UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judge Peter B. Bloch, Presiding Officer
and Robin Brett, Special Assistant

In the Matter of	)	
	)	
HYDRO RESOURCES, INC.	)	Docket No. 40-8968-ML
(2929 Coors Road, Suite 101	)	ASLBP No. 95-706-01-ML
Albuquerque, NM 87120)	)	
	)	

INTERVENORS' JOINT RESPONSE TO HRI'S AND THE NRC STAFF'S RESPONSES TO THE PRESIDING OFFICER'S APRIL 21, 1999 MEMORANDUM AND ORDER (QUESTIONS)

INTRODUCTION

Intervenors Eastern Navajo Diné Against Uranium Mining ("ENDAUM"), Southwest Research and Information Center ("SRIC"), Marilyn Morris ("Morris") and Grace Sam ("Sam") ("Intervenors") hereby respond to the answers filed by Hydro Resources, Inc. ("HRI") and the Nuclear Regulatory Commission ("NRC") Staff to the Presiding Officer's April 21, 1999 Memorandum and Order (Questions) ("April 21 Order"). Hydro Resources, Inc.'s Reply to April 21, 1999 Memorandum and Order (Questions) (HRI's Response"); NRC Staff Response to Questions Posed in April 21 Order (Staff Response"). This Response is filed on May 25, 1999 in accordance with the Presiding Officer's order of May 21, 1999.

U.S. NUCLEAR REGULATORY COMMISSION
RULEMAKINGS & ADJUDICATIONS STAFF
OFFICE OF THE SECRETARY
OF THE COMMISSION

Document Statistics

Postmark Date 5/25/99 (emailed)
Copies Received 3
Add'l Copies Reproduced 0
Special Distribution

OGC, RIDS

This Response is supported by the attached Exhibits 1-4, Response Affidavits of Dr. Richard J. Abitz ("Abitz Response Testimony") (Exhibit 1), Michael G. Wallace ("Wallace Response Testimony") (Exhibit 2), Dr. Spencer G. Lucas ("Lucas Response Testimony") (Exhibit 3), and Dr. Michael F. Sheehan ("Sheehan Response Testimony") (Exhibit 4). This Response also is supported by the study by E.J. Cowan submitted by ENDAUM and SRIC in response to Question 8 of the April 21 Order.[1] This Response addresses Questions 1 through 8.[2]

I. HRI AND THE STAFF HAVE PRESENTED ANSWERS BY INDIVIDUALS WHO ARE NOT QUALIFIED TO ADDRESS THE ISSUES.

A. Neither HRI's attorneys nor its witness are qualified to respond to Questions 1, 2, 3, or 8.

HRI's response to Question 1 is based in large part on the unsworn allegations of its counsel and the opinions of Craig Bartels, who is not qualified to provide expert analysis of the issues presented by that Question. That response therefore should be disregarded by the Presiding Officer; at the very least it should not be given credence as against the conflicting opinions of experts in the field.

Evidence can only be presented by a witness who is both qualified to provide the testimony and sworn to tell the truth. *See* Louisiana Power and Light Co.

---

[1] Cowan, E.J., 1991 *The Large-Scale Architecture of the Fluvial Westwater Canyon Member, Morrison Formation (Upper Jurassic), San Juan Basin, New Mexico: SEPM Concepts in Sedimentology and Paleontology* ("Cowan Study").

[2] By responding to Questions 1 through 7, ENDAUM and SRIC do not waive their objections to those Questions or their May 14, 1999 Petition for Interlocutory Review of the April 21 and May 4 Orders.

(Waterford Steam Electric Station Unit 3), ALAB-732, 17 NRC 1076, 1091 (1983); Duke Power Co. (William B. McGuire Nuclear Station, Units 1 and 2), ALAB-669, 15 NRC 453, 477 (1982); Fed. R. Evid. 603. HRI's attorneys are not witnesses, and there is nothing in the record to indicate that one or more of them has any qualifications to make these statements.

For example, HRI's attorneys are the only authors of the statement that:

> Groundwater at Section 8 is not currently a source of drinking water and its future use is severely restricted due to the naturally occurring concentrations of radionuclides.

HRI's Response at 2.

There is nothing in HRI's Response to indicate which of HRI's three attorneys on the pleading is making these allegations, or which of those attorneys purports to have the knowledge, or the education, training, or experience in hydrology, mining, or other disciplines to make these allegations. As another example, HRI's counsel state:

> As has been discussed in HRI's previous presentations, the history of URI and the ISL industry throughout the United States reflects that groundwater restoration at ISL sites typically has achieved levels at or near baseline.

HRI's Response at 3. This assertion is supported only by the Randall J. Charbaneau article referred to in footnote 3 of HRI's Response, for which there is no evidentiary foundation in the record. The article also is not verified by any expert or other individual providing sworn testimony in this matter, and was written 15 years ago by an individual whose backgrounds and qualifications are not in the record.

These assertions by HRI's attorneys are not evidence, and they should be

stricken from the record or at least disregarded. The Presiding Officer also should not be persuaded by the opinions of Craig Bartels, who is presented by HRI as an expert even though he does not have the requisite qualifications.

HRI cites the opinion of Craig Bartels for its assertion that "no important difficulties, including unlikely but foreseeable difficulties, concerning groundwater restoration present themselves for consideration." HRI's Response at 6. In fact, however, Mr. Bartels states only that the required remediation and other conditions of the FEIS and HRI's license (SUA-1508) are designed to prevent such costs; he never states that environmental costs will not occur. Moreover, he is not qualified to address the costs that may arise.

By his own admission, Mr. Bartels is a Petroleum Engineer and a Professional Engineer in Illinois. Bartels Affidavit filed with HRI's Response, at 1-2. Mr. Bartels' only direct assertion concerning his knowledge of what is likely to happen in the event of ISL mining at Section 8 is his experience in the ISL industry. There is nothing presented, however, that indicates the quality of his work in that industry; he may have more than 20 years of experience doing poor quality work. Moreover, mere length of experience without anything more does not necessarily mean that an individual is well qualified. Virtually all sectors of the economy include many individuals who have long careers but who are not well qualified to be doing their jobs.

As with its Response to Question 1, HRI's Response to Question 2 relies upon the unsworn allegations of its counsel and the affidavit of Mr. Bartels. Here, HRI's

counsel presents conclusory statements such as:

> The detailed mine unit level data reflect the extent of confinement and confirms that the mine zone baseline and monitor wells are functional.

and

> Data compiled by HRI to date are strong evidence that the production zone at the Churchrock Section 8 is confined and is laterally contiguous.

HRI's Response at 8, 9.

HRI's counsel have no qualifications to make these statements. In addition, HRI's witness, Mr. Bartels, is not qualified to address these issues. Mr. Bartels's lack of knowledge on the geology of the site is underscored by his reference to the Poison Canyon and Dakota formations as the overlying layers at Church Rock. As Dr. Lucas has pointed out, this is a "remarkable error" because the Poison Canyon is in fact the designation of an ore horizon in the Ambrosia Lake/Laguna region of New Mexico. The overlying layers at Church Rock are the Dakota and the Brushy Basin B sand. Lucas Response Testimony at 3-4.

HRI's answer to Question 3 also is based on the unsworn and unqualified assertions of its counsel, the unqualified opinion of Mr. Bartels, and the assertion that because the License requires remediation there can be no impact from the proposed mining on ground water. None of these provides an adequate basis for an answer to the Question.

Finally, in response to Question 8, HRI's counsel purports to interpret the Cowan study. Counsel asserts that the study shows that the Westwater Canyon Member consists of coalesced sandstone sheets that preclude confined elongated

channels; counsel also criticizes the Cowan study because of the amount of the Westwater geology that it examined. HRI's Response at 41. Dr. Lucas, who is a very well qualified expert in geology, has testified that HRI's reading of the Cowan study is incorrect. Lucas Response Testimony at 5. He also has stated that HRI's criticism of the study is without basis, and that the method used by the study is "standard sedimentological procedure." Lucas Response Testimony at 7. As Dr. Lucas pointed out: "Any competent geologist would readily extend Cowan's conclusions into the Church Rock area, given the vast scale of the Westwater Canyon Member river system." *Id.* The reason that did not occur to HRI is that its counsel are not geologists.

B. The Staff's witness, Robert Carlson, is not qualified to respond to Questions 4 through 7.

The Staff has presented an affidavit by Robert Carlson in which he addresses Questions 4 through 7, even though he has no qualifications to do so. Mr. Carlson is an Engineer with experience in project and systems engineering as well as operations, personnel, and project management. Carlson Resume (Attachment 1 to his Affidavit, Exhibit 3 to the Staff's February 20, 1998 Response to Motion for Stay, Request for Prior Hearing, and Request for Temporary Stay). There is nothing in Mr. Carlson's education, training, or background to qualify him to give opinions on issues of economics, environmental justice, financial and tax considerations, or treatment of alternatives in the Final Environmental Impact Statement.[3] Yet he does just that.

---

[3] NUREG-1508, Final Environmental Impact Statement to Construct and Operate the Crownpoint Uranium Solution Mining Project, Crownpoint, New Mexico

For example, Mr. Carlson asserts that there are several steps involved in an analysis of Question 4, which deals with issues of economics. Carlson Affidavit at 2-3. In response to that Question, he also makes assertions such as:

> The most important local benefit would be opportunities for employment and earnings.

and concludes that:

> The potential costs of the proposed project to the local communities would not change from those discussed in the FEIS (Section 5.2) regardless of the price of U3O8.

Carlson Affidavit at 4-5.

Similarly, in response to Question 5, Mr. Carlson makes assertions about environmental justice, local governmental needs and services, traffic, and socioeconomic impacts of the CUP. Carlson Affidavit at 6-9. He also quotes the FEIS concerning the implications of application of a tax on the proposed mining project by the Navajo Nation (Question 6), without having the qualifications to validate the opinions expressed there. Finally, in response to Question 7, Mr. Carlson purports to evaluate the advantages and disadvantages of different alternatives examined in the FEIS on the basis of issues such as environmental protection, costs, socioeconomics, environmental justice, and cultural resources. There is no indication anywhere in the record that Mr. Carlson has the qualifications to address any of these issues.

(February, 1997) ("FEIS") (ACN 9703200270).

II. THE PRESIDING OFFICER'S REQUEST FOR INFORMATION IN THE APRIL 21 ORDER'S QUESTIONS DEMONSTRATES THAT THE FEIS DOES NOT COMPLY WITH NEPA.

The issues covered by Questions 1-8 should have been covered in the FEIS. As is indicated in the testimony of Drs. Abitz, Lucas, and Sheehan and Mr. Wallace, these issues are not covered. For example, there is no discussion of the restoration difficulties that are likely to occur at Section 8 or of the environmental costs that probably will arise if there is mining there. There also is no information in the FEIS about the effects of Section 8 mining on the nearest well; in fact the FEIS does not even identify the nearest well. The FEIS also omits any calculation of the environmental and other costs of excursions during operations and restoration. Similarly, the FEIS fails to present adequate analyses of the issues covered by the April 21 Order's Questions relating to economics, environmental justice, comparison of alternatives, and geology.

These are all critical issues that must be examined, and NEPA requires that the examination be set forth in the FEIS. National Wildlife Federation v. Marsh, 568 F.Supp. 985, 996-997 (D.C. Cir. 1983) (holding that "the cost-benefit analysis and the analysis of alternatives must be contained within the environmental impact statement standing alone, and not as complemented by the administrative record.") The Presiding Officer's Questions indicate that the FEIS is deficient, and the provision of the information sought in the April 21 Order confirms that the FEIS does not comply with NEPA.

III. RESPONSES TO QUESTIONS 1-8.

Question 1.

1. Based on the experience of Uranium Resources, Inc. (URI) and of the *in situ* leach mining (ISL) industry generally, as well as the laboratory work reported in the Final Environmental Impact Statement, NUREG-1508, February 1997, Tables 4.8 and 4.9 at pp. 4-32, 33, what *important* difficulties (including unlikely but foreseeable difficulties) may reasonably be considered for the Crownpoint Uranium Project (CUP) concerning restoration of groundwater quality at Churchrock Section 8? What environmental costs may reasonably be expected to result from foreseeable difficulties?[4]

Response 1.

A. The Responses presented by HRI and the Staff are not persuasive.

1. HRI does not have an aquifer designation under the Safe Drinking Water Act.

Once again, HRI asserts that it has a valid temporary aquifer designation under the Safe Drinking Water Act ("SDWA") for Section 8, and therefore the use of groundwater at Section 8 is restricted to uranium mining. HRI Response at 2 and note 1. This assertion is patently wrong because first, HRI does not have an aquifer exemption from EPA and second, it is unlikely that it would be able to obtain one for Section 8.

HRI argues that future use of Section 8 for drinking water is restricted by naturally occurring radionuclides and "[t]his restriction on use of groundwater from Section 8 is assured by the aquifer exemption for Section 8 previously granted by

---

[4] The Presiding Officer acknowledges the information contained in the Affidavit of Mark S. Pelizza Pertaining to Water Quality Issues, at 60-78. None of the issues addressed in that affidavit are a part of this question, which is concerned about estimating the *a priori* risk that baseline values will not be restored.

EPA." HRI Response at 2. HRI, as Intervenors have previously pointed out, does not have an "aquifer exemption previously granted by EPA." Intervenors' Groundwater Presentation at 59-65; ENDAUM'S and SRIC'S Motion for Leave to Submit Reply Brief And Rebuttal Testimony In Response to HRI's Response Presentation on Groundwater Protection Issues at 6 (March 5, 1999). At one time the state of New Mexico issued a temporary aquifer designation, which was approved by EPA Region 6. EPA Region 9 has since determined that it has regulatory jurisdiction over Section 8 under the SDWA, on behalf of the Navajo Nation, and not the state of New Mexico. *See* Intervenors' Groundwater Presentation, Exhibit 8. HRI has therefore, misrepresented that it has a valid aquifer exemption for Section 8, when in fact the State of New Mexico did not have jurisdiction to issue the exemption in the first place, and HRI must instead comply with EPA's federal Navajo UIC program.

HRI refers to the EPA's aquifer exemption regulations as if application and approval with EPA is not required. It is, however, within EPA Region IX's discretion to grant an application for an aquifer exemption. 40 C.F.R. § 146.7. Since the uranium market is so low as to prevent HRI from initiating the CUP (See Response to Question 4), there is no guarantee that the Church Rock groundwater will not be further developed as a drinking water resource before HRI could attempt its project. More importantly, Church Rock qualifies as an "underground source of drinking water," which is a term of art under the SDWA and its implementing regulations. Intervenors' Groundwater Presentation at 59-65. Section 8 cannot

qualify for an aquifer exemption because it currently serves a domestic water supply well, can potentially serve a public water supply system, the water is of good quality, and the TDS content is under 3,000 mg/l. *Id.* at 63-65.

2. HRI and the Staff's Responses as to restoration difficulties are not persuasive.

Both HRI and the Staff take the positions that there will be no difficulties in restoration at Section 8 and that even if there are there will be no environmental costs. This incorrect approach is based on a lack of understanding about the conditions in which mining would occur, and an unrealistic view that since the FEIS and the License prohibit excursions they necessarily will not occur.

As Dr. Richard J. Abitz[5] has pointed out, both HRI and the Staff's hydrologist, William Ford, assert incorrectly that the ground water at Section 8 cannot be used for drinking water because of naturally occurring concentrations of radionuclides. Abitz Response Testimony at 5; HRI's Response at 2, n.1; Ford Affidavit (Staff's Response Exhibit 1) at 2. In fact, as Dr. Abitz has explained, that assertion is based on HRI's improper calculations of baseline, in which HRI has included in their figures the elevated levels of uranium and radium in the oxidized water surrounding the Old Church Rock mine. Abitz Response Testimony at 6-8. Moreover, he has explained the ground water in well CR-4 does meet all EPA standards, and the water in well CR-5 meets almost all of those standards. *Id.*

HRI and Ford also argue incorrectly that the studies of Deutsh support their

---

[5] Dr. Abitz's qualifications are set forth at page 13 below.

assertion that uranium and other elements will not migrate outside the well field area. HRI's Response at 18; Ford Affidavit at 6-7. As Dr. Abitz has pointed out, HRI and Ford have read the pertinent language in the Deutsh study without the operative word "should"; they also have produced no information on reaction kinetics to support their speculation that uranium and other redox sensitive elements such as arsenic and selenium will decrease in the ground water as it leaves the ore zone. Abitz Response Testimony at 8-9.

Mr. Ford also has contradicted himself concerning the likelihood of successful restoration at Section 8. In paragraph 4 on page 2 of his affidavit, he states that it is "extremely likely" that ground water quality will be restored to acceptable levels, but in the next paragraph he concedes that "it is unlikely" that restoration will be achieved for all ground water parameters. Ford Affidavit at 2.

HRI, for its part, simply ignores the unfavorable data in FEIS Tables 4-8 and 4-9. HRI cites a Staff conclusion in the FEIS for authority that at most 9 pore volumes will be required for restoration. HRI's Response at 6. HRI does not address the information in Tables 4-8 and 4-9 showing that uranium and radium levels were not returned to baseline values even after 16, 16.7, 20, and 28 pore volumes in both bench-scale tests and at the Mobil Section 9 pilot site. Abitz Response Testimony at 9-10.

Finally, neither HRI nor the Staff addresses the environmental costs that would result from restoration difficulties at Section 8. Dr. Ford asserts that there is only a low likelihood that any such costs will result. Ford Affidavit at 15. HRI argues that

because restoration is required, no environmental costs will arise. HRI's Response at 4-6. Neither of these approaches is realistic.

A requirement that restoration take place does not guarantee that it will be successful, or that environmental costs will not arise during operations or during restoration. Nor do monitoring and surety requirements insure that there will be no environmental costs; detection and confirmation of an excursion may take as long as 60-70 days during which time significant amounts of water may become contaminated. Finally, if any of the restoration involves consumptive use of water, that water will no longer be available. The argument that costs cannot arise because the License and the FEIS prohibit them from arising simply ignores what may happen on the ground.

B. There will be important difficulties concerning restoration of ground water at Church Rock Section 8.

The difficulties that will arise in efforts to restore the ground water at Section 8 are set forth in the testimony provided in attached Exhibits 1-3 by Dr. Abitz, Michael G. Wallace, and Spencer G. Lucas. Each of these witnesses is very well qualified to address the issues posed by Question 1. Dr. Abitz is a qualified expert in geology and geochemistry, who is currently serving as a technical expert to the United States Department of Energy Fernald Environmental Management Project.[6]

---

[6] Dr. Abitz's qualifications are set forth in detail in his testimony that was filed as Exhibit A to his testimony filed as Exhibit 1 to Intervenors' January 18, 1999 Amended Written Presentation in Opposition to Hydro Resources, Inc.'s Application for a Materials License with Respect to: Groundwater Protection Ground Water Brief Testimony ("ENDAUM's and SRIC's Amended Ground Water Brief").

Michael Wallace is an expert hydrologist.[7] Dr. Lucas, who has a Ph.D. in geology from Yale University, is both the Curator of Paleontology and Geology at the New Mexico Museum of Natural History and an Adjunct Professor of Geology at the University of New Mexico. He has extensive knowledge of the geology of the Crownpoint and Church Rock area in which HRI proposes to conduct the CUP. He has conducted major studies and published several dozen articles on Jurassic strata in New Mexico; these studies and his qualifications are set forth in his testimony (Exhibit 3), his resume (Exhibit 3A), and his publications (Exhibit 3B).

1. The experience of the *in situ* leach mining industry generally indicates the problems that will occur at Section 8.

As Dr. Abitz has pointed out, problems with restoration of ground water have occurred in several other locations where *in situ* leach (ISL) mining has been conducted. The ISL industry has not been successful in restoring uranium and radium ground water quality in New Mexico, Texas, or Wyoming. Abitz Response Testimony at 5. The restoration efforts at an ISL test field at the Teton project did not achieve baseline values for selenium, radium, or uranium. Restoration of ore-zone ground water to either baseline or drinking water standards has not been demonstrated in either core leach tests or the Teton test pilot effort west of Church Rock. *Id.* Similarly, baseline values were not achieved for radium, selenium, or uranium concentrations at ISL operations in Wyoming even though more than 20 pore volumes were used to flush the mined ore zones at those operations. *Id.* In Texas,

[7] Mr. Wallace's qualifications are explained in his resume, Exhibit A to his testimony submitted as Exhibit 3 to Intervenors' Amended Ground Water Brief.

25 pore volumes used in a reverse-osmosis circuit failed to achieve restoration limits for ammonium, sulfate, and uranium concentrations set by the Texas Department of Health. Abitz Response Testimony at 5-6.

Finally, these experiences in New Mexico, Texas, and Wyoming are not isolated instances. As Dr. Abitz has pointed out, in Wyoming ground water that has been affected by commercial ISL operations has *never* been restored either to baseline levels or to U.S. Environmental Protection Agency ("EPA") drinking water standards. *Id.*

2. The conditions at Church Rock Section 8 will cause important restoration difficulties.

Dr. Abitz also has explained that the conditions that exist at Church Rock Section 8 will cause important restoration difficulties. His conclusions are confirmed by the testimonies of Michael Wallace and Dr. Spencer Lucas.

As Dr. Abitz has testified, the ground water in the Westwater Canyon formation is largely within non-ore zones, where the quality of the water ranges from very good to excellent and meets all EPA drinking water standards. Abitz Response Testimony at 5. Moreover, the ground water in the ore zone at Section 8 meets primary EPA drinking water standards at well CR-4, and almost meets those standards at well CR-5. Abitz Response Testimony at 7. In addition, most of the water at Section 8 is not within the ore zones and currently meets EPA standards. A specific example of this is the water at well CR-7. *Id.*

Dr. Abitz has explained that the poor water quality that is referred to by HRI and the Staff is not accurate; it is the result of the statistical bias caused by the

introduction into the water quality calculations (for wells such as CR-8) of the elevated levels of uranium and radium in the oxidized water around the old Church Rock mine. Abitz Response Testimony at 8. As Dr. Abitz has pointed out, HRI's baseline water quality calculations are not correct, and the Section 8 water quality generally cannot be considered to be poor simply because the water in isolated ore zones occasionally exceeds EPA primary drinking water standards for uranium and radium.

The ground water that will be affected at Section 8 therefore is not poor quality, as HRI has alleged. Moreover, the geologic conditions there will make restoration difficult. Dr. Lucas and Mr. Wallace have pointed out that the Recapture Shale at Section 8 is not a confining layer. Lucas Response Testimony at 3-4; Wallace Response Testimony at 18-19. Dr. Lucas has explained specifically that the rock section immediately beneath the Westwater Canyon Member is not shale at all; it is a mixture of sandstone, siltstone, and gypsum beds that overlie the gypsum beds of the upper Toldito Formation. Lucas Response Testimony at 3.

Dr. Lucas has further testified that because these gypsum beds are very ductile and soluble, they are easily deformed or dissolved, and that this produces numerous fractures in the surface and the subsurface. *Id.* He has stated as well that these numerous fractures are conduits for ground water flow (*Id.*), and that the Cowan study provided in response to Question 8 confirms the lithologic heterogeneity of the Westwater Canyon Member at the scale of the small channels and the continuity of long, nearly linear channel belts. Lucas Response Testimony at 4-7. Dr. Lucas's

conclusion is that there are at least three levels of permeability/porosity in the Westwater Canyon Member, and that in the presence of those levels the small channel effects that exist greatly complicate the ground water flow in the larger channels. Lucas Response Testimony at 6.

