Location 1

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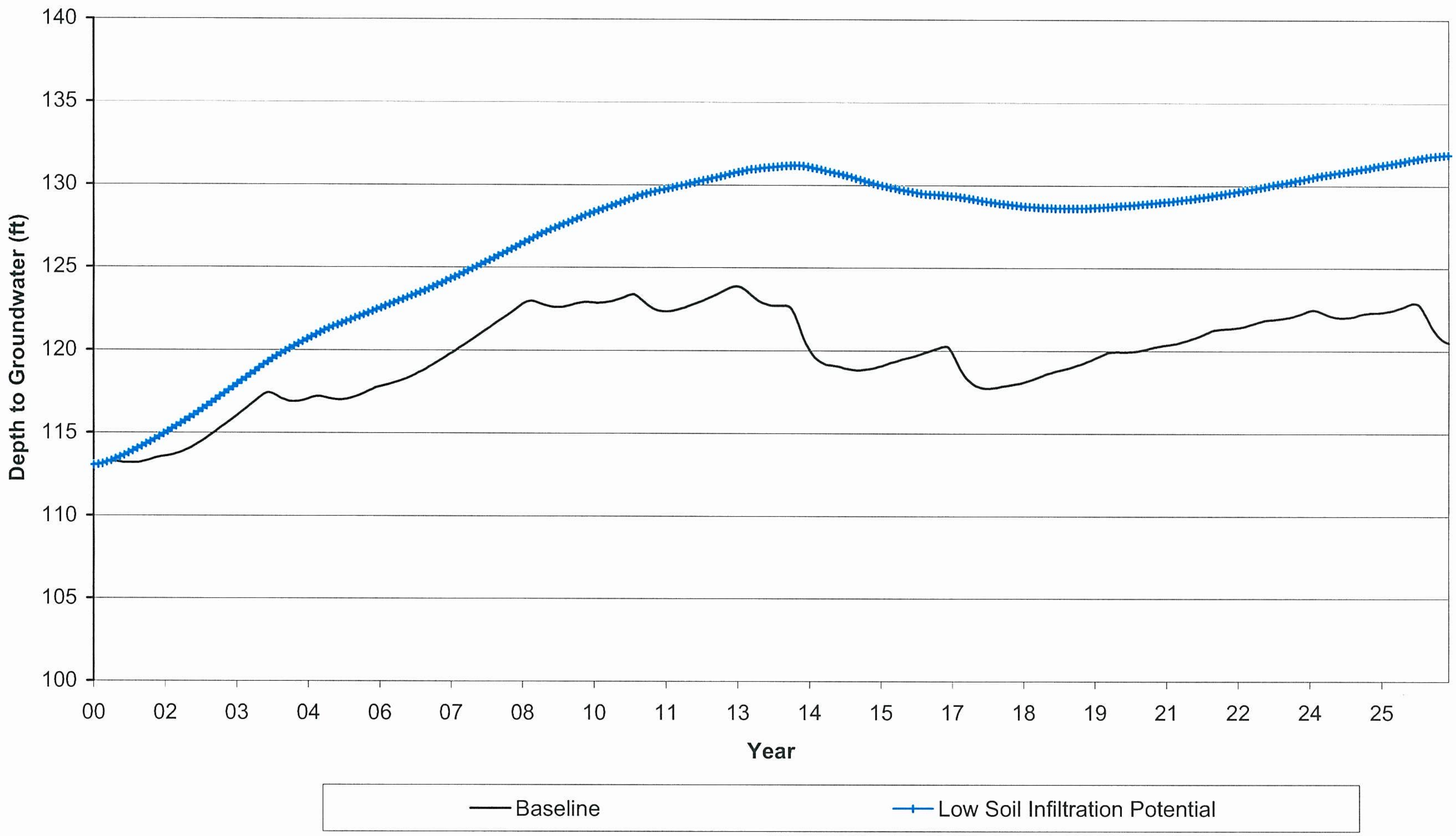
FIGURE 8



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Depth to Groundwater Hydrograph for Baseline and Low Soil Infiltration Potential at Location 2

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FIGURE 9