APPENDIX C-1: ECOLOGICAL INVESTIGATIONS

Yerington Mine Site

Prepared for
Atlantic Richfield Company
6 Centerpointe Avenue
La Palma, CA 90623

Prepared by

integral consulting inc.

7900 SE 28th Street, Suite 410
Mercer Island, WA 98040

Foxfire Scientific, Inc.
1716 Briarcrest Drive, Suite 300
Bryan, TX 77802

BROWN AND CALDWELL

3264 Goni Road, Suite 153
Carson City, NV 89706

August 31, 2007

CONTENTS

1 INTRODUCTION 1

2 VEGETATION SURVEY 2

2.1 SAMPLING AREA IDENTIFICATION 2

2.2 RANDOM SAMPLING 2

2.3 VEGETATION SAMPLING 2

2.4 STATISTICAL EVALUATIONS 3

3 WILDLIFE HABITAT ASSESSMENT 4

3.1 HABITAT DELINEATION AND MEASUREMENT 4

3.2 HABITAT EVALUATION SPECIES SELECTION 4

3.3 HABITAT SAMPLING 5

3.4 STATISTICAL EVALUATIONS 5

4 REFERENCES 7

ACRONYMS AND ABBREVIATIONS

GIS	geographic information system
HEP	habitat evaluation procedures
HSI	habitat suitability index
SI	suitability index

1 INTRODUCTION

The Process Areas of the Yerington Mine Site cover approximately 106 acres at the center of the approximately 3,400-acre site. Current operations in the Process Areas are limited to maintenance and characterization; most area buildings and equipment are abandoned, and public access is restricted. The area bears evidence of extensive human disturbance in the form of buildings, infrastructure, mining equipment, and debris; however, some vegetation grows in portions of the area. In the absence of extensive human activity, the abandoned buildings and colonizing plant species may provide shelter or food to wildlife species. Our objective is to characterize the quantity and quality of potential plant and wildlife habitat in the Process Areas in order to supplement the conceptual site model for the Screening Level Ecological Risk Assessment. This objective will be accomplished through the use of vegetation surveys and wildlife habitat assessments.

2 VEGETATION SURVEY

The Process Areas vegetation survey will use standard methods (Chambers and Brown 1983; Herrick et al. 2005; Pellant et al. 1999) to identify appropriate sampling areas, define metrics of habitat quality, measure vegetative habitat, and ensure statistical validity.

2.1 SAMPLING AREA IDENTIFICATION

The vegetation survey will employ a stratified random sampling strategy to assess vegetative habitat quality across comparable portions of the Process Areas. Ecologists will use remote sensing data to stratify Process Areas habitats. Specifically, plant cover will be stratified through the examination of aerial orthographic quadrangle photographs (ortho-quads) combined with geographic information system (GIS) area calculations (ESRI ArcGIS ; Herrick et al. 2005) . These methods will allow the Process Areas to be divided into relatively vegetated and relatively barren strata for transect sampling. In addition to being used to stratify Process Areas samples, remote sensing will be used to determine appropriate off-site reference areas for comparison to the vegetated stratum. Sample identification pursuant to the above methods is an ongoing task at the time of writing. Once sample identification is complete, we will submit an addendum providing detail on Process Areas and reference area sample locations and area calculations to this work plan.

2.2 RANDOM SAMPLING

Transects will be designed to run parallel to each other as much as possible and to cover as much of their corresponding land cover types as possible for their full length. Given these parameters, transect starting points will be selected randomly using a 200 m by 200 m overlay and a sequence of randomly generated numbers.

2.3 VEGETATION SAMPLING

Sampling of the vegetated portions of the Process Areas will be designed to measure the following aspects of vegetative cover and composition:

- Percent canopy cover
- Percent basal cover
- Percent litter cover
- Percent herbaceous cover
- Percent bare earth

- Percent senescent cover
- Percent cover by species (species composition)
- Percent canopy cover greater than 1.5 m in height
- Percent canopy cover less than 1.5 m in height
- Percent invasive species.

The preceding metrics will be measured on the site by the line intercept transect method (Pellant et al. 1999). This method was chosen for its accuracy and efficiency in quantifying vegetative cover in shrub habitats (Herrick et al. 2005). An appropriate length for each transect will be determined during the remote sensing analyses described above; transect lengths will be chosen to ensure adequate percent land area coverage for each representative land cover type.

2.4 STATISTICAL EVALUATIONS

Measures of site vegetative cover and composition will be compared to reference areas using standard statistics of proportions. A power analysis on the sample sizes will be done to ensure adequate statistical power (α and β will both be set to 0.1). This analysis will determine the numbers of transects to be performed in the vegetated, barren, and reference areas.

3 WILDLIFE HABITAT ASSESSMENT

The wildlife habitat assessment of the Process Areas will integrate information from the vegetative survey and standard USFWS (1980) habitat evaluation procedures (HEP) to determine habitat quality for selected wildlife species. Standard HEP involve measuring and combining important aspects of each species' habitat and comparing them to an optimum value or suitability index (SI); this SI serves as a theoretical reference habitat. Each comparison yields a dimensionless number between 0 (unsuitable) and 1 (optimal) for each measured habitat and species, or a habitat suitability index (HSI). The HSI is a measure of the capacity of the study area to meet the habitat requirements of an evaluation species. In addition, we will perform qualitative assessments of wildlife habitats for those species that lack applicable HSI models.