Mr. Wallace has also testified that the old mine workings at Section 17 will complicate restoration, and that any vertical excursions and excursions caused by leaky aquifers, such as those that have occurred at other ISL operations, will cause problems for restoration. Wallace Response Testimony at 27. As Dr. Abitz has pointed out, excursions will be a particular problem because of the high concentrations of radium, arsenic, and uranium in the pregnant lixiviant. Abitz Response Testimony at 4; FEIS, Table 4-8 at 4-32.

The other restoration difficulty that will be presented in Section 8 is that excursions are likely not to be detected. As Dr. Abitz has testified, the ground water in the Westwater Canyon is largely within non-ore zones, where the water quality is very good and meets all EPA standards for drinking water. The combination of high concentrations of arsenic, radium, and uranium in the pregnant lixiviant, complex channels in the Westwater sheet sands, and low density of down gradient monitoring wells make it probable that there will be excursions that are not detected by the monitoring wells. Abitz Response Testimony at 4-5. Restoration efforts in the ore zones therefore will not even address excursions into non-ore zones. *Id.*

C. The environmental costs of restoration difficulties will be significant.

The only effort to quantify the cost of the problems that will occur at Section 8

is presented by Mr. Wallace in his affidavit. As he has explained, he prepared a model that quantified the volume of ground water that could be expected to be contaminated by the end of restoration. The results of the model are set forth in Exhibits 2F through 2I; he estimates a problem zone of degraded ground water 12,000 feet long, 700 feet wide, and 200 feet thick. That is equivalent to 336 million cubic feet, or 7,713 acre feet of water. Wallace Response Testimony at 28. The value of water rights in an area for similar use for water that is potable but not currently being used for drinking water is between $3,000 and $4,000 per acre foot. Using an average of $3,500 per acre foot, the contaminated ground water would entail an environmental cost of almost 27 million dollars. *Id.*

Question 2.

2. Based on local geology, what assurance is there concerning the likelihood of the existence of shears, fractures, and joints that could transmit appreciable quantities of water above or below the Westwater aquifer?[8] How much greater assurance may reasonably be anticipated prior to commencing ISL operations at Churchrock Section 8? What environmental costs may reasonably be expected to result from foreseeable difficulties at Churchrock Section 8?

Response 2.

A. HRI's and the Staff's assertions concerning shears, fractures, and joints and resulting environmental costs are not accurate.

Both HRI and the Staff deny the existence of shears, fractures, and joints in the Church Rock geology, and both also assert that no environmental costs can result because the License and FEIS provide measures that must be taken in the event of

---

[8] *See* Affidavit of Frank Lee Lichnovsky, February 19, 1999 at 24-25, commenting on the absence of faults and mentioning a "pump test" but not assessing the extent of the risk that could occur through undetected sheers, fractures, or joints.

excursions. These arguments are neither sound nor presented for HRI by anyone with appropriate qualifications to address the issues.

HRI relies on the FEIS and on its "geologic cross sections" to argue that there are not shears, fractures, or joints at the Church Rock site. HRI's Response at 6-9. Speaking for the Staff, Mr. Ford argues that there is little likelihood that vertical excursions will occur because of the "projected thickness and rock type of the overlying confining rock units at the site." The fallacy in these arguments is that there are not confining rock units at the site.

As Dr. Lucas and Mr. Wallace have both testified, the Recapture Shale is not a confining unit and in fact has numerous fractures that are conduits for ground water flow. Lucas Response Testimony at 3-4; Wallace Response Testimony at 18-19. More specifically, Dr. Lucas has explained specifically that the gypsum beds immediately beneath the Westwater Canyon Member are easily deformed or dissolved, and that this produces numerous fractures in the surface and the subsurface. *Id.* He has stated as well that these numerous fractures are conduits for ground water flow (*id.*), and that the Cowan study provided in response to Question 8 confirms the lithologic heterogeneity of the Westwater Canyon Member at the scale of the small channels and the continuity of long, nearly linear channel belts. Lucas Response Testimony at 4-7.

Mr. Wallace has reiterated his earlier testimony (Wallace Ground Water Brief Testimony) that it is quite likely that there are shears, fractures, and joints in the Church Rock site. Wallace Response Testimony at 17. He also has pointed out that

vertical fault planes are common in the San Juan Basin, and that a fault of 70 feet or so could bring the Westwater directly into contact with the overlying Dakota. *Id.* Moreover, as he has testified earlier, the Recapture Shale which the Staff and HRI allege to be the confining unit, may not even exist at Section 8. *Id.*

Finally, Mr. Wallace also has pointed out that HRI's reliance on geologic cross sections is misplaced. Those cross sections are constructed by *artificially* shifting geologic units to create a horizontal top; they therefore cannot provide accurate information on displacement of geologic features. Wallace Response Testimony at 23. Despite that, despite repeated assertions by Mr. Wallace that structural cross sections should be prepared because they will show faults, and despite HRI's possession of the requisite data to prepare structural cross sections, HRI has refused to prepare them. *Id.*

HRI's and the Staff's assertions concerning additional assurances that may reasonably be anticipated prior to mining at Section 8 are similarly unreliable. HRI claims that it will conduct pump tests, but Mr. Wallace has pointed out that HRI does not know how to conduct pump tests properly and that HRI's sister corporation, URI, ignored pump test data when that showed that a well field should not be developed. Wallace Response Testimony at 21-22.

HRI and the Staff also rely upon monitoring and surety updates. HRI's Response at 16; Bartels's Affidavit at 15; Ford Affidavit at 17-20. As Mr. Wallace has testified, however, neither monitoring nor updates of the surety will reduce the likelihood of excursions. Wallace Response Testimony at 24. Although the

immediate detection of an excursion might mitigate resulting environmental damage, the monitoring well plan for Section 8 does not assure that excursions will be detected promptly. Wallace Response Testimony at 24-25. There is no requirement of monitoring in the Cow Springs aquifer, which is the aquifer most likely to be in communication with the Westwater. *Id.* In addition, the spacing of the monitoring wells that are required for the overlying units is over either 4 or 8 acres; by the time that excursions are finally detected and confirmed under this scheme, vast areas of overlying or underlying units could be affected. *Id.* This latter point was also spoken to by Dr. Abitz, who pointed out that the low density of down gradient monitoring wells makes highly probably undetected excursions outside the ore zone. Abitz Response Testimony at 4-5.

B. Significant environmental costs may be expected from the difficulties that will be encountered at Section 8.

Neither HRI nor the Staff addresses the environmental costs that may arise from difficulties at Section 8; rather they assert that there will be no such costs because the conditions in the License are supposed to prevent them from occurring. *See, e.g.* HRI's Response at 15-16; Ford Affidavit at 20. This head in the sand approach is not appropriate. As Mr. Wallace has testified, it is foreseeable that HRI would need to create a cone of depression in order to contain an excursion. Wallace Response Testimony at 25. Depending upon the number and size of excursions that develop, it also is possible that HRI would need to increase its consumptive use of water, which would be an environmental cost, particularly because of the limited ground water resources in the San Juan Basin. *Id.* Finally, if an excursion is not

remediated, there would be contamination of ground water, which is another cost. *Id.*

Use of additional water and contamination of ground water resources would both have high environmental costs. As Mr. Wallace testified, ground water is scarce in the San Juan Basin, and he has pointed out that the value of water in the Section 8 area is about $3,000 to $4,000 per acre foot. Wallace Response Testimony at 28. The monetary costs therefore could be very high; the contamination of usable water in an arid region such as the San Juan Basin is a much more significant loss.

Question 3.

3. Qualitatively and, if possible, quantitatively, what are the effects on the quality of water that may reasonably be foreseen at the closest private water wells to Churchrock Section 8, resulting from the poorest foreseeable condition of groundwater after restoration is completed?

Response 3.

A. Neither HRI nor the Staff addresses accurately the reasonably foreseeable qualitative impacts on water quality in the nearest private well to Section 8 that would result from the poorest foreseeable condition of water after restoration.

The Staff's answer to this Question is not responsive. The Staff identifies the nearest well as being a private well to the south, and concludes that the proposed mining cannot possibly have any impacts on the well. Ford Affidavit at 20. The Staff never addresses impacts that might result from the proposed mining to the nearest well that could be affected.

Dr. Abitz has testified that HRI's response to this Question does not address the issue with respect to the "*poorest* foreseeable condition of ground water after restoration is complete." Abitz Response Testimony at 10-11. As Dr. Abitz stated,

the poorest foreseeable condition of the water is likely to be the restored concentrations reported in Table 4.8 of the FEIS (*id.*), not the return to baseline asserted by Mr. Bartels. Bartels Affidavit at 16. He has also pointed out that the combination of the poor water quality listed in that Table, the reasonable interpretation of the fabric of the Westwater sandstones, and future wells in Sections 8 and 9, that the travel time of ground water is likely to be much faster than the 8.7 feet per year asserted by HRI. Abitz Response Testimony at 11-12.

B. Neither the Staff nor HRI has addressed the qualitative impacts on the nearest well.

There is no mention in the Responses filed by HRI or the Staff of any quantitative analysis on impacts on the quality of water in the nearest well or even of any effort to make such an analysis. The only such analysis that has been performed is presented in Mr. Wallace's Response Testimony.

Using standard industry practices, Mr. Wallace conducted a modeling analysis of the quantitative impact that the Section 8 mine would have on the ground water at the well at the United Nuclear Corporation mill site about 2.5 miles northeast of Section 8. Wallace Response Testimony at 4-6. The model simulated the migration of a plume of contaminants from the mine to the well over a period of 274 years, and Mr. Wallace verified the values that he used in the model by comparing the model's predictions to actual water levels in three Section 8 monitor wells.[9] Wallace

[9] Mr. Wallace also pointed out that the results that follow from HRI's assumption that the Westwater is a homogeneous perfectly confined and infinitely wide aquifer do not match the actual water well levels. Wallace Response Testimony at 7-9.

Response Testimony at 5-11.

In contrast to the vague assurance by Mr. Bartels that it would take 1,632 years for contaminants to reach the United Nuclear well, Mr. Wallace's model demonstrates that concentrations exceeding 0.17 mg/l would reach the well within 200 years. Wallace Response Testimony at 15. The model also demonstrates that uranium concentrations exceeding the NRC restoration standard of 0.44 mg/l would exist only a short distance from the proposed mining within a few years after restoration is complete. *Id.* Moreover, Mr. Wallace has testified that his model takes into account only one contaminant and does not account for the possible future drilling of a well closer to the Section 8 mining site. *Id.*

Mr. Wallace's model is the only quantitative analysis of the impacts of Section 8 mining on the nearest well. It is persuasive and uncontradicted, and is an analysis, unlike Mr. Bartels's vague estimate and HRI's and the Staff's assurance that there can be no impact on the nearest well because the FEIS and License are supposed to prevent such impacts. And Mr. Wallace's model shows that impacts will occur.

Question 4.

4. What are the adjusted benefits of the CUP, as stated in the FEIS, for one or two prices of yellowcake that are at or above the minimum price at which HRI would commence work on this project? (This is important because the price of uranium fluctuates and a reasonable cost/benefit picture requires an assessment of benefits at more than one arbitrary price.)

Response 4.

Question 4 must be addressed in two parts. First, what is the minimum price at which HRI would commence work on the Crownpoint Project? Second, assuming

prices that are at or above the minimum price, what are the adjusted benefits of the project? The first question must be answered before going on to the second question, because there will be neither costs nor benefits if HRI never enters the market place. Neither HRI nor the Staff provides an answer to the first question. Moreover, the figures they provide for a "break even" or "minimum" uranium price have no basis in reality. Thus, they provide no foundation for the analysis of benefits provided in answer to the second question. As a result, HRI's and the Staff's discussions of the second question, i.e., what are the benefits of the Crownpoint Project, amount to baseless illusions.

A. Failure to address minimum cost at which HRI would enter market.

Neither HRI's nor the Staff's responses identifies the minimum price at which HRI would commence work on the Crownpoint Project. HRI does not address the question at all, and the NRC admits that it simply does not know. Carlson Affidavit at 2. HRI identifies a "break even" price for the uranium of $15.70, which happens to coincide with the October 1966 spot market price identified in Table 5.1 of the FEIS. The Staff uses the FEIS to determine a range of production costs of $9 to 12 per pound, and adopts those costs as the "minimum" price that HRI would charge for its uranium. Carlson Affidavit at 2. As discussed in the attached Testimony of Michael F. Sheehan, Ph.D., neither of these responses addresses the question of what price would induce HRI to enter the market. It is extremely unlikely that HRI would enter the market if all it could do was recover its costs. Thus, HRI's and the Staff's failure to address the issue of what price would induce HRI to enter the market leaves

unanswered the fundamental question of whether it is likely that HRI will ever undertaken the activities that it asserts will produce economic benefits for the local community.

B. Flawed analyses of minimum or break-even prices of uranium.

In order to provide a basis for a cost-benefit analysis, HRI and the Staff come up with a "break even" or "minimum" price of uranium, which they assert is conservative for purposes of evaluating costs and benefits. As discussed above, these figures are insufficient to answer the Presiding Officer's question of what price would induce HRI to actually begin operation at Crownpoint. Moreover, the figures are not grounded in reality.

HRI identifies a "break even" uranium price by comparing the October 1996 spot market price of $15.70 per pound (reported in the FEIS at Table 5.2) to Section 8 production costs of $14.50 per pound, and declares that the "FEIS spot price of 15.70 $/lb would allow a reasonable overhead contingency of 8.2% and makes suitable break even production cost for the cost/benefit analysis." HRI's Response at 19. Having identified its "breakeven production cost," HRI then describes the $15.70 per pound figure from the FEIS as "the breakeven price."

The Staff identifies a "minimum" uranium price by essentially adopting the range of production costs set forth in the FEIS at Table 5.1:

> FEIS Table 5-1 indicates that HRI's production costs would vary from $9.38 to $11.83 per pound . . . . Thus, a conservative estimate of benefits would be to assume prices of $9 and $12 per pound.

Carlson Affidavit at 2. The Staff uses these "minimum prices" together with the

roughly identical cost figures to arrive at local economic benefits.

As discussed by Dr. Sheehan, the problem with HRI's use of the $15.70 price is that it has no relationship with real-world market conditions. It is highly unlikely that uranium spot market prices will rise even close to this "break even" level in the foreseeable future. As Dr. Sheehan observes, the $15.70 per pound price is not only significantly above the current spot market price of $10.65 (CIS $8.50), but it is significantly higher than the trend of future spot market prices predicted in Table 5.2 of the FEIS.

Moreover, these prices are unlikely to change significantly any time soon. As acknowledged in the UR 10-Q SEC filing for the Third Quarter of 1998:

> The market price of uranium has fallen to levels that are currently below the Company's cost of uranium production. The outlook for uranium prices through the end of 1999 indicates that a price rebound during this period is not likely."

URI, 10-Q SEC filing, Third Quarter 1998, p.9 attached as Exhibit BB to Testimony of David Osterberg (January 7, 1999).

Even more recently, URI reported that:

> The volatility of the uranium market saw spot prices that ranged from $12.00 per pound in January (1998) to lows at year-end of $8.75. The steady decline during the year, which was attributed primarily to low utility demand, has begun to firm somewhat to the current (March 1999), but remains below the level needed by the Company to obtain the necessary financing to allow development of new production areas at its Kingsville Dome and Vasquez sites.

URI's 1998 10-K at 5 (March 31, 1999). In sum, HRI has no basis for believing that it could command a price of $15.70 for its uranium.

Like HRI, the Staff takes the flawed approach of basing the minimum price of

uranium on the cost of production. The Staff diverges from HRI's approach in that instead of overestimating the price HRI can get for uranium in the market, the Staff underestimates the cost of uranium production. Based on the FEIS, the Staff asserts that the fixed cost of uranium production is about $9 to $12 per pound, and then asserts that this is also the minimum price for HRI's uranium. As discussed in ENDAUM's and SRIC's February 19 presentation and in the February 11 Testimony of Dr. Sheehan, the FEIS significantly underestimates HRI's cost of producing uranium. This is borne out by HRI's Response, which now estimates the cost of uranium production for Section 8 at $14.50 per pound, which is significantly above the approximately $9 to $12 range estimated in the FEIS.

Although the Staff's methodology is flawed, nevertheless, the $9 to $12/lb range arrived at by the Staff is within the range of spot market prices reported in the FEIS and that can reasonably be predicted for the next several years. Therefore, it is a much more realistic figure to use in evaluating the costs and benefits of the CUP. As discussed in Dr. Sheehan's testimony, an estimate for price in the $10 to $11 range over the near term appears to have a reasonable empirical foundation and to be within the range mentioned by the Staff in the FEIS.

HRI and the Staff both fail to address the fundamentally important point that if market prices are significantly below the cost of production, HRI is unlikely to operate the Crownpoint Project, and that therefore the benefits of the project are illusory. As the Staff observes:

> The important point relevant to assessing the project's potential benefits to the local community is that the benefits depend on HRI's costs being

> lower than the future price of U3O8, which has been quite volatile. If the price of U3O8 is less than the cost of operation, then operations may be discontinued. If this happens, there will be no economic benefits to the local community.

Carlson Affidavit at 2 (emphasis added). Given the flawed basis for HRI's and the Staff's "break even" and "minimal" uranium prices, any projection of benefits from those prices amounts to pure fiction.

C. Even Assuming That HRI Could Enter the Market and Sell Its Uranium at $15.70 per pound, HRI's and the Staff's Analysis of Benefits Is Inadequate, and Ignores Significant Costs.

1. HRI and the Staff ignore significant costs.

Even assuming that HRI were able to enter the market at $15.70 per pound, commencement of production at the Crownpoint Project under marginal economic conditions would create significant risks not addressed by either HRI or the Staff. As Dr. Sheehan points out, the $15.70 figure is a "spot" market price, and spot market prices vary greatly over time. Since HRI is in poor financial condition, it needs net revenues from sales to continue to build and operate its operations safely. Anything that imperils this cash flow increases environmental risk. A financially troubled company will hesitate to take the necessary measures to protect the environment if such a course would put the company in greater financial peril. The NRC has recognized this problem (as have all regulators of operations involving hazardous materials):

> [A] licensee in financially straitened circumstances would be under more pressure to commit safety violations or take safety 'shortcuts' than one in good financial shape.

Gulf States Utilities Co. (River Bend Station, Unit 1), 41 NRC 460, 473 (1995).

As discussed in Dr. Sheehan's testimony, HRI's parent, URI, is already cutting costs at its Texas operation due to falling uranium prices. HRI itself is in serious financial straits. If HRI commences operation at the Crownpoint Project, it will incur the need to take environmental and safety measures required in its license that it will not be able to afford if the market takes a downturn. Once the injection of lixiviant and the inception of other parts of the operation with substantial environmental consequences begins, the inability to maintain consistent financing will pose a significant threat to the environment.

In sum, were HRI to begin development and production based on a spot price of $15.70 if the price were to fall again, HRI would be caught in a situation where it its poor financial condition might well result in a substantial increase in environmental risk to the community.

2. No Discussion of Primary Benefits.

It is significant that HRI and the Staff address only the secondary economic benefits of the Crownpoint Project. They are conspicuously silent on the question of whether there are any primary benefits, such as the need for the uranium. As discussed in ENDAUM's and SRIC's initial presentation on this issue, secondary benefits, standing alone, cannot be held to justify this project under NEPA. There must be some primary benefit flowing from a need for the production of uranium. As discussed at length in ENDAUM's and SRIC's presentation and the testimony of Dr. Sheehan and David Osterberg, there is no need for the uranium that would be produced by the Crownpoint Project. In fact, the Project would have a negative

impact by undermining the United States' treaty with Russia to purchase Russia's bomb-grade High Enriched Uranium and blend it down for use in nuclear power plants, thereby decreasing the international weapons inventory. On this ground alone, the FEIS should be rejected as insufficient to support the issuance of the HRI license.

3. Even assuming the Crownpoint Project may confer some local economic benefits, HRI and the Staff overstate them.

Even assuming that the Crownpoint Project may confer some secondary benefits, the Staff continues to distort and overstate them. As discussed in Dr. Sheehan's attached testimony, many of the weaknesses noted in his February testimony remain. For instance, the analysis in Table 2 still assumes that there will about 100 jobs for local residents and that the jobs will pay approximately $24,000 per year. These assumptions are flawed, because (a) HRI is laying off its fully trained production work force in Texas-(why hire untrained local workers when fully trained Texas workers are available?); (b) the $24,000 wage is substantially higher than HRI is paying to its Texas workers (about $16,500 for the same job it claims it will pay $24,000 for in New Mexico)--it is anomalous that the Company would pay untrained worked substantially more than the trained work force simultaneously laid off in Texas; and (c) Given the high level of local unemployment in the project area, the company will probably be in a buyers' market and there will be no reason to pay premium wages. The Staff even admits that its numbers might be all wrong:

> The number of jobs and average salary might be lower with U3O8 prices of $9 and $12 per pound (as compared to $15.70 per pound), if HRI decides to hire fewer workers and pay less salary. The Staff has no information from HRI to make revised assumptions regarding these matters.

Carlson Affidavit at 3.

Moreover, the NRC's royalty figures of $630,000 to $840,000 depend upon production of 1 million pounds per year. Yet there is no reason to suppose that production will remain at 1 million pounds at Unit 1 when the price is assumed lower by such a large amount ($15.70 down to either $9 or $12). In addition, the out-of-pocket cost of bringing the Church Rock property into production is well over $13 million before a single pound of uranium is produced. RAI Q.92 Response: Church Rock 1-2. Royalties to local people will only be paid after Church Rock is producing; if Church Rock does not produce there will be no royalties at Unit 1. Given the financial condition of the Company, including its plan to sharply cut back expenditures on CUP, where is the $13 million up front money to come from?

Finally, the tax amounts set forth on Staff's Tables 2 and 3 are--as the Staff notes--entirely contingent on the outcome of the jurisdictional issue of whether the mine sites are within Navajo Indian County, and therefore subject to the taxing power of the Navajo Nation. In addition, as with Royalties and employment, there is no reason to assume that at sharply lower market prices ($9 versus $15.70), output will remain at the same high level of 1 and 2 million pounds annually.

In summary, neither HRI nor the Staff has presented a reasonable basis for evaluating the costs and benefits of HRI's operation, because they have not identified realistic conditions under which HRI would enter the marketplace. In addition, they have failed to address the significant risks that would be raised by operating the facility in a marginal and highly volatile economic environment. Finally, they have

not justified any primary benefits of the project. Accordingly, the FEIS should be rejected as inadequate to support the issuance of HRI's license.

Question 5.

5. Because of financial and market uncertainties, it is foreseeable that Churchrock Section 8 will be the only section developed. What are the governmental needs that arise because of the CUP? Would local governments need to make any capital expenditures that might not be recouped if the CUP suspended or terminated mining operations without going beyond Section 8? In light of the financial situation of local governments, would environmental justice considerations require indemnification or assurances to local governments for possible losses?[10]

Response 5.

Both HRI and the Staff responded to the Presiding Officer's Question 5, but the arguments that they present are not accurate. HRI and the Staff predict that the only potentially significant public sector costs associated with the project will be those related to the license requirement for replacement of Crownpoint's water wells.[11]

---

[10] *See Louisiana Energy Services, L.P.* (Claiborne Enrichment Center). CLI-98-3, 47 NRC 77, 100 (1998).

[11] In its response to this question, HRI asserts that issues concerning Crownpoint's domestic water wells is "not a specific issue at this phase of the hearing." HRI's Response at 22. Intervenors disagree with this position and assert that all NEPA-related issues raised in the FEIS and implicated by the NRC Staff's licensing decision, including those affecting the Crownpoint wells, are not only ripe for determination, but must be determined at this phase of the proceeding. The Presiding Officer's Memorandum and Order (Scheduling and Partial Grant of Motion for Bifurcation) (September 22, 1998) ("September 22 Order") makes this abundantly clear. It provides in relevant part that "Intervenors may submit written presentations, within the scope of their germane concerns, with respect to **any issue that challenges the validity of the license issued to HRI** . . ." September 22 Order at 2 (emphasis added). All the NEPA-related issues which Intervenors have raised in this proceeding challenge the validity of the NRC Staff's issuance of the materials license to HRI. Either the FEIS as a whole passes muster under NEPA and the CEQ and NRC implementing regulations, or it does not, in which case the Presiding Officer must find the license invalid.

HRI Response at 22-23; Staff Response at 2, Carlson Affidavit at 6-8. Both parties state that HRI will bear the cost of well replacements. *Id.* HRI and the Staff argue that there are no other significant governmental costs associated with the project primarily because of the projected minimal increase in local population. HRI Response at 21; Carlson Affidavit at 6. HRI claims that if only Section 8 is developed, the economy will still benefit from new business activity, although on a reduced scale. HRI Response at 23. HRI admits, however, that Section 8 property taxes will not be paid locally. *Id.* at fn. 12.

HRI argues that since there will be no costs to local government for the proposed project, there is no need for indemnification against such costs. *Id.* at 24. The Staff states that environmental justice considerations do not require "payments or assurances to local governments." Staff Response at 2. HRI relies on the affidavit of County Judge and Presiding Officer of the Commissioner's Court Edmundo B. Garcia of Duval County, Texas to show that Duval County has incurred no public sector costs associated with ten in situ leach mining operations. HRI Response at 24, Garcia Affidavit at 2. Judge Garcia also states that all of the mining companies pay county taxes. Garcia Affidavit at 2.

HRI's and the Staff's response to Question 5 repeats information contained in the FEIS regarding the lack of need for additional housing and other public infrastructure required for the project. HRI Response at 21; Staff Response, Exhibit 2 at 6. The FEIS predicts that few, if any, non-local project employees will choose to live in the Navajo communities of Church Rock and Crownpoint because of

"limited housing, distance from urban services, and limited amenities." FEIS at 4-99.

HRI and the Staff's positions on these points are not correct. In fact, severe geographic and sociological inequities make the Navajo communities of Church Rock and Crownpoint more susceptible to environmental risks and therefore necessitate a comprehensive environmental justice analysis.[12] Intervenors' Environmental Justice Brief, Vol. 1, Bullard Testimony at 11. Environmental justice guidelines stress the need for an analysis of historical and cumulative exposures to environmental and health hazards and of cultural, economic, or social factors which "amplify the natural and physical effects of proposed agency action." Council on Environmental Quality, Environmental Justice Guidance Under the National Environmental Policy Act at 8-9 (March, 1998) ("CEQ Environmental Justice Guidance"); Intervenors' Environmental Justice Brief at 9.

The FEIS instead ignores data showing that poverty, geographic isolation, poor health conditions, and ongoing radiological contamination from earlier uranium mining activities make the Church Rock community especially vulnerable to cumulative adverse environmental impacts of the project. Intervenors' Environmental Justice Brief at 2. The FEIS provides general socioeconomic information for McKinley County but fails to provide meaningful and detailed information for the communities of Church Rock and Crownpoint. *Id.* at 15. The FEIS provides health

---

[12] ENDAUM's and SRIC's Brief in Opposition to Hydro Resources, Inc's Application for a Materials License with Respect to Environmental Justice Issues (February 19, 1999) ("Intervenors' Environmental Justice Brief").

statistics for the general population served by the Navajo Area Office of the U.S. Indian Health Service but ignores specific health data available for Church Rock and Crownpoint. *Id.* at 16, 22. The FEIS fails to even provide an accurate account of the population located near the Church Rock mine site. Bullard Testimony at 24. Describing the Church Rock area, the FEIS erroneously states that there are "only a few scattered residences located within 3 km (2 miles) of the site." FEIS at 3-55. In fact, there are 87 residences, representing at least 350 people, located within a 2-and-a-half mile radius of the HRI Section 8 site. Bullard Testimony at 25, Bullard Exhibit L. Finally, the FEIS fails to conduct a disparate impact analysis addressing 96 abandoned uranium mines in the Church Rock project area. Intervenors' Environmental Justice Brief at 22, Benally Exhibit P.

HRI and the Staff argue that the only impact to local governments will be the need to replace Crownpoint's domestic water wells and minimal increases in public safety and emergency services. HRI Response at 21-23; Staff Response at 2, Staff Exhibit 2 at 6-7. The FEIS does not describe whether there are any suitable locations available for new water wells that are of similar quality to current wells. Intervenors' Environmental Justice Brief at 29, 37. Instead, the FEIS proposes a groundwater restoration standard of 0.44mg/L for uranium for Crownpoint's replacement wells. FEIS Appendix B at 2, Intervenors' Environmental Justice Brief at 37. This standard is 176 times greater than the existing concentration of uranium in Crownpoint's water wells and is significantly more lax than U.S. Environmental Protection Agency water restoration standards. Bullard Testimony at 34-35. The FEIS also does not discuss

the impacts of contamination of current wells or of the Navajo Tribal Utility Authority's opposition to the replacement of their water wells.

Mitigative measures such as the relocation of Crownpoint's wells and HRI's agreement to provide the Crownpoint hospital with equipment and training for uranium slurry accidents fall short of protecting public health and reducing the adverse impacts of the mine on the environmental justice communities of Church Rock and Crownpoint. Intervenors' Environmental Justice Brief at 29-31. Environmental justice guidelines recommend "heightened agency attention" to "monitoring needs" if disparate impacts on environmental justice communities are found. CEQ Environmental Justice Guidance at 10; Bullard Testimony at 45. The FEIS does not consider this issue at all. Bullard Testimony at 45. Comprehensive health studies of Church Rock and Crownpoint residents and the clean-up of abandoned uranium mines are some of the immediate needs that exist in the proposed project area. What is conspicuously overlooked by the FEIS is whether it is acceptable to compound the environmental risk of an already disproportionately and adversely impacted minority population with additional impacts from the proposed project.

Question 6.

6. What are the financial effects of uncertainties about the application of a tax on the CUP on the Navajo Nation? In light of these uncertainties and the possibility of litigation about this tax, are the parties willing to offer to begin negotiation with relevant governments? Have negotiations begun? Are negotiations producing results?

Response 6.

NEPA requires agencies to balance a proposed project's economic benefits against its adverse environmental effects. *See, e.g.*, Calvert Cliffs' Coordinating Committee v. U. S. Atomic Energy Comm'n, 449 F.2d 1109, 1113 (D.C. Cir. 1971). NRC and CEQ regulations embody this requirement, providing that NRC Staff consider socioeconomic or "secondary" benefits in an FEIS. Louisiana Energy Services, 47 N.R.C. at 99 (citing 10 C.F.R. § 51.71 and 40 C.F.R. § 1508.8(b)). More specifically, the regulations require the NRC Staff "to consider and weigh the environmental, technical, and other costs and benefits of a proposed action and its alternatives, and, 'to the fullest extent practicable, quantify the various factors considered.'" *Id.* at 88 (quoting 10 C.F.R. § 51.71(d)). The Staff undertook this analysis with respect to the proposed benefit that the CUP would have on Navajo Nation tax revenues in sections 4.9 (Socioeconomics) and 5 (Costs and Benefits Associated with the Proposed Project) of the FEIS, and it is that discussion that provides the proper context for an informed response to this question.

HRI and the NRC Staff have done little to actually answer question 6. HRI, in particular, never answers the questions, but rather makes a series of points seemingly calculated to confuse the Presiding Officer regarding potential tax benefits to the Navajo Nation from the CUP. However, upon careful reading, HRI's Reply actually emphasizes Intervenors' point that the potential tax benefit to the Navajo Nation is in actuality not a "significant" benefit that can be relied upon to justify the NRC Staff's recommendation of Alternative 3. *See* Final Written Presentation of

Grace Sam and Marilyn Morris, February 19, 1999 (hereinafter Sam's NEPA Brief) at 24-27; ENDAUM's and SRIC's Written Presentation in Opposition to Hydro Resources, Inc.'s Application for a Material License with Respect to: NEPA Issues Concerning Project Purpose and Need, Cost/Benefit Analysis, Action Alternatives, No Action Alternative, Failure to Supplement EIS, and Lack of Mitigation, February 19, 1999 (hereinafter ENDAUM's NEPA Brief) at 43-45.

It is well-established that, in analyzing the costs and benefits of a proposed project, an FEIS must not contain misleading information on the economic benefits of a project or distorted economic assumptions that impair fair consideration of the project's adverse environmental effects. *See*, *e.g.*, Hughes River Watershed Conservancy v. Glickman, 81 F.3d 437, 446 (4th Cir. 1996) (EIS evaluating proposed dam construction project violated NEPA since it was based on misleading economic assumptions which impaired fair consideration of the project's adverse environmental effects). When the FEIS concludes that "[t]he potential contribution of the proposed project to the Navajo Nation would be a significant part of Navajo Nation tax revenues," FEIS at 4-103, it violates this fundamental tenet of NEPA law. HRI's Reply nevertheless urges upon the Presiding Officer the point that the potential tax benefits to the Navajo Nation from the project would be significant. HRI Reply at 24-25 (citing FEIS at 4-104).

This conclusion is erroneous and thus misrepresents any actual benefit that might inure to the Navajo Nation through the collection of taxes for two reasons: first, historical tax collection data demonstrates that the potential tax payments to the

Navajo Nation from the CUP, *see* FEIS at 4-104 (Table 4.31), cannot be expected to represent a "significant part of Navajo Nation tax revenues" during the years in which HRI intends to operate the CUP; and second, the consideration of any tax benefit to the Navajo Nation from the proposed project is too speculative to even be considered a benefit in the FEIS in light of the uncertainty surrounding the Navajo Nation's taxing jurisdiction, reflected in HRI's position "that taxation over private land such as the Churchrock Section 8 property is within the jurisdiction of [the] State of New Mexico." HRI Reply at 24.

It is projected that the Navajo Nation's General Fund gross revenues will be $104.4 million for fiscal year 1999 and $105 million per year for fiscal years 2000 and 2001. *See* Resolution of the Navajo Nation Council, Fiscal Year 1999 General Fund Revenue Projection, Exhibit "A" (attached as Exhibit 5). Total Navajo tax revenues are projected to be $26.2 million for each of these years. *Id.* In comparison, the estimated tax revenues from the CUP are relatively low, projected to be anywhere from $39,000 to $1,200,000. *See* FEIS at 4-104 (Table 4.31) (cited in HRI's Reply at 24). Thus, even in the unlikely possibility that HRI was able to produce 2 million pounds of yellowcake and the market price for yellowcake was $20 per pound, HRI's contribution would only be 4% of the Navajo Nation's total revenue from taxes and 1% of the Navajo Nation's total gross revenue. Needless to say, HRI's contribution to the Navajo Nation's revenues would not be significant. Considering that it is extremely doubtful that HRI will produce 2 million pounds of yellowcake at the market price of $20 per pound, the contribution of the CUP to

Navajo tax revenues reasonably can be expected to be even more insignificant. For example, if the CUP contributed only $39,000 to Navajo Nation tax revenues in the year 2000, *see id.* (assuming production of 100,000 pounds of yellowcake at a market price of $13 per pound), the CUP would contribute only .001% of the Navajo Nation general tax revenues and .00037 % of total Navajo Nation revenues.[13] Thus, HRI's endorsement of the FEIS's analysis of potential tax payments to the Navajo Nation from the CUP appears intended to sway the Presiding Officer into believing the Navajo Nation will see significant financial benefit from the project when in fact it will not. In truth, the potential benefits are insignificant at best and HRI has failed to provide any information in their answer that calls Intervenors' analysis of this issue into doubt.

HRI specifically fails to answer the Presiding Officer's question of whether it has begun or is willing to offer to begin negotiations with the Navajo Nation. This failure to answer can only be interpreted as an indication that HRI is not willing either to submit to the Navajo Nation's taxing jurisdiction or informally resolve this jurisdictional matter with the Navajo Nation. This interpretation is further buttressed by HRI's comments regarding taxing jurisdiction over Section 8. Despite originally touting the CUP's "significant contribution" to the tax revenue of the Navajo Nation

---

[13] The NRC staff submits a "conservative estimate of benefits" assuming prices of $9 and $12 per pound. Affidavit of Robert D. Carlson, ¶4 at 2. Accordingly, the Staff projects a Navajo Business Activity Tax of $540,000 annually at $9 per pound and $720,000 annually at $12 per pound. Under these projections the BAT contribution remains insignificant. At $9 per pound, the contribution to total Navajo revenue would be .005% and to Navajo tax revenues would be .02%. At $12 per pound, the contribution to total Navajo revenue would be .007% and to Navajo tax revenues would be .03%.

in its reply to question 6, HRI goes on to admit that it does not believe that the Navajo Nation would see any tax revenues from Section 8. HRI Reply at 25. Such a statement provides support for Intervenors' argument that the actual tax "benefit" to the Navajo Nation is so speculative as to be no benefit at all because of HRI's likely objection to Navajo taxes, thus flawing the entire cost-benefit analysis in the FEIS in violation of NEPA. See Sam's NEPA brief at 26-27; ENDAUM's brief at 43-45.

HRI's assertion that Alaska v. Native Village of Venetie Tribal Gov't, 522 U.S. 520, 118 S.Ct. 948 (1998), "holds that taxation over private land such as the Church Rock Section 8 property is within the jurisdiction of the State of New Mexico" appears further calculated to muddy the waters surrounding the issue of taxing jurisdiction over the CUP. See HRI Reply at 25. This statement reveals either HRI's total lack of understanding of the relevant law or its desire to confuse the Presiding Officer into thinking he need not consider the uncertainty of these tax "benefits" in deciding issues of cost-benefit analysis in the FEIS. In truth, the question of taxing over Section 8 and all of Indian country is not nearly as simple as HRI would have the Presiding Officer believe.

First, Venetie simply does not hold that taxation over private land is within the taxing jurisdiction of the State of New Mexico. Venetie discusses the definition of "dependent Indian community" as it relates to a village in Alaska and has nothing to do with taxation over private land in New Mexico as HRI implies.

Second, even the application of the Venetie decision to Navajo Indian country in New Mexico is dubious at best. In Venetie, the Supreme Court found that all of

the land owned by the Native Village of Venetie tribal government was not a dependent Indian community because it was neither set aside by the federal government nor under federal superintendence. The Court found that this land could not be set aside by the federal government because the land had been specifically revoked as a reservation through the Alaska Native Claims Settlement Act ("ANCSA"). Even if the Native Village of Venetie repurchased in fee simple all the land which had originally comprised the reservation, the land would not be a dependent Indian community. Unlike the native villages in Alaska, Navajo Indian country has not been revoked by the ANCSA or any analogous law and none of the relevant areas in Church Rock have been repurchased by the Navajo Nation. Therefore, the application of Venetie, which deals with a uniquely Alaskan situation, is inappropriate and irrelevant to the present set of facts set in the southwestern United States.

Finally, the major effect of Venetie on Indian law was to redefine the test for determining whether an area is a "dependent Indian community" such that it meets the definition of "Indian country" in 18 U.S.C. § 1151. *See Id.*, 118 S.Clt. at 952-53. The test on which the Court settled is not a significant departure from that previously used by the majority of the courts of appeals. *See,e.g.,id.* at 952 (six-part test employed by the Ninth Circuit). Although the Venetie court found that the Alaska lands in question were not part of a dependent Indian community, and thus not Indian country, that result in no way mandates a similar finding with respect to the Church Rock Section 8 property. "The resolution of this issue involves substantial

factual determinations," including a determination "of the proper community of reference for dependent Indian community analysis under [18 U.S.C.] § 1151(b)" for the Section 8 property. Pittsburgh & Midway Coal Mining Co. v. Watchman, 52 F.3d 1531, 1542-45 (10th Cir. 1995). Thus, even if the Venetie test were applied to Church Rock Section 8, it is more than likely that there would be a finding that the area is part of a dependent Indian community in Indian country. This is one of the issues currently before the 10th Circuit Court of Appeals in the case mentioned in NRC's Reply. Affidavit of Robert D. Carlson at 9, ¶16 (referring to HRI v. USEPA, No. 97-9556 (10th Cir. petition for review filed Aug.27, 1997). However, neither the NRC Staff nor HRI mention that the basic question currently before the 10th Circuit is which government has the authority to issue **environmental permits** for operations in Church Rock, not specifically which government or governments will have taxing authority. Furthermore, the 10th Circuit case also deals with disputes involving EPA regulations and procedural rules under the Safe Drinking Water Act, the outcome of which may decide that case. Thus, even if the current 10th Circuit case is decided soon, uncertainties regarding the application of a tax on the CUP may remain an issue open to litigation.

HRI's Reply further suggests that the Presiding Officer is without authority to consider the question of Navajo Nation taxing jurisdiction on the CUP. HRI Reply at 25. Although the Presiding Officer does not have authority to decide whether the Navajo Nation has taxing authority over the CUP, he should and must consider the uncertainties of the potential tax benefit in deciding whether the cost-benefit analysis

in the FEIS complies with NEPA and the applicable implementing regulations. Intervenors previously have argued that the FEIS improperly relies on erroneous assumptions to justify the proposed project, including an overstated and mistaken reliance on tax "benefits" to the Navajo Nation. Sam's NEPA Brief at 24-27; ENDAUM's NEPA Brief at 43-45. The Presiding Officer must consider the inaccuracies of the FEIS's statements regarding Navajo tax "benefits" because, under NEPA, an FEIS must not contain misleading information on economic benefits of a project. Hughes River Watershed Conservancy v. Glickman, 81 F.3d at 446 (EIS violated NEPA since it was based on misleading economic assumptions which impaired fair consideration of the project's adverse environmental effects). As Intervenors have pointed out, this FEIS does exactly that which NEPA prohibits.

Exact quantitative financial effects of uncertainties about the application of a Navajo tax may be unknown at this time, but there are almost certain to be some. The NRC Staff is correct when it states that if Section 8 is found not to be in Navajo Indian country, the Navajo Nation will lose potential tax revenues. Affidavit of Robert D. Carlson at 9, ¶16. However, the uncertainty itself will cause the Navajo Nation to incur costs associated with pursuing litigation and any negotiations for the payment of the tax.

As pointed out above, it is unlikely that HRI will accept Navajo taxing jurisdiction or is willing to resolve the matter through negotiation. Evidence of this is found not only in HRI's assertion that the Venetie case is determinative of the issue of taxing jurisdiction over Section 8, but also in its unsupported belief that the Navajo

Nation taxation requirements for properties with different ownership types may be different and that thus "this issue may involve a **good deal** of future negotiation." HRI Reply at 25 (emphasis added). In truth, the Navajo Nation does not have different requirements for different ownership types. HRI also asserts that, "[a]s discussed in the FEIS at 3-63 & 5-4, the Navajo Nation taxation requirements for each of these land types may be different and at this time are largely unresolved." *Id.* However, the FEIS merely states that the Navajo Nation could tax off the Navajo Reservation if the production is determined to occur in Indian country. *See* FEIS at 3-63 and 5-4. There is never any mention of different taxing requirements for different ownership types. The Navajo Tax Code also offers no varying requirements based on distinctions in "ownership type." Therefore, it appears that this argument by HRI is yet another smokescreen to explain away a faulty cost-benefit analysis. Any disputes regarding Navajo Nation taxing authority can arise only from HRI itself, not the Navajo Nation.

HRI further attempts to confuse the Presiding Officer when it states that it intends to pay taxes "to the appropriate government authority with jurisdiction." HRI Reply at 26. HRI fails to mention the possibility that it may have to pay taxes to both the Navajo Nation and the State of New Mexico, thus increasing even more its motivation to elude the taxing jurisdiction of the Navajo Nation. *See* Cotton Petroleum Corp. v. New Mexico, 490 U.S. 163, 109 S.Ct. 1698 (1989) (upholding imposition of New Mexico state taxes on non-Indian lessee's oil and gas production from Jicarilla Apache reservation despite previous imposition and collection of tribal

tax; in practical effect, Cotton Petroleum was found to owe both tribal and state taxes for its oil and gas production on the Jicarilla Apache reservation).

HRI and the NRC Staff in the FEIS treat the potential tax payments to the Navajo Nation which the CUP may generate as a significant secondary benefit of the proposed project that supports the NRC Staff's decision to grant HRI a source materials license. As the Presiding Officer himself has recognized in propounding this question in the first place, however, the uncertainty surrounding the actual tax benefit that might inure to the Navajo Nation from the project is much too tenuous to be considered a real secondary benefit in the FEIS because of the open question concerning whether the Section 8 property is Indian country. This is true also of the FEIS's characterization of potential tax payments to the Navajo Nation as "significant." In truth, the potential amount of such payments is anything but that.

Question 7.

7. For Churchrock Section 8 (and 28 days later for the entire CUP[14]): What is your comparative analysis of the NRC Staff-Recommended Action to: (1) the non-action alternative, and (2) Alternative 2 (modified action) -- including a concise, descriptive summary of the advantages and disadvantages of the options? In your answers to this question, please consider the answers to the questions set forth in your overall discussion.

Response 7.

As Intervenors have pointed out in their written presentations, the FEIS submitted by the NRC does not comply with NEPA and the applicable implementing regulations because there is a lack of analysis and adequate explanation why the Staff

[14] These answers may not be required to complete the determination of whether or not HRI may proceed to mine Churchrock Section 8.

rejects Alternative 2 (modified action) and Alternative 4 (no action) in favor of Alternative 3 (Staff Recommended Alternative). *See* Sam's NEPA Brief at 14-24; ENDAUM's NEPA Brief at 56-60. In particular, the FEIS lacks a proper comparative analysis between the NRC-Staff Recommended Action (Alternative 3) and the no-action alternative (Alternative 4) and the modified action alternative (Alternative 2). CEQ regulations require that the FEIS "present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public." 40 C.F.R. § 1502.14. An FEIS should briefly discuss the reasons why an alternative was rejected and not further studied. Louisiana Energy Services, 47 N.R.C. at 98 (citing Tongass Conservation Soc. v. Cheney, 924 F.2d 1137,1141 (D.C. Cir. 1991)) ("By merely reciting all of the benefits expected from the [project], the "no-action" section does not indicate how the agency evaluated the relative significance of these individually cited benefits."). The NRC staff failed to provide a comparative analysis of the alternatives in the FEIS.