3.1 HABITAT DELINEATION AND MEASUREMENT

Land cover providing potential wildlife habitats will be delineated based on an evaluation of ortho-quads. The area of each identified habitat will be calculated using GIS software (ESRI ArcGIS 2007). As above, sample identification is an ongoing task at the time of writing; we will submit an addendum providing detail on Process Areas and reference area sample locations and area calculations to this work plan once sample identification is complete. Decisions on wildlife habitat delineations will be ground-truthed and subsequently modified, if necessary. The suitability of potential habitats will be qualitatively assessed through available site data and observations of evidence of past or present wildlife use. Areas without vegetation will be considered unsuitable as wildlife habitat. As with the vegetated portions of the Process Area, the extent of nonvegetated areas will be calculated using GIS software; these data will be used to determine the percentage of the Process Areas that provides potential wildlife habitat.

3.2 HABITAT EVALUATION SPECIES SELECTION

Wildlife species will be selected by the following criteria:

- Their use of representative local land cover types
- Their suitability as surrogates for other wildlife species as necessary
- The availability of adequate habitat suitability index (HSI) models.

A preliminary list of potential wildlife species fulfilling these requirements in the Process Areas includes the mule deer, western meadowlark, and chukar. Methods for evaluating the habitat suitability for other species likely to inhabit the Process Areas but for which HSI models are not available will be considered. These species include jackrabbits, coyotes, kit fox, pigeons, and ravens. At a minimum, the suitability of Process Areas habitat for these animals will be

evaluated through a comparison of site observations to a literature review of these species' habitat requirements; these results will then be coded in an evaluation matrix.

3.3 HABITAT SAMPLING

Habitat surveys will focus on the vegetated portions of the site and will be conducted along transects determined during the vegetation survey (Section 2.3). Barren and human-made portions of the site will be considered unsuitable for wildlife habitat *a priori*. Requisite metrics for selected wildlife species' HSI models will be collected along each transect. These metrics include the following:

- Percent herbaceous canopy cover
- Percent herbaceous canopy cover consisting of grass
- Herbaceous plant height
- Percent shrub canopy cover
- Percent shrub canopy cover less than 1.5 m high
- Percent preferred forage canopy cover less than 1.5 m high (for mule deer)
- Distance from forage sites to perch sites (for meadowlark)
- Distance from forage sites to exposed rocky areas (for chukar).

These metrics will allow us to calculate HSIs for selected species in vegetated portions of the Process Area. These HSIs will then be weighted by the proportion of available habitat over the proportion of total habitat to provide HSIs for the entire Process Area.

For wildlife species of interest without HSI models, we will record the presence and quantity (%) of important life factors in an evaluation matrix. These factors include food (e.g., appropriate forage plants or signs of prey), cover (e.g., vegetation or accessible buildings), and evidence of use (e.g., scat, tracks, remains). We will rate these parameters on a 5-point scale, with 0 representing absence of a resource and 5 representing presence of resources of high quality and quantity.

3.4 STATISTICAL EVALUATIONS

The number of transects determined by the vegetation sampling power analysis (Section 2.4) will be evaluated for applicability to wildlife habitat comparisons. The final number of transect samples necessary for robust HSI calculations will depend on how many land cover types are delineated and the variability of the habitat sampling metrics. Running means of wildlife habitat metrics will be calculated for each transect while field sampling, and the means of every five transects will be averaged. If the means of each group of five transects vary by more than

10 percent at the conclusion of the vegetation survey, additional randomly assigned transects will be sampled until variation is reduced or 30 transects have been conducted.

Qualitative habitat evaluation matrices will be created for those species for which HSI models are unavailable. Each evaluation matrix row (representing a species) will be summed to create a habitat suitability value between 0 and 15. Habitat suitability from 0 to 5 will be considered "poor," from 6 to 10 "adequate," and from 11 to 15 "good." This process will allow us to consider a broader variety of species in the habitat evaluation than by HEP alone.

4 REFERENCES

Chambers, J.C. and R.W. Brown. 1983. Methods for vegetation sampling and analysis on revegetated mined lands. Gen. Tech. Rep. INT-151. U.S. Departmente of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 57 pp.

ESRI ArcGIS. 2007. ESRI Software. Environmental Systems Research Institute, Inc., Redlands, CA.

Herrick, J.E., J.W. Van Zee, and W.G. Whitford. 2005. Monitoring manual for grassland, shrubland and savanna ecosystems. USDA-ARS Jornada Experimental Range, Las Cruces, New Mexico.

Pellant, M., P. Shaver, D. Pyke, and J.E. Herrick. 1999. Interpreting Indicators of Rangeland Health, Version 3. Interagency Technical Reference 1734-6. Bureau of Land Management, Denver, CO.

USFWS. 1980. Habitat evaluations procedures (HEP). ESM 102. Division of Ecological Services, U.S. Fish and Wildlife Services, Department of the Interior, Washington, DC.