The NRC staff, in its May 11 Reply, attempts to answer question 7, but regarding only Section 8. Despite the Presiding Officer's request to do so, these answers must be disregarded because a comparative analysis of only Section 8 is inadequate, irrelevant, and a violation of NEPA because it in effect disregards Alternative 2 as an option.

As a practical matter, any analysis of the alternatives for only Section 8 would be inadequate and useless as a comparative tool. The primary characteristic of

Alternative 2 is that it differs from Alternatives 1 and 3 in that "ISL mining would occur at only one or two of the proposed sites" under Alternative 2. FEIS at 2-31. By limiting the comparative analysis to only Section 8, the Presiding Officer has in effect changed Alternative 2 by removing the primary characteristic that sets it apart from the proposed project and the other alternatives. This renders any comparative analysis inaccurate and therefore inadequate. At the very least, limiting an analysis to only one site changes Alternative 2 into something other than what is described in the FEIS. Such a comparative analysis is useless for determining how the agency evaluated the relative significance of the benefits of each alternative as described in the FEIS. For example, it would be equally useless if the Presiding Officer asked for a comparative analysis of the alternatives, but required an assumption that each alternative would incorporate NRC's license conditions as described in Alternative 3. In this hypothetical, Alternative 3's major difference with the other alternatives would be stripped, making any comparative analysis inaccurate. This is essentially the same kind of improper analysis that is asked for in question 7.

The fact that the Presiding Officer has decided to make a decision regarding only Section 8 at this point has no bearing at all on the inappropriateness of a comparative analysis for only Section 8. The Presiding Officer, in his September 22 Memorandum and Order, allowed Intervenors to file written presentations "with respect to any issue that challenges the validity of the license issued to HRI." Memorandum and Order, September 22, 1998 at 2, clarified and reiterated in Memorandum and Order, October 13, 1998 at 3. In full accordance with the

Presiding Officer's orders, Intervenors have challenged the FEIS as inadequate under NEPA, arguing that through an invalid FEIS, the NRC improperly issued the materials license to HRI.[15] Specifically, Intervenors asserted that the FEIS lacks a proper comparative analysis and adequate explanation why the Staff rejects Alternative 2 (modified action) and Alternative 4 (no action) in favor of Alternative 3 (Staff Recommended Alternative). *See* Sam's NEPA Brief at 14-24; ENDAUM's NEPA Brief at 56-60. Any comparative analysis would need to address Alternative 2 as it is described in the FEIS and as it was considered by the NRC in issuing the materials license to HRI. Under NEPA and the NRC regulations, the NRC must discuss in the FEIS alternatives to HRI's proposed project. 42 U.S.C. § 4332(2)(C)(iii); 10 C.F.R. § 51.91(c). Alternative 2 has already been described as an option in the FEIS. However, by changing the scope of the comparative analysis to only Section 8, the full character of Alternative 2 is not currently being taken into account. In fact, a comparative analysis of only Section 8 essentially removes Alternative 2 from discussion, in violation of the mandate from NEPA to discuss the alternatives to the project.

Even if the analysis submitted by the NRC for Section 8 was appropriate and allowable under NEPA, the NRC Staff's latest submission still would not be a sufficient comparative analysis under NEPA. Merely reciting all of the benefits

---

[15] The NRC Staff has acknowledged that the scope of Intervenors' arguments is proper in accordance with the Presiding Officer's orders in that in responding to Intervenors' NEPA arguments, the Staff waived its "usual objection" to the scope of Intervenors' presentation inasmuch as the FEIS addressed all potential operation sites. See NRC Staff's Response to Intervenor Presentations On NEPA Issues (Purpose, Need, Cost/Benefit, Alternatives, and Supplementation), April 1, 1999 at 2-3.

expected from the project does not indicate how the agency evaluated the relative significance of these individually cited benefits as required by NEPA. *See* Tongass Conservation Soc. v. Cheney, 924 F.2d 1137,1141 (D.C. Cir. 1991). Pursuant to the Presiding Officer's question 7, the NRC submitted a summary of the advantages and disadvantages of Alternatives 2, 3, and 4. Affidavit of Robert D. Carlson at 10. However, the NRC fails to compare any of these alternatives with each other or provide any indication of how it evaluated the relative significance of the cited advantages and disadvantages. For example, the NRC staff indicates that Alternative 3 "would have the advantage of allowing HRI to develop Section 8, while providing more environmental protection than the Modified Action." Affidavit of Robert D. Carlson, ¶ 19 at 10. However, there is no discussion of how these listed advantages are weighed in comparison to the advantages of avoiding all environmental impacts as listed for the No Action Alternative. *See Id.* ¶21 at 10.

The NRC Staff further submits tables on the various alternatives and their impacts, but freely admits that these tables only "summarize information in FEIS Sections 4.1 through 4.12." Affidavit of Robert D. Carlson, ¶ 18 at 10. Any reliance by the NRC staff on the FEIS for a comparative analysis is faulty for the reasons previously stated in Intervenors' written presentations. No comparative analysis among the various alternatives exists in the FEIS and thus the conclusory nature of the NRC's "analysis" is equally evident in its tables. In fact, if one were to consider the NRC's Tables 4 through 15, one would have to conclude that Alternative 4 (no action) should have been the preferred alternative rather than Alternative 3.

The tables clearly show that Alternative 4 will have the least amount of impacts, and there is no indication that the advantages and disadvantages of the other alternatives outweigh this benefit.

Finally, HRI's reply to question 7 is noteworthy in that it does not even attempt to provide a comparative analysis of the given alternatives at all and simply underscores one of the underlying problems with the FEIS. Following a rather lengthy regurgitation of relevant NEPA principles and a layout of the FEIS, HRI's reply to question 7 boils down to a simple conclusion without any comparative analysis: ". . . it is sufficient to say that the FEIS adequately addresses the reasonable alternatives, giving "substantial treatment" to each in full satisfaction of the requirements of NEPA as related to the NRC in Part 51." HRI's response substitutes a simple conclusory statement for a comparative analysis and points out no language in the FEIS which indicates how the NRC Staff evaluated the relative significance of any benefits or disadvantages of any of the alternatives. As pointed out by Intervenors in their written presentations, the FEIS simply does not provide the NEPA-mandated comparative analysis of the alternatives and the mere reassurance of HRI that the FEIS is adequate does not eliminate the FEIS's flaws.

Question 8.

Intervenors Groundwater Exhibit L quotes Cowan (1991) who states that near Church Rock, channelways "15-30 m. thick" occur "which would affect fluid flow." SRIC/ENDAUM will please promptly provide a reference for the citation so that we may discover whether Cowan says anything about the width of those channelways.

Response 8.

Intervenors have provided the Cowan study, and the statements of Dr. Lucas

and Dr. Abitz explain the importance of that study for this proceeding. Those statements also demonstrate the need for qualified witnesses to address technical questions, as opposed to the misstatements made by HRI's unsworn and unqualified counsel concerning the study.

As was pointed out above, contrary to HRI's assertions, the Cowan study does not indicate that the Westwater is made up of coalesced sandstone sheets that preclude the existence of confined elongated channels. HRI's Response at 41. Dr. Lucas has testified that HRI's position is an inaccurate reading of the study. Cowan documents the lithologic heterogeneity of the Westwater, and concludes that the Westwater deposition was in channel belts one to several km wide composed of numerous, smaller channels. Lucas Response Testimony at 5. Dr. Lucas also discredits HRI's counsel's criticism of the Cowan study based upon the amount of the Westwater Canyon that it examined; as Dr. Lucas stated, the method used by the study is "standard sedimentological procedure." Lucas Response Testimony at 7. Dr. Lucas concluded that Cowan's conclusions would be readily extended into the Church Rock area by any competent geologist, given the vast scale of the Westwater Canyon Member river system." *Id.* As was also pointed out above, HRI's counsel, who are not geologists, did not take that position.

Finally, the Cowan study and the interpretation of it presented by Dr. Lucas, a known international authority on Jurassic sediments including those of the Morrison Formation in northwestern New Mexico (Abitz Response Testimony at 12), demonstrate the heterogeneity of the Westwater Canyon Member, a heterogeneity that

is not considered by the FEIS. Abitz Response Testimony at 13. The FEIS's treatment of the hydrology and contaminant transport within the Westwater is therefore flawed and inadequate. *Id.*

IV. The Presiding Officer's request for responses to Questions 1-8 requires supplementation of the FEIS.

As the Presiding Officer has implicitly conceded by asking Question 1, the FEIS should have contained additional information. For that reason, NEPA requires supplementation of the FEIS. Moreover, use of that information to make a decision pursuant to NEPA without providing the information to the public and decision makers in a supplement to the FEIS would violate NEPA.[16]

NEPA mandates that relevant information be provided in the FEIS so that it is available to the decision maker and to the public.

> The primary function of an environmental impact statement under NEPA is "to insure a fully informed and well-considered decision," ...." In order to fulfill its role, the EIS must set forth sufficient information for the general public to make an informed evaluation ... and for the decisionmaker to "consider fully the environmental factors involved and to make a reasoned decision after balancing the risks of harm to the environment against the benefits to be derived from the proposed action."

Sierra Club v. U.S. Army Corps of Engineers, 701 F.2d 1011, 1029 (2d Cir. 1983) (citations omitted) (holding invalid as violating NEPA the Corps' reliance on an EIS whose conclusions lacked a substantial basis).

"At the very least, NEPA is an environmental full disclosure law." By enacting it, Congress "certainly intended to make ... decisionmaking more responsive

---

[16] The April 21 Order appears to recognize that supplementation of the FEIS may be necessary (April 21 Order, 4), but makes no commitment to do that.

and more responsible." Environmental Defense Fund v. Corps of Engineers of the U.S. Army, 325 F. Supp. 749, 759 (E.D. Ark., 1971) (prohibiting the Corps of Engineers from proceeding with a project because of the inadequacy of the environmental impact statement for the project). *See also* Committee for Nuclear Responsibility, Inc. v. Seaborg, 463 F.2d 783, 787 (5th Cir. 1971) ("[T]he [environmental impact] statement has significance in focusing environmental factors for informed appraisal by the President ... and in any event by Congress and the public.")(reversing a district court grant of summary judgment for the Atomic Energy Commission because it precluded the plaintiffs from demonstrating that the Commission omitted scientific opinions from an environmental impact statement). *See also* ENDAUM's and SRIC's NEPA Brief at 60-62 and authorities cited therein.

For these reasons, any information that is provided in response to the April 21 Order's Questions must be presented in a supplement to the FEIS that is circulated to the public and made available for comment. The request for more information demonstrates that the FEIS must be supplemented. In addition, use of such information without supplementation of the FEIS would violate NEPA.

Dated: May 25, 1999.

Johanna Matanich
Lila Bird
Douglas Meiklejohn
NM Environmental Law Center
1405 Luisa Street, Suite 5
Santa Fe, NM 87505
(505) 989-9022

Diane Curran
Harmon, Curran, Spielberg,
& Eisenberg, LLP
1726 "M" Street, N.W. Suite 600
Washington, DC 20036
(202) 328-3500

May 21, 1999

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before Administrative Judges
Peter B. Bloch, Presiding Officer
Robin Brett, Special Assistant
Thomas D. Murphy, Special Assistant

In the Matter of:	)	
HYDRO RESOURCES, INC. 2929 Coors Road NW, Suite 101 Albuquerque, NM 87120	)	Docket No. 40-8968-ML ASLBP No. 95-706-01-ML

AFFIDAVIT OF DR. RICHARD J. ABITZ
IN RESPONSE TO THE PRESIDING OFFICER'S QUESTIONS
IN THE MEMORANDUM AND ORDER OF APRIL 21, 1999

I, Richard J. Abitz, being duly sworn, declare as follows:

1. I am competent to make this affidavit, and the factual statements herein are true and correct to the best of my knowledge, information and belief. The opinions expressed herein are based on my best professional judgment.

2. I am making this affidavit on behalf of Eastern Navajo Diné Against Uranium Mining ("ENDAUM") and Southwest Research and Information Center ("SRIC") to provide responses within my areas of expertise to the questions on groundwater protection contained in the Presiding Officer's Memorandum and Order (Questions) dated April 21, 1999 ("April 21 Order").

3. My qualifications to make this affidavit are contained in my resume, which was attached as Exhibit A to my written testimony of January 11, 1999 (hereafter "Abitz January Testimony"), given in support of Intervenors ENDAUM's and

EXHIBIT
1

SRIC's amended written presentation on groundwater protection, dated January 18, 1999. My relevant education, training and experience were summarized on pages 1-3 of my January Testimony. As stated therein, I have a Ph.D. in geology and extensive professional experience in geology and geochemistry, serve as a technical expert to the U.S. Department of Energy ("DOE") on uranium mobility and remediation at the DOE Fernald, Ohio, facility, and have worked on groundwater contamination at the United Nuclear Corporation ("UNC") uranium mill tailings site located 2.5 miles from the proposed HRI Section 8 and Section 17 Church Rock ISL mine.

4. In preparing this affidavit, I reviewed the following documents: (1) the Presiding Officer's April 21 Order; (2) NRC Staff Response to Questions Posed in April 21 Order, and the affidavit of William H. Ford attached thereto (hereafter, "NRC Staff Response" and "Ford Affidavit", respectively); (3) Hydro Resources, Inc.'s Response to April 21, 1999 Memorandum and Order (Questions), and the affidavit of Craig S. Bartels, attached thereto (hereafter, "HRI Response" and "Bartels Affidavit"). In addition to these documents, I am familiar with the written testimonies of Dr. William P. Staub and Mr. Michael Wallace, which were attached as Exhibits 2 and 3, respectively, to Intervenors' Amended Groundwater Presentation, and Dr. Staub's and Mr. Wallace's reply affidavits given in support of ENDAUM's and SRIC's Reply in Response to HRI's and NRC Staff's Response Presentations on Groundwater Protection Issues (April 8, 1999) ("ENDAUM-SRIC Reply Brief"). I also reviewed the affidavit of Dr. Spencer G. Lucas, given on behalf of ENDAUM and SRIC in response to the April 21 Order, and the paper by A. Jun Cowan (hereafter, "Cowan Paper"), that Dr. Lucas discusses in detail. Finally, I remain familiar with the professional literature relevant to groundwater issues associated with the Crownpoint Uranium Project ("CUP").

5. In the paragraphs that follow, I address Questions 1, 3, and 8 of the April 21 Order, either in whole or in part.

6. Question 1 of the April 21 Order stated:

Based on URI's experience, the experience of the ISL industry in general, and the lab work reported in Tables 4.8 and 4.9 of the FEIS, what important difficulties (including unlikely but foreseeable difficulties) may reasonably be considered for the CUP concerning restoration of groundwater quality at Church Rock Section 8? What environmental costs may reasonably be expected to result from foreseeable difficulties?

7. Based on my evaluation of the geology of the Westwater Canyon Formation, analytical data on the water quality of the Westwater Canyon Aquifer in ore and non-ore zones below Section 8, and on the relevant experience in the uranium ISL industry, it is my professional opinion that it is highly unlikely that Westwater Canyon groundwater in the southeastern quarter of Section 8 will be restored to either primary or secondary restoration goals, as those goals are defined in the FEIS (at 4-27 to 4-29) and in the HRI license (SUA-1508, License Condition 10.21(A)). Moreover, it is unlikely that Westwater Canyon groundwater at the nearest downgradient off-site locations in Section 9 and the northeast quarter of Section 8 will be restored to baseline conditions or drinking water standards. In fact, the NRC Staff's clear intention, revealed in Mr. Ford's affidavit (at 13-15), is to hope that restoration standards can be achieved by natural attenuation through chemical reduction. This restoration approach technique is not based on any field-level redox studies or empirical data, and is likely to fail. My reasons for these conclusions follow.

8. Restoration of ore-zone groundwater to baseline or drinking water standards was not demonstrated in core leach tests for several critical parameters, even after flushing of the crushed ore more than 20 times. FEIS, Table 4.8 at 4-32 and Table 4.9 at 4-33. Complete restoration to baseline was not demonstrated after three

pore volumes in the Teton field-level pilot test for 11 of 28 parameters. Abitz January Testimony, Table 1 at 12, and FEIS Table 4.12 at 4-36. Restoration to baseline was not successful after 16.7 pore volumes at the Mobil Section 9 pilot project for several critical, health-based constituents, including barium, boron, cobalt, lead, mercury, molybdenum, nickel, radium-226, uranium and zinc. FEIS, Table 4.13 at 4-36. The Teton and Mobil pilot projects are the most relevant field-level experience for predicting restoration performance at the commercial scale proposed by HRI at Church Rock and Crownpoint. At both sites, leaching was done in the Westwater Aquifer in groundwater possessing virtually the same water quality as that at the HRI sites. Id. at 4-36, 4-38; Abitz January Testimony at 12; Staub Testimony at 40. In the Mobil case, leaching took place over an 11-month period, yet restoration efforts continued for some 6 years before NRC released Mobil from further remedial activities. Staub Testimony at 20, Exhibit L.

9. Undetected excursions outside the ore zone are highly likely for the following reasons:

(a) The pregnant lixiviant contains high concentrations of several regulated constituents, including arsenic, uranium, radium and total dissolved solids (FEIS, Table 2.1 at 2-6; Table 4-8 at 4-32; and Table 4.13 at 4-38). Once oxidized, arsenic, uranium and other mobile constituents will migrate outside of the leaching zones.

(b) Lixiviant containment will be jeopardized by reinjection of nearly all of the 1 percent bleed rate. Wallace Reply Testimony at 13-19; Staub Testimony at 34-35.

(c) The complex channel structures in the sheet sands of the Westwater Canyon Formation, which were described, photographed and drawn by Cowan (1991, at 83-85) (see, also, Lucas Affidavit at ¶¶9-10), will

facilitate contaminant migration away from the ore zones. Wallace Reply Testimony at 19.

(d) The wide spacing of downgradient monitoring wells (i.e., one well every 400 feet) — a spacing that has no relation to the geometry of the narrow and thin sand channels — will allow contaminant plumes to migrate undetected beyond the monitor well ring. Id. at 18; Staub Testimony at 36-38; Abitz January Testimony at 27-30, 31-33.

10. Contamination of fresh, potable groundwater, found largely in *non-ore zones*, will occur as a result of undetected excursions. This is because the bulk of the groundwater within the Westwater Canyon Formation is within *non-ore zones*, where the water quality is very good to excellent and meets all EPA drinking water standards. Abitz January Testimony at 11-15. Restoration limited to the ore zone will not address the impacts of excursions in non-ore zones of the aquifer.

11. Uranium ISL restoration to baseline levels or EPA drinking water standards has not been demonstrated in high water quality environments in Wyoming and New Mexico. See, generally, Staub Testimony at 17-22. No commercial-scale ISL mine in Wyoming has been restored to baseline or drinking water standards. Abitz Reply Testimony at 2; Staub Reply Testimony at 7. ISL operations in Wyoming did not restore selenium, radium, and uranium concentrations to baseline values after more than 20 pore volumes were passed through the mined ore zones. Abitz January Testimony at 48 and Exhibit J. Restoration at a small-scale ISL field test, the Teton Pilot site located 2 miles west of Church Rock, did not return selenium, radium, and uranium concentrations to baseline values. Abitz January Testimony, Table 1 at 12. At the Bruni Project in Texas, 25 pore volumes were processed in a reverse-osmosis circuit, yet ammonium, sulfate, and uranium concentrations continue to exceed the restoration limits of the Texas Department of Water

Resources. Abitz January Testimony at 49. Restoration schedules were lengthened and some restoration standards were relaxed to facilitate restoration at several Texas sites, including Uranium Resources, Inc.'s ("URI") Benavides Mine. Staub Testimony at 22-23.

12. In describing "baseline" water quality at its New Mexico sites, including at the Church Rock site, HRI grouped ore, non-ore, and non-Westwater groundwater samples into a single population, thereby artificially distorting upward average baseline concentrations. As illustrated in Tables 1 and 6 of my January testimony (at 12 and 26, respectively), and as I discussed at length therein, baseline values need to be calculated for ore and non-ore zones in the Westwater Canyon aquifer, and samples showing clear indication of contamination from anthropogenic activities (i.e., non-Westwater samples) must be excluded from the data set. Given HRI's past practice of averaging ore zone water quality with non-ore zone water quality, and the NRC Staff's uncritical acceptance of this practice (see, e.g., FEIS at 3-27, 3-32 and 3-36; Ford Affidavit at 13), I have serious concerns about the accuracy of formal baseline values that would be determined for each of the HRI sites pursuant to License Conditions 10.21, 10.22 and 10.25. SUA-1508 at 7-8.

13. Neither HRI nor the NRC Staff has published site-specific geochemical data to support the conclusion that redox conditions downgradient of the ore zone will enhance restoration efforts by the precipitation of uranium and other redox sensitive metals (e.g., arsenic and selenium). At a minimum, HRI should have evaluated well-established redox "couples" (e.g., Fe^{2+}/Fe^{3+}, As^{3+}/As^{5+}, Mn^{2+}/Mn^{4+}, Se^{4+}/Se^{6+}, U^{4+}/U^{6+}) in downgradient groundwater to establish the reduction potential in all zones of the aquifer (i.e., sand channels, silt and mud in point bars, etc.). Without such geochemical studies, the NRC staff has no real basis for its view that redox reactions will attenuate any residual contamination leaving the

mining zones during operations or after restoration. See, Ford Affidavit at 7-8, 13-15.

14. Rather than answering the question posed by Judge Bloch, "...what important difficulties (including unlikely but foreseeable difficulties) may reasonably be considered, . . ." HRI and the NRC Staff chose to continue to cite the incorrect conclusions in the FEIS while ignoring the substantial body of evidence on (1) the groundwater data that indicate very good water quality in the Westwater under Section 8, (2) the documented ISL history of excursions, and (3) the failure of the ISL industry to restore commercial-scale uranium ISL operations in Wyoming.

15. HRI and the NRC Staff hydrologist William Ford respond to the query on restoration of groundwater quality by simply stating that:

(a) "Groundwater at Section 8 is not currently a source of drinking water and its future use is severely restricted due to the naturally occurring concentrations of radionuclides." HRI Response at 2.

(b) "Given the poor water quality now present in the ore zone at Church Rock Section 8 as a result of uranium and radium concentrations [and] the chemical inability of these groundwater constituents to move outside the well field area, . . .it is extremely likely that after in situ leach mining is completed, the groundwater quality will be restored to acceptable levels so that the water use of the aquifer is maintained." Ford Affidavit at 2.

(c) HRI and Ford are incorrect on these points. As I discussed in detail in my January testimony (at 11-15) and reiterated in Paragraph 10 above, Section 8 groundwater from the ore zone meets EPA primary drinking water standards at well CR-4, and very nearly at well CR-5 (radium-226 = 5.3 pCi/L). Further, most of the groundwater in the Westwater Canyon aquifer lies outside the ore zones and currently meets the EPA primary drinking water standards (e.g., CR-7). The poor water quality referred to by HRI and Ford is a result of

HRI's mixing of ore-zone water and oxidized water surrounding the old Church Rock underground mine (see, e.g., data for CR-8, in Abitz January Testimony, Table 2 at 14) with non ore-zone water, thereby introducing statistical bias into their calculations of baseline. This practice particularly distorted levels of uranium and radium. Since HRI has not calculated baseline properly at the Church Rock sites, groundwater quality in Section 8 cannot be argued to be of poor quality simply because isolated ore zones in the aquifer occasionally yield uranium and radium concentrations that exceed their respective EPA primary drinking water standards.[1]

16. Mr. Ford further assumes that once mobilized, arsenic, uranium, and radium are not chemically able to migrate outside the well field area. He supports his conclusion by citing the studies of Deutsch (1983 and 1985), which state that "...redox- (oxidation/reduction) sensitive ions such as uranium, arsenic, selenium, and molybdenum precipitate from solution if the restored water moves into a reducing zone. Therefore, after restoration activities, if groundwater moves into a reducing area, concentrations of these ions should rapidly decrease in the groundwater" (emphasis added). Ford Affidavit at 6-7. Mr. Ford misses the operative word "should" in Deutsch's conclusion. Uranium and other redox sensitive elements (e.g., arsenic and selenium) are placed in a highly mobile form during in situ leaching and commonly migrate outside the well field area, as demonstrated by the excursion history of ISL operations in Wyoming and Texas. See, Staub Testimony at 11-15 and Exhibits C through K. Mr. Ford produces no information on reaction kinetics to support the speculation that the concentrations of uranium and redox sensitive ions will rapidly decrease in the groundwater of

[1] **As I have noted before in this proceeding, EPA proposed a drinking water standard for uranium of 0.020 mg/L, but never promulgated a final standard. EPA has promulgated a final uranium standard of 0.044 mg/L (or 30 pCi/L) for cleanup of groundwater at UMTRA (Uranium Mill Tailings Remedial Action) Project sites.**

the Westwater Canyon aquifer as water moves away from the ore zone. Further, as noted above in Paragraph 13, neither HRI nor the NRC Staff has produced geochemical data on the redox state of the Westwater Canyon aquifer downgradient from the proposed ISL operations.

17. Finally, Mr. Ford demonstrates his own confusion about the chances of successful restoration at Church Rock with two contradictory statements: First, in Paragraph 4, he concludes that "it is extremely likely" that groundwater quality will be restored "to acceptable levels" (emphasis added). Ford Affidavit at 2. Then, in Paragraph 5, he concludes from examination of the Mobil Section 9 pilot restoration data that "it is unlikely that groundwater restoration activities at the Church Rock site will achieve baseline concentrations for all groundwater parameters" (emphasis added). Id. Mr. Ford notes correctly in Paragraph 5 that groundwater restoration was not successful at the Mobil Section 9 pilot site for most chemical and radiological constituents of concern. He does not acknowledge, however, that Mobil's experience was not unique in the history of the uranium ISL industry. As Dr. Staub and I discussed at length in our January 1999 testimonies (see, Staub Affidavit at 20 and Abitz Affidavit at 47), the ISL industry has not had success in restoring uranium and radium groundwater quality at ISL mines in Wyoming, Texas, or New Mexico. Moreover, based on these discussions presented in the testimonies of Abitz and Staub, HRI is also incorrect when it states that "Intervenors...have been unable to cite credibly a single instance of significant groundwater degradation or environmental cost much less adverse public health consequences associated with ISL uranium extraction." HRI response at 3.

18. In citing the FEIS at 4-39, HRI notes: "...the staff conclude that practical production-scale groundwater restoration activities would at most require a 9 pore volume restoration effort." This statement is incorrect and simply unbelievable,

as Tables 4-8 and 4-9 in the FEIS clearly show that uranium and radium were not returned to baseline values after 16, 16.7, 20 and 28 pore volumes in both bench-scale tests and at the Mobil Section 9 pilot site. Mr. Ford corroborates the failure of restoration for the critical contaminants in Paragraph 18. Ford Affidavit at 10-11. Undeterred by the facts, HRI concludes that, "No important difficulties, including unlikely but foreseeable difficulties, concerning groundwater restoration present themselves for consideration." In a fashion true to the history of this project, HRI chooses to believe what suits its case and ignores a large body of evidence that shows excursions are prevalent in ISL operations and groundwater parameters are rarely restored to drinking water standards. And in the instances where restoration has been completed at the Texas sites, the water quality was poor to begin with, restoration goals were relaxed, and restoration schedules lengthened. Staub Testimony at 21-25.

19. Question 3 of the April 21 Order stated: **"Qualitatively, and if possible, quantitatively, what are the effects on the quality of water that may reasonably be foreseen at the closest private water wells to Church Rock Section 8, resulting from the poorest foreseeable condition of the groundwater after restoration is complete."**

20. The poorest foreseeable condition of groundwater after restoration is likely to be represented by restored values shown in Table 4.8 of the FEIS where uranium ranged from 5.1 mg/l to 10.6 mg/L and radium ranged from 231 pCi/l to 1,010 pCi/l in "restored" core leach water. As Mr. Wallace has now demonstrated by modeling post-restoration transport of uranium at only 1 mg/l (Wallace Response Affidavit, May 20, 1999, ¶¶24-27), post-restoration contamination will migrate offsite, far from Section 8. Given the high quality of groundwater in the Westwater Canyon Aquifer that can reasonably be expected to occur in Section 9, immediately downgradient of Section 8, and the high value of groundwater as the

only drinking water source in the area, future groundwater use in Section 9 (which is virtually certain) is seriously jeopardized by contaminant migration from Section 8. Future use is an appropriate concept for groundwater protection and is embodied in many statutes, including the New Mexico Water Quality Act. Therefore, the inability of the ISL industry to restore groundwater to EPA drinking water standards endangers the future use of the Westwater Canyon aquifer as a drinking water supply.

21. The nearest locations where local residents or regional water suppliers could choose to install and complete water wells for domestic and/or municipal water supplies include that portion of Section 8 which lies north of the HRI's property boundary and that portion of Section 9 which lies immediately east of and adjacent to HRI's property boundary. As noted above in Paragraphs 10 through 18, HRI will have considerable difficulties restoring groundwater to premining, baseline values and protecting the very high quality groundwater that exists in the Westwater Aquifer at the nearest point of reasonably foreseeable future use. Therefore, the quality of groundwater at future wells placed in Sections 8 and 9 is likely to be unfit for human consumption should HRI conduct ISL operations in Section 8.

22. HRI asserts, "There will be no impact, pre- or post-restoration, on water quality at the closest private well as a result of HRI's operations at Church Rock Section 8." HRI Response at 16. Again, HRI's conclusion is based on incorrect conclusions in the FEIS on restoration capabilities and future use of the aquifer. HRI has not addressed the question with respect to the "...poorest foreseeable condition of groundwater after restoration is complete." As noted in Paragraph 20, the poorest foreseeable condition for restored groundwater is likely to be the restored concentrations reported in Table 4.8 of the FEIS. Given the poor water quality reported in Table 4.8 of the FEIS, a reasonable interpretation of the architectural

fabric of the Westwater sandstones (Cowan, 1991, and Lucas Affidavit at ¶¶13-14), and future wells in Sections 8 and 9, groundwater travel times are likely to be much faster than estimated by HRI's Craig Bartels (see, Bartels Affidavit at 17-18). Indeed, Mr. Wallace has now demonstrated adverse impacts of contaminant migration within a generally accepted "future use" planning horizon of 200 years. Wallace Response Affidavit, ¶¶24-27 and Exhibits 2-G and 2-H. Hence, ENDAUM and SRIC have presented credible and compelling evidence that off-site groundwater in Sections 8 and 9 is likely to be degraded beyond non ore-zone baseline levels and drinking water standards.

23. Question 8 of the April 21 Order states: **"Intervenors Groundwater Exhibit L quotes Cowan (1991), who states that near Church Rock, channelways '15-30 m. thick' occur 'which would affect fluid flow.' SRIC/ENDAUM will please promptly provide a reference for the citation so that we may discover whether Cowan says anything about the width of these channelways."**

24. The work of Cowan (1991), and the interpretation of the Cowan work by Dr. Spencer Lucas, a known international authority on Jurassic sediments, including those of the Morrison Formation in northwestern New Mexico, clearly shows that heterogeneity exists in the Westwater Canyon Formation on the scale of tens of meters. As noted in Dr. Lucas's affidavit (at ¶12 and ¶13), Cowan argues that the channel systems identified by Campbell are 30 to 300 meters wide and are not primary depositional features, but instead are "post-depositional aquifer conduits, or permeability-pathway components." The aquifer conduits, or permeability pathway components, are precisely the type of hydrologic anisotropy that invalidates the groundwater transport model presented by HRI in its application and uncritically accepted in the FEIS. Moreover, the geohydrologic conceptual model of the Westwater Canyon proposed by Mr. Wallace and I in our January testimonies is corroborated by the Cowan study and Lucas's interpretation of it.

The bottom line is that hydraulic anisotropy is present in the Westwater Canyon Formation and neither HRI nor the NRC Staff have adequately addressed its implications for the fundamental issue of lixiviant control and containment at Section 8. The FEIS remains, therefore, substantially inaccurate in its treatment of hydrology and contaminant transport issues within the Westwater sands, and therefore in a wholly inadequate document for evaluating the environmental impacts of the Crownpoint Uranium Project.

AFFIRMATION

I declare on this 21 day of May, 1999, at Ross, Ohio, under penalty of perjury that the foregoing is true and correct to the best of my knowledge, and the opinions expressed herein are based on my best professional judgment.

Richard J. Abitz

Sworn and subscribed before me, the undersigned, a Notary Public in and for the State of Ohio, on this 21 day of May, 1999, at Ross, Ohio.

My Commission expires on _____.

Notary Public

CARL F. FAUVER
NOTARY PUBLIC
IN AND FOR THE STATE OF OHIO
MY COMMISSION EXPIRES 4 MAY 2000

May 20, 1999

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before Administrative Judges
Peter B. Bloch, Presiding Officer
Robin Brett, Special Assistant
Thomas D. Murphy, Special Assistant

In the Matter of	)	
	)	
HYDRO RESOURCES, INC.	)	Docket No. 40-8968-ML
2929 Coors Road, Suite 101	)	ASLBP No. 95-706-01
Albuquerque, NM 87120	)	
	)	

RESPONSE AFFIDAVIT OF MICHAEL G. WALLACE

I, Michael G. Wallace, being duly sworn, submit the following response affidavit on behalf of Eastern Navajo Diné Against Uranium Mining ("ENDAUM") and Southwest Research and Information Center ("SRIC"), in response to the answers filed by Hydro Resources, Inc. ("HRI"), and the NRC Staff ("HRI Response" and "NRC Staff Response," respectively), to questions 3, 2, 1, and 8 posed by the Presiding Officer in his Memorandum and Order of April 21, 1999 ("April 21 Order").

1. My name is Michael G. Wallace. My qualifications are set forth in my written testimony and Exhibit A attached thereto, which were submitted on behalf of Intervenors' Written Presentation in Opposition to Hydro Resources, Inc.'s, Application for a Materials License with Respect to: Groundwater Protection (January 11, 1999) ("Intervenors' Groundwater Presentation") ("Wallace January Testimony"). I have a

EXHIBIT
2

master's degree in hydrology from the University of Arizona and extensive knowledge and experience in the movement of contaminants in groundwater systems, as a consultant to industry and government agencies. My experience includes development of hydrogeologic conceptual models and the application of those to the valid prediction of contaminant transport through numerical modeling. For much of the past 10 years, I have been a consultant to the U.S. Department of Energy ("DOE") working on modeling radionuclide movement through hydrogeologic formations at the proposed Waste Isolation Pilot Project (WIPP) in southeastern New Mexico. I continue to work in this capacity as a contractor within Sandia National Laboratories on an essentially full-time basis.

2. In addition to the materials listed in my January testimony in support of Intevenors' Groundwater Presentation, and the documentation cited in my April 8, 1999, affidavit in support of ENDAUM's and SRIC's Reply to HRI's and the NRC Staff's Response Presentations on Groundwater Protection ("Wallace April Affidavit" and "ENDAUM-SRIC April Reply"), I have reviewed the HRI Response and the Staff Response to questions posed in April 21 Order, including the affidavits of Craig Bartels on behalf of HRI and William Ford on behalf of the NRC Staff, and the various attachments thereto.

Question 3 of April 21 Order

3. Question 3 of the April 21 Order asks:

Qualitatively and, if possible, quantitatively, what are the effects on

the quality of water that may reasonably be foreseen at the closest private water wells to Church Rock Section 8, resulting from the poorest foreseeable condition of groundwater after restoration is completed?

4. In response to this question, the Staff has little to say, other than that the FEIS identified the nearest operating well, 0.5 mile to the south, and that HRI believes the groundwater flow is northerly. Ford Affidavit at 20. HRI addresses the question by stating that the nearest downgradient well is at the United Nuclear Corporation ("UNC") millsite located about 2.5 miles northeast of Section 8.[1] Bartels Affidavit at 16. Mr. Bartels states that he calculated the groundwater travel time from Section 8 to the UNC well as 1,632 years, and concludes that restoration at Section 8 cannot have a negative effect on this well. Neither HRI nor the Staff quantifies the impact on groundwater quality from Section 8 development.

5. Quantitative predictions of the quality of groundwater several miles downgradient from a contaminant source such as the Section 8 ISL mine not only are possible, but it is routinely used in industry. I have conducted such an analysis using professionally accepted modeling methods and software to respond to this question. My analysis shows that contamination can reach a distance equivalent to that of the nearest private water supply well, i.e., the UNC well cited by Mr. Bartels. Hence, as I explain in detail below, I have demonstrated that HRI's Section 8 ISL mine can have an adverse effect on the downgradient groundwater quality when an initial contaminant concentration that represents "the poorest foreseeable condition of groundwater after

[1] This fact, which I have been able to verify, was not disclosed in the FEIS and has not arisen in any previous filings by HRI or the NRC Staff.

restoration" is used in the model.

6. My modeling analysis also makes two important collateral contributions to estimates of post-restoration adverse effects on the offsite groundwater. First, the analysis provides estimations of the total volume of water in the aquifer that would be degraded by the mine. Based on those estimations, I calculate the "cost" of this contaminated groundwater. And second, my analysis provides strong supporting evidence for the existence of isolated sand channels similar to those that I posited in my previous affidavits and in my January testimony. This evidence, in my opinion, makes the sand channel conceptualization nearly irrefutable, since it is now additionally supported by a calibration to HRI's actual Section 8 pump test data that were derived from pump tests conducted in September and October 1988.[2]

Model Development

7. In my April testimony, I presented some simple, plausible model simulations that dealt with issues of lixiviant containment during ISL operations at the Church Rock site. In response to the Presiding Officer's more recent request, I have prepared new model simulations. These simulations address the long-term water quality consequences upon the area aquifer(s) following ISL restoration activities. These types of simulations provide a quantitative means to estimate impacts of the proposed activities upon nearby water supply wells and upon the aquifer in general.

---

[2] The relevant pump test results were reported by HRI in Appendix E of its Church Rock Revised Environmental Report (March 1993).

8. The simulations are comprised of a combination of two numerical codes, MODFLOW and MT3D. MODFLOW is a finite-difference groundwater flow simulator, developed by the U.S. Geological Survey. MT3D is a solute transport simulator that is compatible with MODFLOW, and was developed through funding by the U.S. Army Corps of Engineers.

9. I developed a flow model that approximated both pre-and post-pump test conditions, as those conditions were described in HRI's December 1988 report.[3] I then incorporated into the transport model an initial distribution of post-restoration solute levels, using a dimensionless concentration value.[4] Due to the linearity of the transport solution, all concentration results can be raised or lowered by a common factor. In this manner, various assumptions about the actual post-restoration concentration value can be evaluated without resorting to additional modeling.

10. The contaminant transport model simulated the migration of a plume of contaminants to the north and northeast from Section 8. The time period of this simulation ranged from the time at end of restoration (i.e., time = 0) to 274 years into the future. I examined the model results to determine contamination values at various locations and at various times within the model domain. I also developed approximate values for the volume of contaminated groundwater. Table 1, which is attached to this affidavit as **Exhibit 2-A**, presents assumptions and parameter values used in these

---

[3] Id.

[4] By "dimensionless," I mean a concentration that is expressed only as a numerical value without its customary units. Accordingly, a concentration value of "1" could be 1 milligram per liter or 1 picoCurie per liter. The actual units do not matter for proper operation of the model.

models. The finite difference grid is presented in Figures 1a and 1b, which are attached to this affidavit as **Exhibits 2-B** and **2-C**, along with boundary conditions and the Westwater Canyon wells used in HRI's Section 8 pump test.

Calibration and Model Validity

11. A model is in part a computer simulation that approximates the geology and hydrology of the area of concern. The flow of water and transport of dissolved contaminants (such as uranium) are simulated in a dynamic manner. Such models are routinely used to predict future impacts of proposed activities. The believability of the model prediction rests on the plausibility of the conceptualization, the accuracy of the simulator and the nature of the approximation of the geologic conditions in which the flow and transport take place.

12. It is not possible to effectively evaluate these features without some ground truth to compare against. In the case of groundwater models, one generally relies heavily on calibration to pump test data and so-called steady state data. Calibration in this context means the use of the simulator/predictor to re-create the dynamic water level fluctuations measured in a pump test and to re-create the ambient water levels prior to such a test. The goodness-of-fit of such a simulation can then be used to evaluate the believability of the model's future predictions. The rationale for this is that if the model can approximate dynamics of the system that are already known, then some confidence can be had in its ability to predict future phenomena.

13. HRI has not provided calibration results to support any of its groundwater

models or travel time estimates. As I indicated in my April affidavit (Exhibit C to ENDAUM-SRIC April Reply, at 9), HRI cannot provide such results because it cannot calibrate, or match, its historic water level data and pump test data to its homogeneous, perfectly confined aquifer models. To demonstrate this point, I have taken my model and assigned it a homogeneous hydraulic conductivity equivalent to the value HRI used for the area. I then ran the model, simulating steady state conditions and the Section 8 pump test. I compared the model-calculated values (in feet) for residual differences in water levels with the measured values. The results of this comparison are depicted in the "Table of Residual Differences in Water Levels" below and in Figure 2, attached hereto as **Exhibit 2-D**.

14. In the Table of Residual Differences and in Figure 2 (**Exhibit 2-D**), net differences in water levels between the model calibration results and the results using HRI's homogeneous model are expressed as "residuals" greater than or less than 0.0. In Figure 2, the horizontal black line represents a water-level difference value of 0; the difference values from my calibration model are depicted by black dots, and values derived from using HRI's homogeneous model are depicted by gray crosses. The closer the differences are between the measured water levels and the model results, i.e., the closer the "residuals" are to 0, the better the match of the measured levels to the model.

15. As shown in the Table of Residual Differences and in Figure 2, in most cases, my model calibration results are closer to the actual water level values than the results from HRI's homogeneous model. In other words, my results "match" well with the measured results, while results from HRI's model match poorly. For example,

Table of Residual Differences in Water Levels (in feet)
(Presented graphically in Figure 2, attached as Exhibit 2-D)

Section 8 Monitor Wells	HRI homogeneous model (pre-pump test)	Wallace model calibration (pre-pump test)	HRI homogeneous model (post-pump test)	Wallace model calibration (post-pump test)
CR-5	-12.5	+2.0	-14.0	+2.0
CR-6	+2.0	+2.0	+11.0	+2.0
CR-8	-8.5	-5.0	+5.0	-8.0

monitoring well CR-5[5] had a measured post-pump test head (i.e., water level) that is 14 feet lower than the model head. Similarly, the post-pump test head for CR-6 was 11 feet higher than the model head. Both represent significant departures from the measured levels. In only one case, the post-pump test results for well CR-8, did my model have a residual value greater than the value resulting from HRI's model.

16. To make HRI's model fit better for the CR-5 results, I could have adjusted the hydraulic conductivity downward to improve fit, but that would in turn make the match of the other transient observation well points even worse. Unless I resorted to incorporating leakage from overlying or underlying units into the model (leakage that HRI has repeatedly asserted does not exist), there is simply no way to come close to matching all of the measured data shown with HRI's homogeneous model.

---

[5] The locations of CR-5 and other Section 8 monitoring wells discussed in this affidavit can be seen in Figure 3.11 of the FEIS (at 3-37); however, this map disagrees with the well-location map marked as Figure 2 of HRI's December 1988 pump test report. The well called CR-6 in Figure 3.11 should have been marked CR-8, and the well called CR-4 in Figure 3.11 should have been marked CR-6. The locations of CR-3, the pumping well, and CR-5, an observation well, in Figure 3.11 appear to agree with those in Figure 2 of the December 1988 report.

17. Why the poor matches for HRI's model? Precisely for the reasons discussed in my April affidavit (at, e.g., 7-8, and Figures A and B): Namely, that HRI used a model that assumed, incorrectly, that the aquifer is homogeneous, perfectly confined and of infinite width. I confirmed this from calibrating my heterogeneous model. For example, CR-8 is located closer to the pumping well, CR-3, than CR-5[6] is. One would expect drawdown to be greater in the closer observation well, unless there is some barrier between the closer well and the pumping well. After many attempts to calibrate, I found that channels seemed the only appropriate type of configuration to best match the data. In this case, a channel had to connect the pumping well, CR-3, to the observation well, CR-5, to the northeast, but a lower-permeability channel wall had to separate the pumping well from CR-8 to the southwest. When I incorporated these conditions, as shown in Figure 3, attached hereto as **Exhibit 2-E**, the difference between measured and modeled water levels CR-5 was only 2 feet. (See, also, Table of Residual Differences above and Figure 2 [**Exhibit 2-D**].) Hence, the channelization configuration resulted in a better match to the actual water level data, indicating that my model, since calibrated to the pump test data, will provide a more reliable and accurate prediction of contaminant transport at Section 8 than any of the predictions offered to date by either the Staff or HRI. Figure 3 illustrates the final heterogeneity channel patterns used in my model.

18. No calibration to data can be considered unique. While there are an

---

[6] According to data in Table 2 of HRI's December 1988 pump test report, CR-5 is located 536 feet from CR-3, the pumping well, and CR-8 is located 398 feet from CR-3.

infinite number of possible configurations that can feasibly match the historic water level data, there are always an even greater number of configurations that cannot match the data, such as the homogeneous configuration that HRI used. In fact, the solutions that are viable are often merely variations on a theme. Channel-like features are a type of theme distinctive from other types of underground porous media. I believe (with good reason) that most, if not all, of the successful Section 8 calibration possibilities would result in channel-like features. Some realizations may show even more pronounced pipeline-like effects; others might show slightly less channeling.

19. While my model is nothing more than one of many plausible configurations based on a channel theme, it is the only calibrated model used by any of the parties to date to evaluate quantitatively the groundwater impacts of just one contaminant, uranium, migrating from Section 8 after restoration. HRI and NRC did not provide a calibrated model in their responses to the Presiding Officer's request for quantitative estimates of post-restoration groundwater impacts. Moreover, both HRI and the Staff have failed to provide any new modeling or realistic calculations, whatsoever. In HRI's case, its had more than 10 years to do so but has chosen not to. The models HRI has used to date are useless for their value to predict adverse impacts, if only for the reason that they have not been calibrated against real-world conditions.[7]

---

[7] The Geraghty & Miller report, "Analysis of Hydrodynamic Control...." (1993), claims a calibration to historic conditions, but provides no direct quantitative data for evaluation. My review of what is provided shows yet even more inconsistencies, beyond those I already have identified and discussed. Notably, no calibration to the pump test is presented, and also, more telling still, no data for wells CR-6 or CR-8 are provided in Figure 21 of the Geraghty & Miller report. Data from those critical wells were certainly available, as they have been around since late 1988, whereas the report was written in 1993. In essence, there was no calibration. Because of the simplicity of HRI's model setup, my re-creation

20. Mr. Bartels's recent travel time estimates (Bartels Affidavit, at 18) do not qualify as quantitative estimates of impacts on water quality. A travel time estimate simply does not provide any clue as to contamination values at any point along the flowpath. Perhaps he hoped to suggest that the travel times are so long that any water quality question is superfluous. However, his estimate of 1,632 years for contaminant travel to the nearest downgradient private well is based on the same old faulty, uncalibrated homogeneous HRI model. As such, he uses a relatively low uniform value of hydraulic conductivity (0.77 ft/day) and a uniform hydraulic gradient to arrive at a simplistic, nonconservative estimate of groundwater velocity. In contrast, to calibrate my model, I had to develop a channel feature having a hydraulic conductivity of 13 ft/day (about 17 times greater). This, in conjunction with the rest of the model setup, led to much faster times for contaminants to reach that well. Furthermore, my model provides direct water quality impact information. Results are detailed in a later section.

Leakage

21. Although HRI has had more than 10 years to do contaminant transport modeling and to calibrate it against actual pump-test data from Section 8, I haven't.[8]

---

is an acceptable replicate of what HRI's calibration statistics would show, had they been properly revealed.

[8] Based on my recommendation, Counsel for Intervenors ENDAUM and SRIC requested "excursion scenario" modeling data from HRI and the NRC Staff in the fall of 1998. See, letter from Johanna Matanich, NMELC, to John T. Hull and Mitzi Young, NRC (September 29, 1998), and Item 5 from the list of 10 information items attached thereto. In an October 16, 1998, letter to the NRC Staff, HRI's Mark Pelizza responded that ENDAUM and SRIC could buy the modeling software. He did not, however, state whether HRI had or had not done excursion modeling. Since then, I have had to assume that HRI has not done the kind of contaminant transport modeling that I've presented in this affidavit and that is routinely done by companies whose activities may affect groundwater quality. This deficiency remains, in my professional opinion, a gaping hole in the evaluation of the CUP to date, and another reason

Model development and calibration are extremely time consuming. To incorporate leakage into my model, I would have to put more layers in. More layers means more variables to consider and requires far longer computational times. The model I have presented in this affidavit was built to respond, in less than one month's time, to the questions posed by the Presiding Officer in his April 21 order. Although I would like to investigate the leakage question with a model, I haven't had time to do so for this particular stage. Therefore, the model presented here does not consider leakage. Yet, that does not mean that such leakage cannot or will not exist.

Contaminant Transport Model and its Inputs

22. Although my model was calibrated to hydraulic data, its primary purpose is to address possible water quality impacts. Predicting water quality impacts is accomplished here by the companion MT3D contaminant transport model. That model incorporates several different ways to simulate contaminant transport. I chose two methods. The first was a default finite difference technique. The second employed the method of characteristics ("MOC"). At present, there are no contaminant data that can be used to calibrate either of these models. However, both of these models rely principally on the ground water velocity fields imported from the calibrated flow model. Therefore, the results are supported to a great degree by the validity of the flow calibration. This approach is standard industry practice.

---

why the NRC Staff should not have issued the license in the first place.

23. The initial contaminant source is considered to be a roughly rectangular area that encompasses the mine zones in Section 8, and is depicted in Figure 4 attached hereto. I assumed, based on the Presiding Officer's interest in the "poorest foreseeable condition of groundwater after restoration" (April 21 Order at 2), an initial concentration of uranium in this area of 1 milligram per liter (mg/l). I chose this value for several reasons. First, it is about 2.3 times greater than the restoration standard of 0.44 mg/l, but considerably less than the anticipated lixiviant concentration of 50 to 250 mg/l. FEIS at 2-6. Second, the January testimonies of Dr. Richard Abitz and Dr. William Staub, attached as Exhibits 1 and 2, respectively, to Intervenors' Groundwater Presentation, reported the many difficulties that operators in Wyoming have had restoring groundwater to uranium levels less than 1 mg/l. And third, should HRI have similar difficulties, my understanding is that it can always petition the NRC for alternate concentration limits. Invariably, such alternates are greater than the original license-imposed standard. I also consulted with Dr. Abitz on this question, and while he concurred that a 1 mg/l initial concentration is reasonable, he stated his belief that an even higher level could be justified as the "poorest foreseeable conditions of groundwater after restoration." Dr. Richard Abitz, personal communications, May 11 and May 19, 1999.

24. I should note here that the MT3D model does not evaluate redox (i.e., oxidation-reduction) conditions in the aquifer. While the NRC Staff has asserted strongly that redox conditions in the Westwater Canyon Aquifer downgradient of the mining zone can be counted on to re-immobilize the uranium and other constituents following restoration (see, e.g., Ford Affidavit at 7-8, 13-14), a close examination of these

arguments shows that they are not supported by any actual geochemical evidence. For example, there are no dissolved oxygen ("DO") concentration data or DO contour maps in the FEIS or any other part of the HRI license application. Similarly, as pointed out by Dr. Abitz in his May 20 affidavit, there are no studies of trace metal concentrations in site monitoring wells such that redox reactions and conditions could be calculated or predicted. Of course, the uranium now in the rock has to be reduced to be immobilized, but this natural reduction appears to be intimately related to the presence of humate deposits in the formation. When all is said and done, then, the Staff's redox argument is nothing more than sheer speculation and wishful thinking. I am justified, therefore, in using a model that does not account for redox attenuation of contaminant migration.

Discussion of Results and Conclusions

25. The initial contaminant source distribution is depicted in the shaded area of Figure 4, which is attached hereto as **Exhibit 2-F**. The contaminant source area is roughly equivalent to the central portion of the proposed Section 8 mining zone. Contaminant distribution results from the finite difference and the MOC models are depicted in two color diagrams, marked as Plate 1 and Plate 2 and attached to this affidavit as **Exhibits 2-G** and **2-H**. Both plates show the striking impact of the channel features on the transport dynamics, and track closely with the channel features shown in Figure 3 (**Exhibit 2-E**). Basically, the plume migrates northeastward, within the channel,

almost as if it were a "pipeline."[9] For the MOC case (Plate 2), I modeled concentrations over time, ending at the location of the UNC well that is considered the nearest downgradient private well. See, Bartels Affidavit at 16. The modeled concentration data are included shown in Table 2, which is attached hereto as **Exhibit 2-I.** Table 2 shows that concentrations reach 0.17 mg/l at the well location in approximately 200 years; lower concentrations reach the location of this well even earlier. Assuming that the "background" concentration is approximately 0.0025 mg/l, or the equivalent of the average uranium concentration in the Town of Crownpoint municipal wells (see, FEIS at 3-26), then the modeled concentration represents nearly a 70-fold increase in concentration levels at that location at that point in time.[10]

26. As stated earlier, these results rest on the foundation of a relatively well-calibrated flow model, the *only* truly calibrated flow model for this site generated by any party in this proceeding to date. The results represent two solutions among many possible solutions that could fit the data. While alternative solutions could show lower impacts on the downgradient well, other alternative solutions could show even greater impacts at any earlier time. Also, I set up the model to be consistent with the context and direction implicit in the formal question posed by the Presiding Officer. And most important, the channel orientations incorporated in my model are consistent with the

---

[9] What's more, the 'walls' of this channel are permeable themselves, only roughly an order of magnitude lower in conductivity than the channel they line. This is nothing close to an impenetrable wall such as that described by Bartels in his earlier critique of my work.

[10] A December 1998 monitoring report submitted by United Nuclear Corporation to the NRC lists a uranium concentration of 0.0028 mg/l for a "Domestic Water Well" located at the UNC millsite. A copy of the relevant portions of that monitoring report are attached to this affidavit as **Exhibit 2-J.**

professional literature's repeated descriptions of the Westwater Canyon Member as a heterogeneous fluvial environment.

27. Finally, the model I have presented does not consider other contaminants that could reasonably be expected to be co-mobilized with uranium and migrate contemporaneously to the end point where human exposure could occur. It does not take into account the fact that, in future years, local land users or governments could select a location for drilling a new water supply well that might coincide with the location of a contaminant plume emanating from Section 8. I should also note that the modeled contaminant plume depicted in Plates 1 and 2 (**Exhibits 2-G** and **2-H**) contains uranium concentrations exceeding the NRC restoration standard of 0.44 mg/l only a short distance from the initial source and within only a few years after restoration is complete. Accordingly, adverse impacts to a future well located, say, in the northwestern quarter of Section 8 or in the western half of Section 9, would occur shortly after restoration ends. And even if a new well is not installed in those immediate off-site areas, the groundwater itself will be contaminated, thereby potentially precluding future water supply development in a potable, high-capacity aquifer. In a later part of this affidavit, I calculate the value of this contaminated groundwater.

Question 2 of April 21 Order

28. Question 2 of the April 21 Order, which I have divided into three subquestions, asks:

(A) Based on local geology, what assurance is there concerning the

likelihood of the existence of shears, fractures, and joints that could transmit appreciable quantities of water above or below the Westwater aquifer? (B) How much greater assurance may reasonably be anticipated prior to commencing ISL operations at Church Rock Section 8? (C) What environmental costs may reasonably be expected to result from foreseeable difficulties at Section 8?

(Subquestion headings added.) I will reply to the parties' responses to each subquestion in the paragraphs that follow:

29. Both HRI and the NRC Staff claim that the Westwater is well-contained above and below, without a significant likelihood of faulting. HRI Response at 8; Ford Affidavit at 15. However, as noted by the Presiding Officer in his April 21 Order, one of HRI's witnesses, Mr. Lichnovsky, did not assess the risk of contaminant migration "through undetected sheers, fractures or joints." April 21 Order at 2, n. 2. My review of the available information indicates a likelihood of the existence of structural features, including shears, fractures, joints, and faults, because of several factors. Some of these factors I identified in my January Testimony, while others were recently identified.

30. In my January Testimony (at 17-18), I explained that vertical fault planes are common in the San Juan Basin, and that a fault of 70 feet or so could bring the Westwater in direct contact with the overlying Dakota. Such contact obviously could facilitate the transfer of a large amount of contaminated fluid. Given the operating pressures described by HRI, smaller faults could also conduct significant quantities of contaminants. I then explained that fractures could exist in the absence of faults, and sometimes serve as conduits for flow. I also discussed Hilpert's 1969 report that identified a series of vertical fractures extending from the mine workings in Section 17

through the Section 8 ore zones. Wallace January Testimony at 65 and Exhibit N, citing Hilpert (1969) at 77. In HRI's February 19 rebuttal, Mr. Lichnovsky argued that the Hilpert cross-section was regional in nature and lacked sufficient localized detail to prove that faults exist in the mining horizon. Yet the Hilpert cross section provides a more detailed look at the subsurface stratigraphy under Sections 17 and 8 then virtually any of the literature cited by Mr. Lichnovsky.[11] Additionally, Hilpert used some of the same borehole logs that HRI used to construct the stratigraphic cross sections that appear in Section 2.6 of HRI's Church Rock Revised Environmental Report (March 1993). Hilpert's data were site-specific; they just happened to be incorporated into a wider discussion of regional uranium mineralization that stretched beyond the HRI Church Rock site. The discussion by Hilpert of these fractures concerns this area as well.

31. I also have demonstrated that HRI's and the Staff's claim that Section 8 is confined below the Westwater by continuous shale is inaccurate. The underlying Recapture is not a classic shale as inferred by HRI and the NRC staff, but a "complexly

---

[11] Mr. Lichnovsky's criticism of my use of Hilpert's cross-section through the Church Rock site is curious given that Mr. Lichnovsky himself relied on regional information to support many of his views about the absence of faults at the site. For example, in paragraph 28 of his February 19 affidavit, he cited Kirk and Condon's seismic studies in the area to bolster his view that no *faults* are evident in the Westwater. Yet a close examination of the Kirk and Condon's 1995 paper, which Dr. Staub attached as Exhibit O to his January testimony, shows that only a small portion of a 14-mile-long seismic cross section intersects the Church Rock mining site. The extent to which it goes through the mining zone cannot be discerned from the relevant figures or text. In contrast, the relevant cross-section in the Hilpert paper, which I attached as Exhibit N to my January testimony, is presented in a larger scale so that details about the stratigraphy that underlies Sections 17 and 8 can be readily examined. Hence, the reference I relied on presents a far more detailed picture of the subsurface than the reference Mr. Lichnovsky used. And there is nothing in the Kirk and Condon paper, or in the paper by Phelps, Zech and Huffman (1995) (attached as Exhibit Q to Dr. Staub's January testimony), that proves that localized sheers, fractures, or joints are absent from the Dakota-Brushy Basin-Westwater-Recapture sequence. Indeed, finding such features, which are much smaller geologic features than regional faults, was not the purpose of the either the Kirk and Condon study (see, abstract at 105) or the Phelps, Zech and Huffman study (see, abstract at 145).

interbedded. . .mudstone interbedded with fine- to medium-grained. . .quartzose sandstone" that was deposited in a fluvial environment, much as the Westwater was. Kirk and Condon (1995) at 111; attached as Exhibit O to Dr. Staub's January testimony. A companion affidavit by the Morrison Formation expert, Dr. Spencer Lucas, also discusses these features of the Recapture. See, Lucas Affidavit, ¶¶5-6. Additionally, the Recapture may not even exist under most, if not all, of the mine zone in Section 8. See, Wallace January Testimony at 14-17 and 62-65, and Exhibit N, which shows Hilpert's 1969 cross-section in which the Recapture is thin to nonexistent under Sections 17 and 8.[12] Without an adequate confining layer below the Westwater under Section 8, flow of contaminants into the underlying Cow Springs aquifer, or into a water-bearing layer of the Recapture, from the mining zones would be not only likely, but inevitable.

32. Mr. Bartels states in his May 6 affidavit (at 5-6) that most vertical excursions occur due to artificial pathways, such as boreholes and well casings. Assuming this is true, the Staff has not assessed the risk that old boreholes on Section 8, which number at least 174, may serve as conduits for migration of contaminants into overlying or underlying aquifers. See, Ford Affidavit of February 20, 1998, at 9.

33. The subject of artificial penetrations and their effects brings up another

---

[12] In his February 19 affidavit, Mr. Lichnovsky uses the "principal of continuity" to support his position that the Recapture underlies the entire site, even though the single borehole that he cited is located at least 900 feet west of the Section 8 mining area. The principal of continuity is simply a rule of thumb that geologists use to interpret stratigraphy that they observe in the field. It cannot and should not be used to interpret geology at another location, more than 900 feet away, when additional and substantial site-specific geologic information exists. In this case, as I have stated on several occasions, HRI has data on hundreds of boreholes in Section 8, and used some of those records to construct five different stratigraphic cross sections in the southeast quarter of Section 8. However, these records, coupled with Hilpert's cross-section through sections 17 and 8, do not show convincingly that the "Recapture" is 180 feet thick and continuous throughout the area.

discrepancy in the logic of HRI's arguments. HRI has argued that all of its boreholes and wells are properly sealed, with state of the art techniques. At the same time, HRI has, on several occasions, expressed concern about its ability to adequately seal deeper boreholes, and also expressed concern that deep boreholes that penetrate the Recapture and Cow Springs Sandstone could provide conduits for fluid migration between the mine zones and the underlying aquifers. HRI has consistently relied on this argument to justify its decision not to install monitor wells into or through the Recapture unit at Section 8. However, in my experience, drilling boreholes and studying the resulting core samples may be the only tools available or affordable to clarify the small-scale geology underlying the Westwater. Furthermore, because of greater rock stresses with depth, deeper boreholes are generally easier to seal than shallow ones. Thus, HRI has it backwards. It would have us believe that hundreds of relatively shallow boreholes and injection and production wells used in the ISL process will be perfectly sealed. Yet HRI dared not drill a single, deep borehole to evaluate the characteristics and integrity of the rocks that underlie the Westwater, supposedly out of its concern for potential fluid migration.

34. The seismic profile referenced by Mr. Lichnovsky in his February affidavit, and cited by Mr. Bartels in this May affidavit (at 8), was used by HRI to support its argument that faulting does not exist at Section 8. As I discussed in footnote 11 above, the cited profile was regional in nature, and as such does not contain sufficient resolution to make any site-specific determinations. In this sense, it is similar to using a regional structure contour map to show no faulting at a much smaller local level on the

scale of the Section 8 property.

35. In summary, I believe that HRI and the NRC Staff have provided very little assurance that fluid movement will not occur below the Westwater aquifer. This lack of assurance is particularly worrisome for protection of the underlying layers because of the presence of a potential underground source of drinking water in the Cow Springs Sandstone. As I discussed in my January testimony (at 62-63), one borehole, offset from the mining zone by at least 900 feet, does not by itself prove that the Recapture is present below the Westwater, or, even if it is present, is a suitable confining layer. Given that the Recapture intertongues with the Westwater and was eroded by scouring at that contact (Kirk and Condon [1995] at 111; attached as Exhibit O to Dr. Staub's January testimony), conduits for fluid migration may exist, but are too small and localized to have been detected by earlier pump tests or by examination of borehole logs.

36. Part B of Question 2 states:

How much greater assurance may reasonably be anticipated prior to commencing ISL operations at Church Rock Section 8?

37. HRI claims that the pump tests required by its license will provide the greatest assurance that vertical excursions can be limited because the tests themselves will determine whether vertical connection exists between aquifers or whether the aquifers are confined. As I have previously explained, pump tests are the best tools to locate breaches of confining units. Wallace January Testimony at 19. Yet, I continue to have serious concerns about HRI's ability to properly perform and analyze pump tests, given the many mistakes that I have identified in HRI's aquifer characterization program

to date. Id. at 43-55. Statements made by Mr. Bartels in his May 6 affidavit now give me even more discomfort about HRI's willingness to take aquifer testing seriously, or to report the results thereof accurately, at the Church Rock site.

38. In his May 6 affidavit (at 13), Mr. Bartels states that well field 2 at URI's Longoria project had no vertical or horizontal excursions, "[y]et, the pump test prior to production of that well field showed significant vertical hydraulic communication and potential for vertical excursions." That Longoria Well field 2 had no excursions, as Mr. Bartels asserts, is irrelevant (whether true or not) to the question of whether proceeding with well-field development in the face of adverse aquifer confinement findings is prudent practice. I don't understand how the state agency in that case would allow such an operation to proceed, but it is certainly something that I trust the NRC Staff would not endorse. In any event, I fear that any assurance that additional pump testing may provide will be undermined by HRI's demonstrated inclination to proceed with ISL mining even when aquifer testing shows hydraulic communication between the mining zone and overlying or underlying aquifers. And unlike URI's experience at Longoria in Texas, a mistake by HRI at its New Mexico sites could have damaging consequences for the purity of the groundwater in Church Rock and Crownpoint.[13]

39. As I have testified previously in this proceeding, structural cross-sections, fence diagrams and structure contour maps are reliable tools to identify faults. HRI has

---

[13] Baseline water quality at Longoria was poor compared to that at Church Rock. Average total dissolved solids concentrations ranged from 1,100 to 1,900 mg/l at Longoria, compared with an average concentration of about 370 mg/l at Church Rock. FEIS at 3-36. See, also, Texas Department of Health memorandum on restoration values for URI's Longoria and Benavides projects, attached to this affidavit as **Exhibit 2-K.**

stated that it does not have such documentation. See, letter from Mark Pelizza to Robert Carlson (October 16, 1998), attached to letter from John T. Hull to Johanna Matanich (November 13, 1998). HRI has provided only stratigraphic cross-sections. Stratigraphic cross-sections are constructed by artificially shifting geologic units to create a horizontal top, and so cannot provide information on displacements. I stated in my January testimony (n. 3 at 20) that HRI has represented that structural data were analyzed for faulting and no such faults were discovered, when in fact, only the stratigraphic cross-sections were consulted. Then again in HRI's Response to the April 21 Order, HRI refers to "geologic cross sections" that "show no significant geologic structure," citing the 1993 Church Rock Revised Environmental Report. HRI Response at 8. Despite HRI's adoption of the ambiguous label "geologic cross sections," the 1993 Church Rock Revised ER still contains only stratigraphic cross-sections, not structural cross-sections. For its part, the NRC Staff has contributed to the unwarranted acceptance of HRI's geological interpretative information by claiming in several parts of the FEIS that structural data were reviewed to verify the absence of faulting. See, e.g., FEIS at 3-15, 3-21, 4-42, and 4-55. Structural data could provide some of the additional assurance on Section 8 faulting that the Presiding Officer is looking for. And HRI could prepare structural contour maps and structural cross sections fairly easily, based on the hundreds of driller's logs in its possession. Unfortunately, the NRC Staff has not required that such information be incorporated in the application, as recommended in its own Draft Standard Review Plan on uranium ISL mine applications, and HRI, on grounds of confidentiality, has refused to provide the driller's logs that could be used to generate the requisite

structural information.[14] HRI has not provided grounds to assert confidentiality for this information, and I can think of no valid reason for the need of confidentiality. HRI's very intransigence on this matter is to me a factor that influences the credibility of any assurances that they would now offer.

40. HRI and the Staff both claim that monitoring wells and regular surety updates will reduce the likelihood of contamination. HRI Response at 16; Bartels Affidavit at 15; Ford Affidavit at 17-20. It is important to point out that neither monitoring wells nor surety upgrades will reduce the likelihood of vertical excursions, although immediate detection of an excursion may mitigate the resulting environmental damage. As Dr. Abitz, Dr. Staub and I have testified repeatedly in this proceeding, the monitoring well plan for the Crownpoint Uranium Project, including for Section 8, does not assure prompt detection of horizontal or vertical excursions. The 400-foot spaced perimeter monitor well ring is not consistent with geometries of the subsurface sand channels. No monitoring of the Cow Springs aquifer is planned or required, unless HRI determines, on the basis of new pump tests, that vertical connections exist between the Westwater and the Cow Springs. See, SUA-1508, License Conditions 10.25 and 10.32. Given the confusion and continuing debate over just what does underlie the Westwater, this issue has a serious potential to be completely mishandled, with possible serious environmental detriment. As for the overlying units, monitor wells are spaced over either 4 or 8 acres. License condition 10.20; Ford Affidavit at 16. By the time

---

[14] See, Pelizza letter to Carlson (October 16, 1999), at 1-2.

excursions are detected and finally confirmed under this regime, large areas of overlying or underlying units could be impacted.

41. Part C of Question 2 asks:

What environmental costs may reasonably be expected to result from foreseeable difficulties at Church Rock Section 8?

42. HRI and the NRC Staff never reach this point of discussion in their responses, and it appears that the FEIS also fails to address the environmental costs that can be reasonably expected.

43. As I have explained above, vertical excursions may occur at Section 8. Because the monitoring requirements are loose, significant amounts of contaminants could travel into other units in an excursion. Dr. William Staub testified in January that correction of vertical excursions can be particularly problematic, and requires lengthy restoration efforts. Staub January Testimony at 16.

44. The FEIS does not identify the costs of vertical excursions. Certainly, given the difficulties, it is foreseeable that HRI would need to create a cone of depression to contain an excursion. Depending on the size of the excursion and the number of excursions that develop, HRI may be obliged to increase its consumptive use of water. The loss of this water is an environmental cost of the project operations, and of particular concern, given the limited groundwater resources of the San Juan Basin. And finally, there is the foreseeable risk that a vertical excursion may not be corrected, leaving measurable damage to the water quality of the surrounding units.

Question 1 of the April 21 Order

45. Question 1 of the April 21 Order asks:

> **Based on the experience of Uranium Resources, Inc. (URI) and of the in situ leach mining (ISL) industry generally, as well as the laboratory work reported in the Final Environmental Impact Statement, NUREG-1508, February 1997, Tables 4.8 and 4.9 at pp. 4-32, 33, what important difficulties (including unlikely but foreseeable difficulties) may reasonably be considered for the Crownpoint Uranium Project (CUP) concerning restoration of groundwater quality at Church Rock Section 8? What environmental costs may reasonably be expected to result from foreseeable difficulties?**

46. The NRC Staff responded that it believes baseline for Section 8 will be set at high levels of uranium and radium, thereby reducing "the difficulties in restoring the uranium and radium levels in the groundwater to baseline," and given the "chemical inability" of contaminants to move outside the well field, the license requirement of a restoration demonstration, and surety updates, environmental costs resulting from lixiviant excursions would be "very low." Ford Affidavit at 14-15.

47. HRI similarly asserts that "if HRI were to fail to restore the groundwater at Section 8 to or near baseline, the practical significance would be that previously unusable water would remain unusable." HRI Response at 2-3. HRI claims that the "a priori risk that groundwater restoration will not attain baseline values probably cannot be quantified" and the FEIS communicates confidence that HRI will achieve restoration. HRI Response at 4-5. HRI also asserts that even if restoration did not occur, there would be "no significant environmental costs." HRI Response at 6.

48. As Dr. Abitz states in his Response Affidavit, however, the water quality outside of the ore zones of the Westwater is generally pristine, and the water inside the

ore zones is generally very good, with the except of slightly elevated levels of uranium and radium-226. The overall superior quality of the native groundwater at the Church Rock site, coupled with the well-documented difficulties that the uranium ISL industry continues to have in restoring good quality water at commercial-scale mines in Wyoming, suggests to me that restoration at Church Rock Section 8 will be difficult. The difficulties inherent in remediating groundwater that has been willfully contaminated as a consequence of mining will be exacerbated if, as the NRC Staff suggests (Ford Affidavit at 13-15), HRI will depend largely on natural attenuation through chemical reduction to achieve baseline or drinking water standards that it could not achieve through active remedial methods.

49. In addition, Section 8 presents certain foreseeable complications for groundwater restoration. First, as I explained in my January Testimony, the mine workings at Section 17 promise to complicate any restoration at Section 8. I further explained that any restoration of Section 17 well fields will require the mine workings to be dewatered below the regional water table. Wallace January Testimony at 66-75. This approach would also lower the water table on Section 8, reintroducing oxygen into Section 8 ore zones, and mobilizing contamination, despite any previously successful restoration efforts.[15] Second, any vertical excursions for the project would impede successful restoration. I described how undetected leaky aquifers quickly created

---

[15] In his February 1999 affidavit, Mr. Ford postulates that since dewatering had occurred in Section 17 in the past, this may have already occurred. I concur, and consider this to be a potentially important issue. However, the next time dewatering occurs (if it occurs), sodium bicarbonate (the 'paint-stripping' component of the lixiviant) will also be present, as well as oxygen. This will exacerbate the problem much more than reintroduction of only oxygen.

excursion problems at other ISL mines. Id. at 50-51. And in my reply to HRI's and the Staff's responses to Question 2A above, I identified several factors that support the existence of aquifer interconnection at Church Rock, and concluded that there is little assurance that these factors can or will be mitigated to prevent contaminant migration.

50. The environmental costs of these foreseeable risks during restoration can be quantified with a minimal amount of effort, yet the FEIS was completely void of any quantitative estimate, or even qualitative description, of the cost of contaminated groundwater after restoration.

51. In a relatively short time, I developed a model to quantify the volume of groundwater that may reasonably be contaminated at the end of restoration. I employed a simple scenario, rather than introduce the foreseeable complications, such as a vertical excursion. Examination of the plumes in Plate 1 **(Exhibit 2-G)** shows at least some cases in which the plume is stretched along the entire 14,000-plus-foot length from the mining area to the water well. Dispersion has widened the plume considerably as well. However, some of this width is comprised of low-concentration solute. Giving the applicant the benefit of the doubt, I would estimate a problem zone of degraded groundwater with dimensions of 12,000 feet long by 700 feet wide by 200 feet thick. Assuming a porosity of 0.2, this is equivalent to 336 million cubic feet. That is equivalent to 7,713 acre-feet of water. Potable groundwater that is not in use as drinking water has a water rights value $3,000 to $4,000 per acre-foot. See ENDAUM's and SRIC's NEPA Presentation (February 19, 1999) at 37, n.11. At approximately $3,500 per acre-foot of treatment cost, this volume of ISL-contaminated groundwater represents

an estimated environmental cost of nearly $27 million. Hence, at current uranium market prices of $10 to $11 per pound and projected production levels of 800,000 to 1 million pounds per year, HRI would have to produce uranium from Section 8 for at least 2.5 years just to raise enough money in gross revenues to pay the cost of the groundwater cleanup.

Question 8 of April 21 Order

52. In Question 8 of his April 21 Order, the Presiding Officer ordered the Intervenors to provide a reference to a 1991 paper by A. Jun Cowan. Intervenors ENDAUM and SRIC located the paper and provided a full copy to the Presiding Officer, his special assistants and the Service List on May 18, 1999. HRI chose not to provide a copy of the Cowan paper. Since then, Dr. Lucas, who is recognized internationally as a preeminent expert in Jurassic paleontology and sedimentology, particularly in the San Juan Basin of northwestern New Mexico, has reviewed the Cowan paper and concluded that it fully supports the Intervenors' experts' conceptualization of the Westwater Canyon Member as a highly heterogeneous, fluvial environment of stacked, thin and narrow sand channels. Lucas Affidavit at ¶12.

53. Cowan's work may cause a reconsideration of important depositional history, but it does not change a thing hydrologically. Cowan's conduits, scallops, scour fills, and other small-scale geologic features observed within the regional "channel belt system" support heterogeneity more than ever. HRI's recent response, apparently willfully ignorant of differences between hydrologic and geologic nomenclature, takes

one line from the abstract of the Cowan paper completely out of context, and then distorts the implications of the paper for this proceeding.[16] HRI Response at 41-43. The Cowan paper, as a geologic report, concerns the definition of what constituted a "channel" during the time of deposition of the unit millions of years ago. My testimony and affidavits in this case concern what constitutes a channel in a hydrological sense. Hydrologically, a "channel" is a conduit for increased flow. Geologically, a "channel" is basically a linear depression in the land surface through which surface water collects and flows, such as a stream or river. Cowan describes how a previous author had characterized certain fluvial features within the Westwater Canyon Sandstone as ancient channels in the geologic sense. Cowan argues convincingly that these features are actually "conduits," not channels. These conduits are nothing more than one element of the hydrologic channel features that I refer to. Even Cowan refers to these conduits as "permeability-pathway compartments". Lucas Affidavit, ¶12. To a hydrologist, these are basically questions of geologic nomenclature, since whatever the features in question may be called, they are still fluvial heterogeneous channel-like structures that impact groundwater flow. There is simply no way any professional hydrogeologist could misinterpret Cowan's article (see, e.g., Cowan's Figure 18) to suggest homogeneity of the Westwater in any shape or form.

---

[16] I don't know which Cowan paper that HRI's attorneys reviewed, but the one at issue here does not conclude, as they so assert, "that no channel systems exist in the Westwater." In fact, Cowan describes, photographs and draws dozens of sand channels averaging 30 meters (or, about 100) in width within a regional "channel belt." Cowan (1991), at 80-81; Lucas Affidavit, ¶12.

LIST OF EXHIBITS

AFFIDAVIT OF MICHAEL G. WALLACE
MAY 21, 1999

EXHIBIT NO.	DESCRIPTION	NO. PAGES
2-A	Table 1. Values Used in Section 8 Model	1
2-B	Figure 1a. Grid and other model features	1
2-C	Figure 1b. Detail of grid	1
2-D	Figure 2. Observed vs. Residuals: Calibration Results for Channel Case (circles) and for Homogeneous Case (crosses)	1
2-E	Figure 3. Heterogeneity map for model	1
2-F	Figure 4. Initial contaminant source distribution (shaded)	1
2-G	Plate 1. Selected plume distributions from the Finite Difference model run (concentration shown by color bar legend)	1
2-H	Plate 2. Selected plume distributions from the MOC model run	1
2-I	Table 2. Time History of Concentration Impacts at Nearest Private Well	9
2-J	Letter from Edward H. Morales, UNC, to Ross Scarano, NRC (December 10, 1998), transmitting environmental monitoring data for 4th Quarter 1997 to 3rd Quarter 1998	3
2-K	Memorandum from Joseph F. Thiel, Texas Department of Health, to License File #8-2704 (May 4, 1987), concerning Recommended Radiological Restoration Values for Uranium Resources Inc.'s Benavides and Longoria Projects	1

AFFIRMATION

I declare on this 20th day of May, 1999, at Albuquerque, New Mexico, under penalty of perjury that the foregoing is true and correct to the best of my knowledge, and the opinions expressed herein are based on my best professional judgment.

Michael G. Wallace

Michael G. Wallace

Sworn and subscribed before me, the undersigned, a Notary Public in and for the State of New Mexico, on this 20 day of May, 1999, at ALBUQUERQUE New Mexico.

My Commission expires on 4-14-2002

OFFICIAL SEAL
Allison L. Clough
NOTARY PUBLIC
STATE OF NEW MEXICO
My Commission Expires: 4-14-2002

Notary Public

LIST OF EXHIBITS
AFFIDAVIT OF MICHAEL G. WALLACE
MAY 21, 1999

EXHIBIT NO.	DESCRIPTION	NO. PAGES
2-A	Table 1. Values Used in Section 8 Model	1
2-B	Figure 1a. Grid and other model features	1
2-C	Figure 1b. Detail of grid	1
2-D	Figure 2. Observed vs. Residuals: Calibration Results for Channel Case (circles) and for Homogeneous Case (crosses)	1
2-E	Figure 3. Heterogeneity map for model	1
2-F	Figure 4. Initial contaminant source distribution (shaded)	1
2-G	Plate 1. Selected plume distributions from the Finite Difference model run (concentration shown by color bar legend)	1
2-H	Plate 2. Selected plume distributions from the MOC model run	1
2-I	Table 2. Time History of Concentration Impacts at Nearest Private Well	9
2-J	Letter from Edward H. Morales, UNC, to Ross Scarano, NRC (December 10, 1998), transmitting environmental monitoring data for 4th Quarter 1997 to 3rd Quarter 1998	3
2-K	Memorandum from Joseph F. Thiel, Texas Department of Health, to License File #8-2704 (May 4, 1987), concerning Recommended Radiological Restoration Values for Uranium Resources Inc.'s Benavides and Longoria Projects	1

Table 1. Values Used in Section 8 Model

parameter/feature	value in model
'avg'. K (ft./day), rounded	.66 dominant K feature in model
variation in K (when applicable)	Channelized features. Total variation in K is 4 orders of magnitude.
orientation of channel zones	roughly consistent with paleo depositional patterns in that area, i.e. from SW to NE
restoration area size	N-S = approx. 2500 ft. E-W = approx. 700 ft.
aquifer thickness	200 ft.
flow characteristics	initial setup approximates steady state, followed by pump test period (~3days) followed by a return to steady state conditions
transport characteristics: finite difference model	long. dispersivity = 70 ft. transv. horiz. dispersivity = 7ft.
model domain size	N-S = 13,250 ft. E-W = 16,455 ft.
boundary conditions	constant head along SW boundary constant head along NE boundary
boundary effects	all boundaries at least one mile from zone of concern

EXHIBIT
2-A

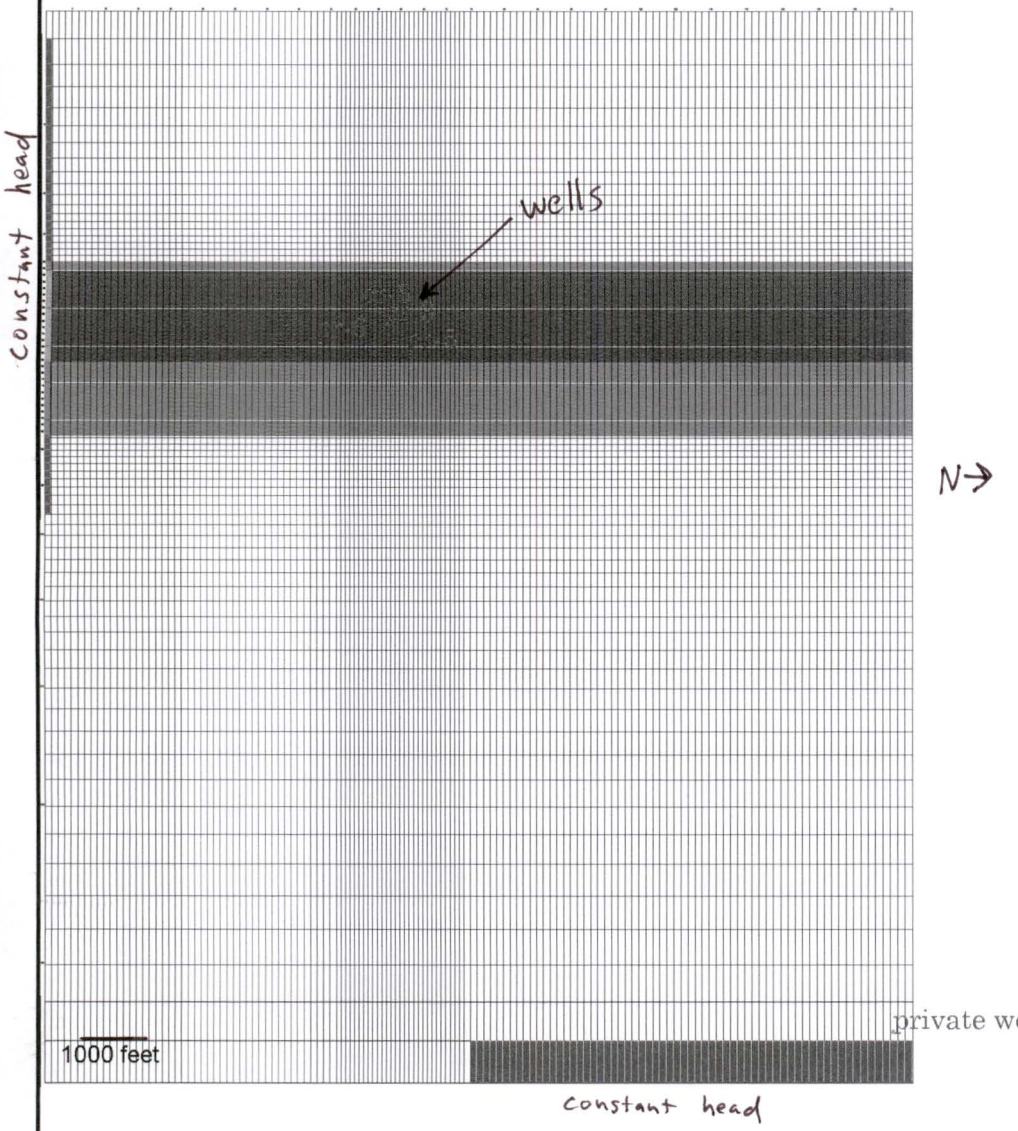


FIGURE 1a. Grid & other model features

EXHIBIT
2-B

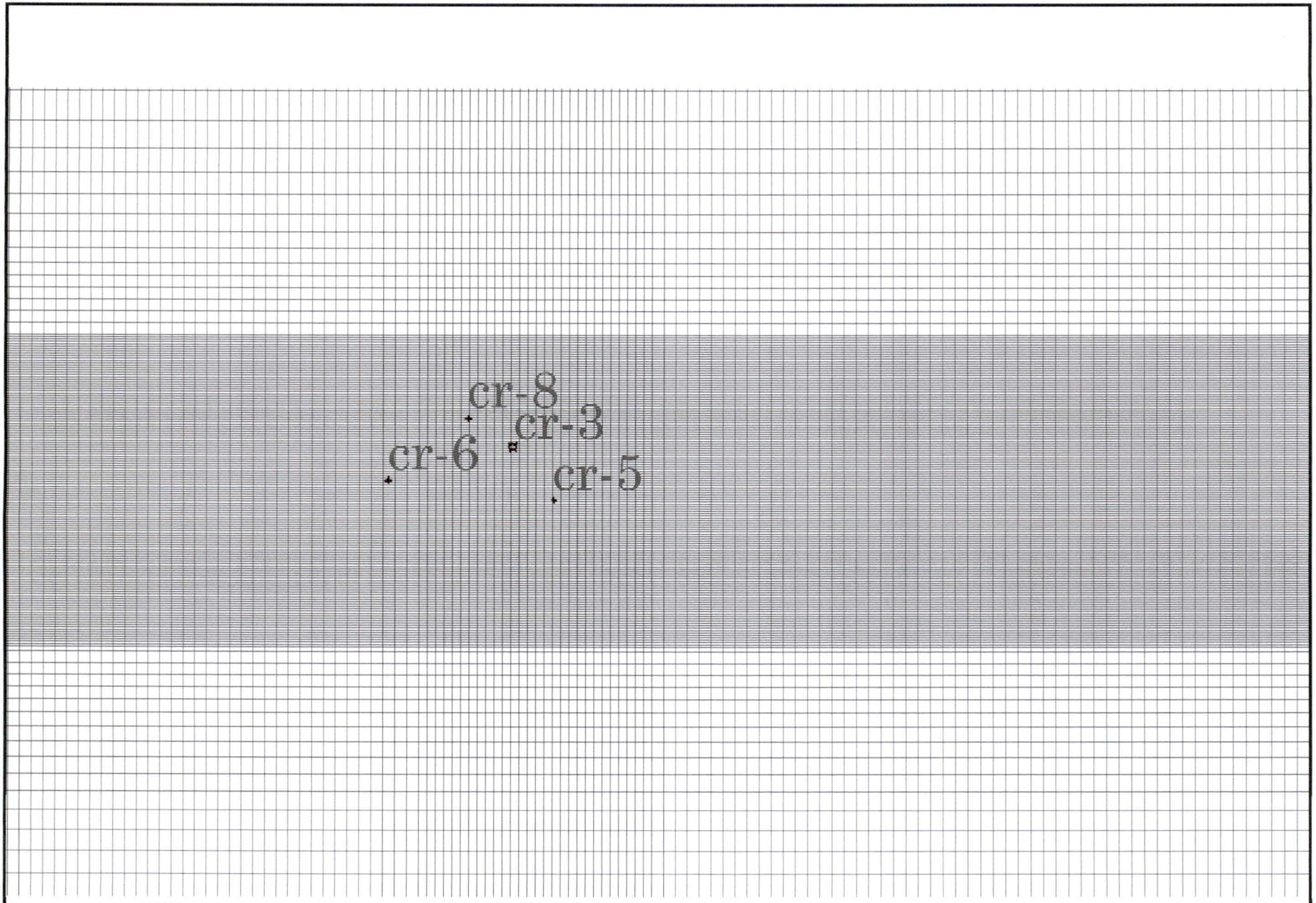


FIGURE 16. Detail of grid

EXHIBIT
2-C

FIG. 2

Observed vs. Residuals: Calibration Results for Channel Case (circles) and for Homogeneous Case (crosses)

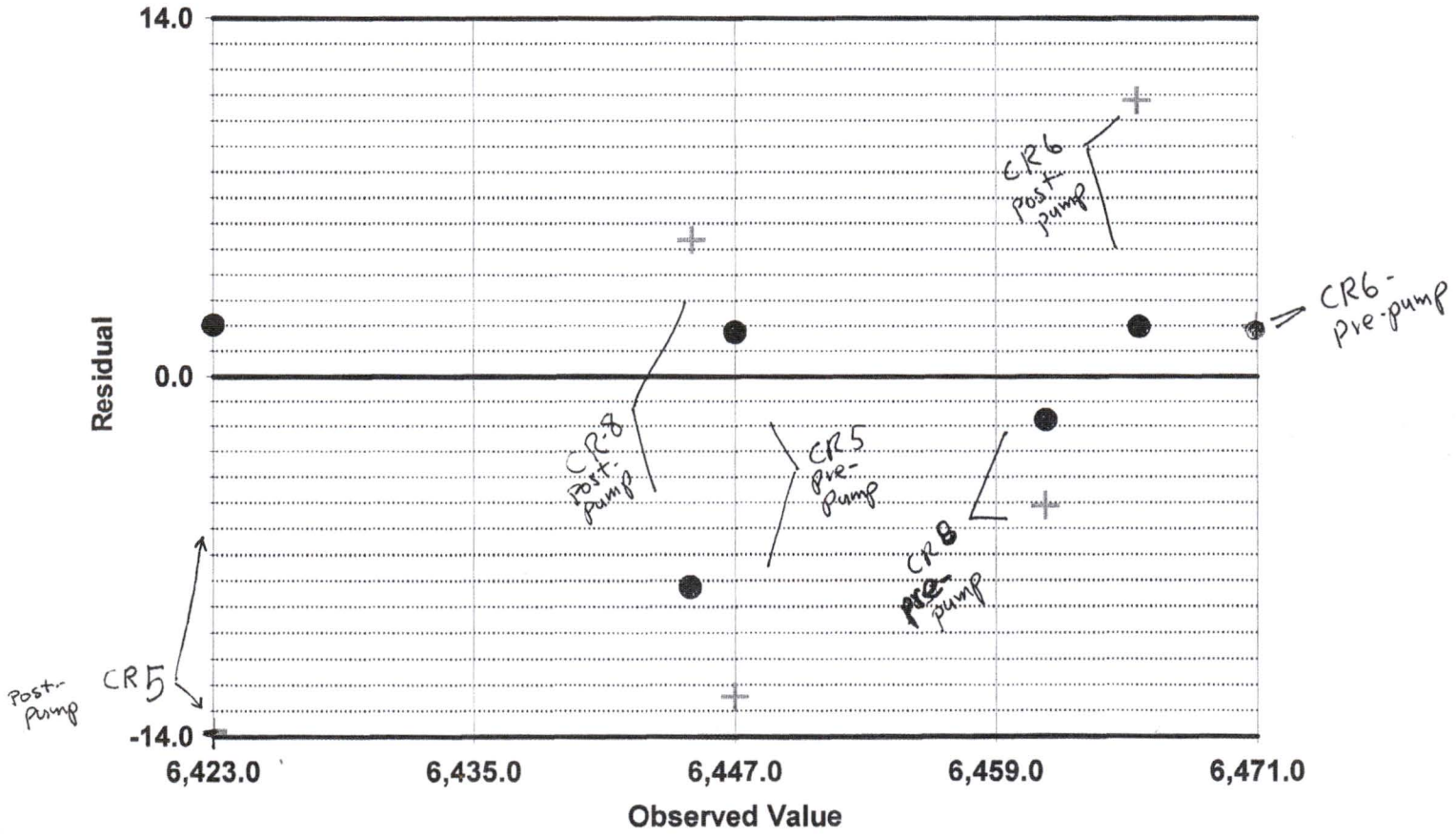
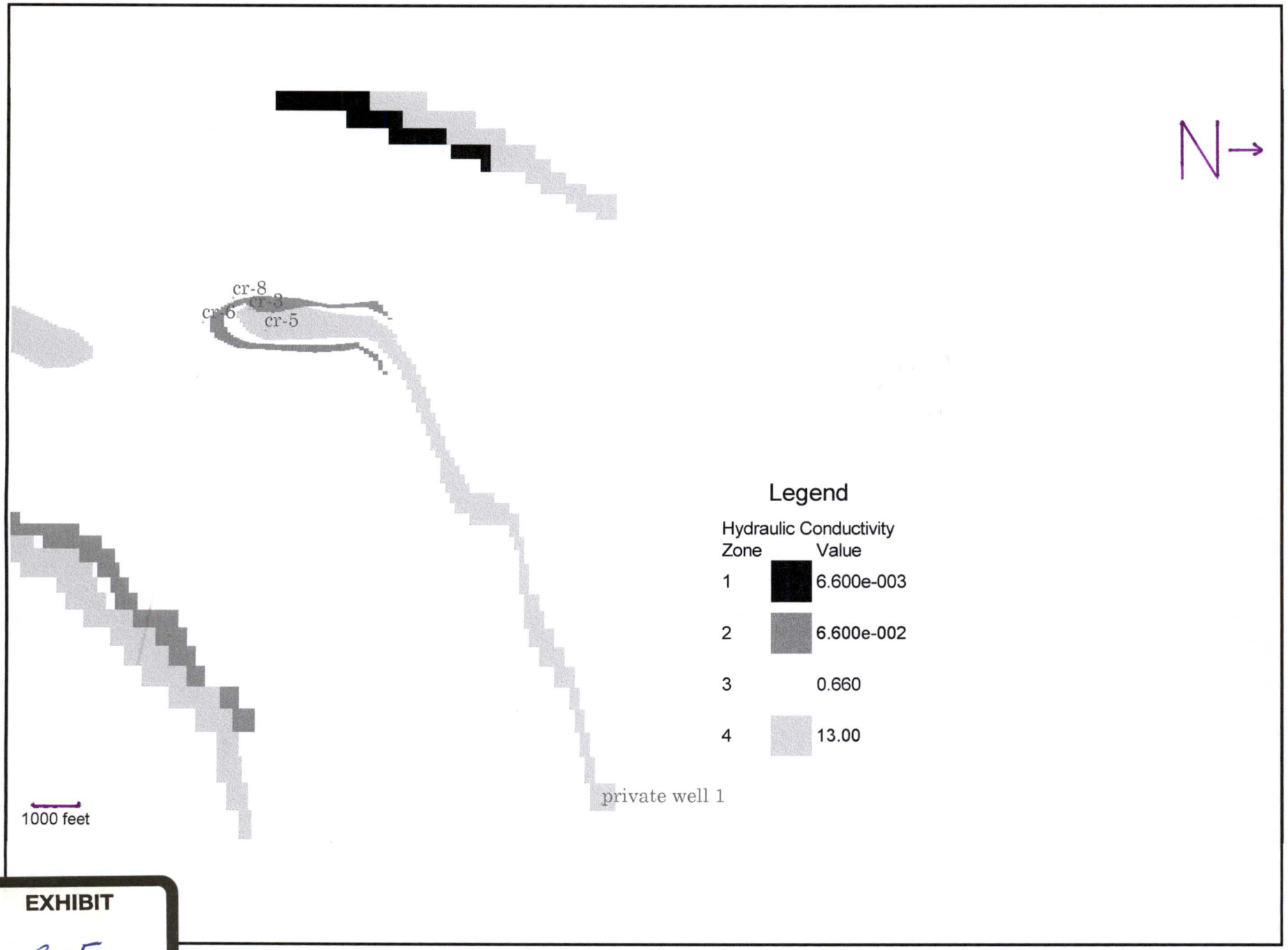


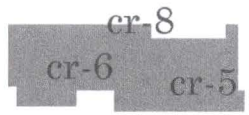
EXHIBIT
2-D



EXHIBIT

2-E

FIGURE 3. Heterogeniety map for model



S

N

FIGURE 4. Initial contaminant source distribution (shaded)

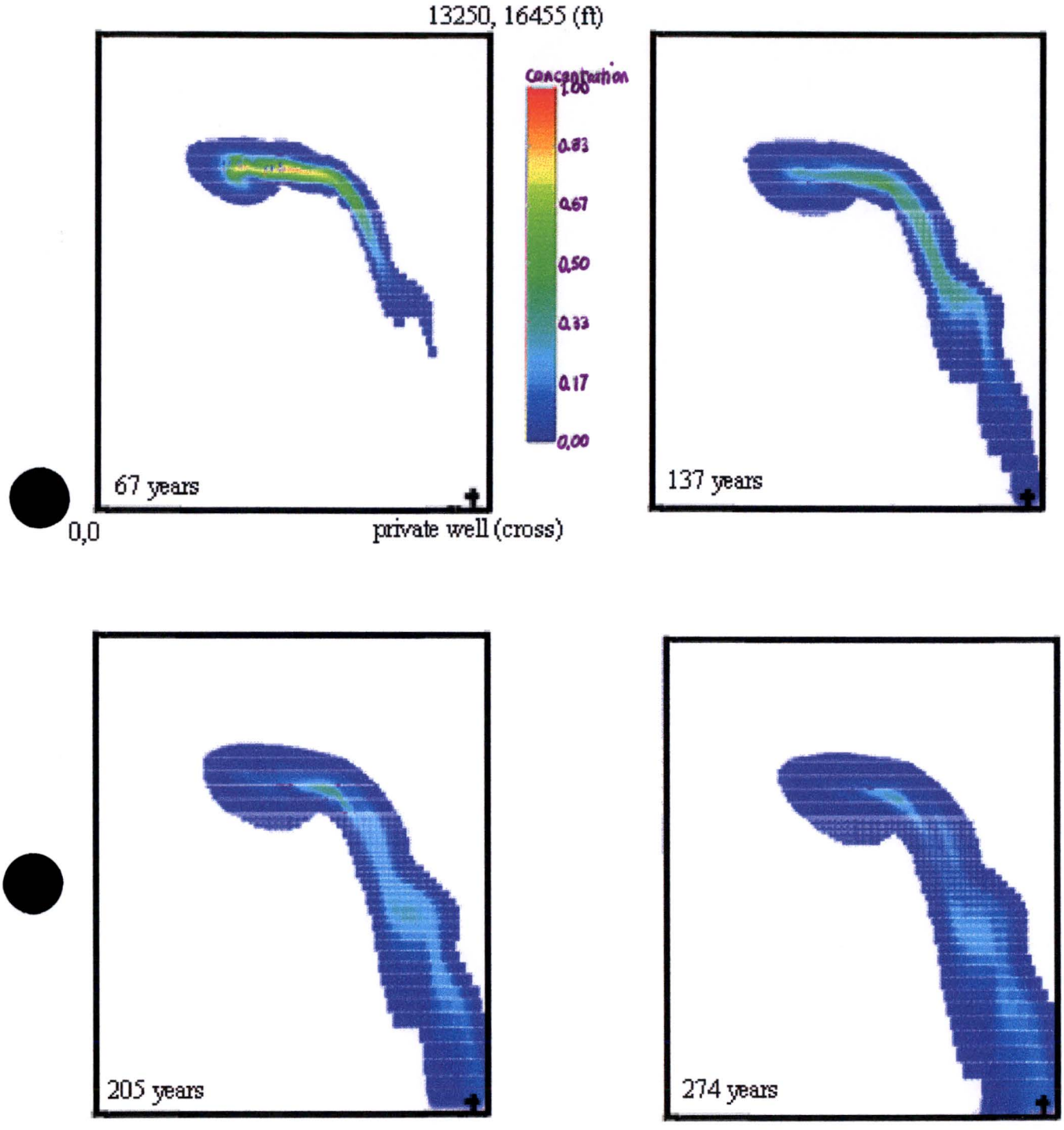


Plate 1. Selected plume distributions from the Finite Difference model run (concentration shown by color bar legend)

EXHIBIT
2-G

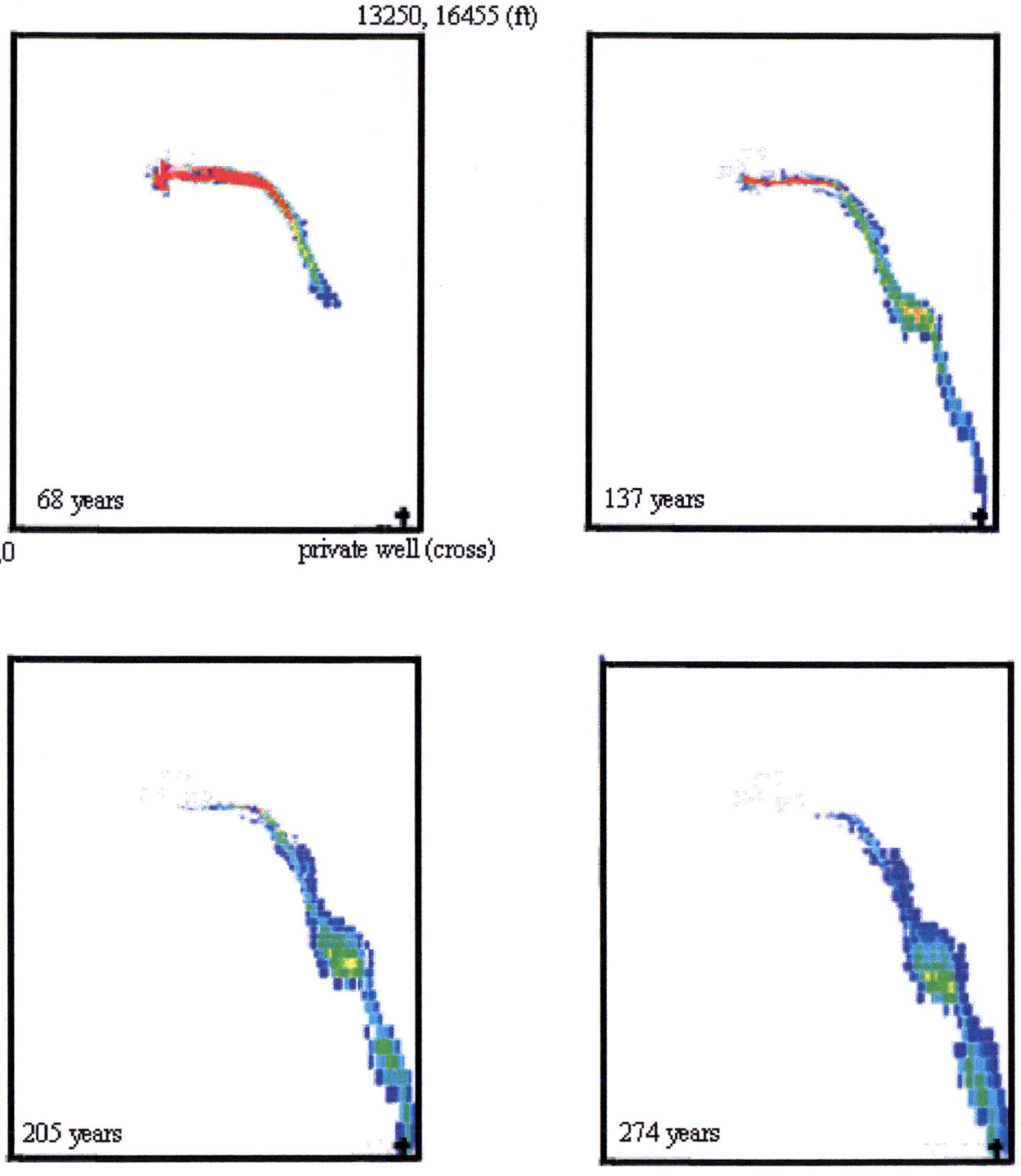


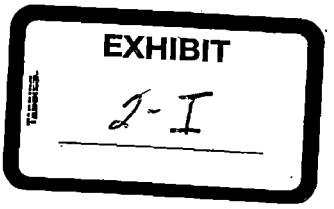
Plate 2. Selected plume distributions from the MOC model run (red = highest relative concentration, max = 1 dk blue = lowest shown relative concentration = 0.0001)

(see Plate 1 for concentration key)

EXHIBIT
2-H

Table 2. Time History of Concentration Impacts at Nearest Private Well
LOCATION OF OBSERVATION POINTS (K,I,J)= 1 187 135

STEP	TOTAL TIME (days)	concentration (mg/l)
1	50.000	.00000
2	100.00	.00000
3	150.00	.00000
4	200.00	.00000
5	250.00	.00000
6	300.00	.00000
7	350.00	.00000
.		
.		
.		
.		
1022	51100.	.00000
1023	51150.	.00000
1024	51200.	.00000
1025	51250.	1.50310E-06
1026	51300.	1.50310E-06
1027	51350.	1.50310E-06
1028	51400.	1.50310E-06
1029	51450.	1.50310E-06
1030	51500.	1.50310E-06
1031	51550.	3.00996E-06
1032	51600.	3.00996E-06
1033	51650.	3.00996E-06
1034	51700.	3.00996E-06
1035	51750.	2.51702E-06
1036	51800.	2.51702E-06
1037	51850.	2.51702E-06
1038	51900.	2.51702E-06
1039	51950.	2.51702E-06
1040	52000.	2.51702E-06
1041	52050.	2.51702E-06
1042	52100.	2.51702E-06
1043	52150.	2.51702E-06
1044	52200.	2.51702E-06
1045	52250.	2.51702E-06
1046	52300.	2.51702E-06
1047	52350.	2.51702E-06
1048	52400.	2.51702E-06
1049	52450.	2.51702E-06
1050	52500.	2.51702E-06
1051	52550.	2.51702E-06
1052	52600.	1.11744E-05
1053	52650.	1.11744E-05
1054	52700.	1.11744E-05
1055	52750.	1.11744E-05
1056	52800.	1.11744E-05
1057	52850.	1.11744E-05
1058	52900.	1.11744E-05
1059	52950.	1.11744E-05
1060	53000.	1.11744E-05
1061	53050.	1.11744E-05
1062	53100.	1.48383E-05
1063	53150.	1.48383E-05
1064	53200.	1.48383E-05
1065	53250.	1.48383E-05
1066	53300.	1.48383E-05



1067	53350.	1.48383E-05
1068	53400.	1.48383E-05
1069	53450.	1.48383E-05
1070	53500.	1.48383E-05
1071	53550.	1.48383E-05
1072	53600.	1.48383E-05
1073	53650.	1.48383E-05
1074	53700.	1.48383E-05
1075	53750.	1.48383E-05
1076	53800.	1.48383E-05
1077	53850.	1.48383E-05
1078	53900.	1.48383E-05
1079	53950.	1.48383E-05
1080	54000.	1.48383E-05
1081	54050.	1.48383E-05
1082	54100.	1.48383E-05
1083	54150.	1.48383E-05
1084	54200.	1.48383E-05
1085	54250.	1.48383E-05
1086	54300.	1.48383E-05
1087	54350.	1.48383E-05
1088	54400.	1.48383E-05
1089	54450.	1.48383E-05
1090	54500.	1.48383E-05
1091	54550.	1.48383E-05
1092	54600.	1.48383E-05
1093	54650.	1.48383E-05
1094	54700.	7.21722E-03
1095	54750.	7.21722E-03
1096	54800.	7.21722E-03
1097	54850.	7.21722E-03
1098	54900.	7.21722E-03
1099	54950.	7.21722E-03
1100	55000.	7.21722E-03
1101	55050.	7.21722E-03
1102	55100.	7.21722E-03
1103	55150.	7.21722E-03
1104	55200.	7.21722E-03
1105	55250.	9.53355E-03
1106	55300.	9.53355E-03
1107	55350.	9.53355E-03
1108	55400.	9.53355E-03
1109	55450.	9.53355E-03
1110	55500.	9.53355E-03
1111	55550.	1.44303E-02
1112	55600.	1.44303E-02
1113	55650.	1.44303E-02
1114	55700.	1.44303E-02
1115	55750.	1.44303E-02
1116	55800.	2.79805E-02
1117	55850.	2.79805E-02
1118	55900.	2.79805E-02
1119	55950.	2.79805E-02
1120	56000.	2.79805E-02
1121	56050.	2.79805E-02
1122	56100.	2.79805E-02
1123	56150.	2.79805E-02
1124	56200.	2.79805E-02
1125	56250.	2.79805E-02
1126	56300.	2.79805E-02
1127	56350.	2.79805E-02
1128	56400.	2.79805E-02
1129	56450.	2.79805E-02
1130	56500.	2.79805E-02
1131	56550.	2.79805E-02
1132	56600.	2.79805E-02
1133	56650.	2.79805E-02
1134	56700.	2.79805E-02
1135	56750.	2.79805E-02
1136	56800.	2.79805E-02
1137	56850.	2.79805E-02
1138	56900.	2.21742E-02
1139	56950.	2.21742E-02
1140	57000.	2.21742E-02
1141	57050.	1.77508E-02
1142	57100.	1.92083E-02
1143	57150.	1.92083E-02
1144	57200.	1.92083E-02
1145	57250.	1.92083E-02
1146	57300.	1.92083E-02
1147	57350.	1.92083E-02
1148	57400.	1.92083E-02
1149	57450.	1.92083E-02
1150	57500.	1.92083E-02
1151	57550.	1.92083E-02
1152	57600.	1.92083E-02
1153	57650.	1.92083E-02
1154	57700.	1.92083E-02
1155	57750.	1.92083E-02
1156	57800.	1.92083E-02
1157	57850.	1.92083E-02
1158	57900.	1.92083E-02
1159	57950.	1.92083E-02
1160	58000.	1.92083E-02
1161	58050.	1.92083E-02
1162	58100.	1.92083E-02
1163	58150.	1.92083E-02
1164	58200.	2.34879E-02
1165	58250.	2.34879E-02
1166	58300.	2.34879E-02
1167	58350.	2.34879E-02
1168	58400.	2.34879E-02
1169	58450.	2.34879E-02
1170	58500.	2.28593E-02
1171	58550.	2.28593E-02
1172	58600.	2.28593E-02
1173	58650.	2.28593E-02
1174	58700.	2.17498E-02
1175	58750.	2.17498E-02
1176	58800.	2.17498E-02
1177	58850.	1.50076E-02
1178	58900.	1.50076E-02
1179	58950.	1.50076E-02
1180	59000.	1.50076E-02
1181	59050.	1.50076E-02
1182	59100.	1.50076E-02
1183	59150.	1.50076E-02
1184	59200.	1.50076E-02
1185	59250.	1.50076E-02
1186	59300.	1.50076E-02

1187	59350.	1.50076E-02
1188	59400.	1.50076E-02
1189	59450.	1.50076E-02
1190	59500.	1.50076E-02
1191	59550.	1.02542E-02
1192	59600.	1.02542E-02
1193	59650.	1.43977E-02
1194	59700.	1.43977E-02
1195	59750.	1.43977E-02
1196	59800.	1.43977E-02
1197	59850.	1.43977E-02
1198	59900.	1.43977E-02
1199	59950.	.00000
1200	60000.	.00000
1201	60050.	.00000
1202	60100.	.00000
1203	60150.	.00000
1204	60200.	2.42766E-02
1205	60250.	2.42766E-02
1206	60300.	2.42766E-02
1207	60350.	2.42766E-02
1208	60400.	2.42766E-02
1209	60450.	2.42766E-02
1210	60500.	2.42766E-02
1211	60550.	2.42766E-02
1212	60600.	2.42766E-02
1213	60650.	1.19681E-02
1214	60700.	1.19681E-02
1215	60750.	1.19681E-02
1216	60800.	4.14363E-02
1217	60850.	4.14363E-02
1218	60900.	4.14363E-02
1219	60950.	4.14363E-02
1220	61000.	4.14363E-02
1221	61050.	5.19702E-02
1222	61100.	5.19702E-02
1223	61150.	5.19702E-02
1224	61200.	4.19338E-02
1225	61250.	4.19338E-02
1226	61300.	4.19338E-02
1227	61350.	4.19338E-02
1228	61400.	4.19338E-02
1229	61450.	4.19338E-02
1230	61500.	4.19338E-02
1231	61550.	4.19338E-02
1232	61600.	4.19338E-02
1233	61650.	4.19338E-02
1234	61700.	4.19338E-02
1235	61750.	4.19338E-02
1236	61800.	4.19338E-02
1237	61850.	4.19338E-02
1238	61900.	4.19338E-02
1239	61950.	4.19338E-02
1240	62000.	4.16014E-02
1241	62050.	4.16014E-02
1242	62100.	4.16014E-02
1243	62150.	4.16014E-02
1244	62200.	4.16014E-02
1245	62250.	4.13697E-02
1246	62300.	4.13697E-02
1247	62350.	3.61953E-02
1248	62400.	3.61953E-02
1249	62450.	3.61953E-02
1250	62500.	3.61953E-02
1251	62550.	3.61953E-02
1252	62600.	3.61953E-02
1253	62650.	3.61953E-02
1254	62700.	3.61953E-02
1255	62750.	3.61953E-02
1256	62800.	3.61953E-02
1257	62850.	3.61953E-02
1258	62900.	3.61953E-02
1259	62950.	3.61953E-02
1260	63000.	3.61953E-02
1261	63050.	3.61953E-02
1262	63100.	3.61953E-02
1263	63150.	3.61953E-02
1264	63200.	3.61953E-02
1265	63250.	3.61953E-02
1266	63300.	3.61953E-02
1267	63350.	3.61953E-02
1268	63400.	3.61953E-02
1269	63450.	3.61953E-02
1270	63500.	3.61953E-02
1271	63550.	3.61953E-02
1272	63600.	3.56027E-02
1273	63650.	3.56027E-02
1274	63700.	3.56027E-02
1275	63750.	3.56027E-02
1276	63800.	3.56027E-02
1277	63850.	3.56027E-02
1278	63900.	3.56027E-02
1279	63950.	3.61953E-02
1280	64000.	3.61953E-02
1281	64050.	3.61953E-02
1282	64100.	3.61953E-02
1283	64150.	3.61953E-02
1284	64200.	3.61953E-02
1285	64250.	3.43418E-02
1286	64300.	3.43418E-02
1287	64350.	3.43418E-02
1288	64400.	3.43418E-02
1289	64450.	3.43418E-02
1290	64500.	3.43418E-02
1291	64550.	3.43418E-02
1292	64600.	3.43418E-02
1293	64650.	4.79011E-02
1294	64700.	2.09171E-02
1295	64750.	2.09171E-02
1296	64800.	2.09171E-02
1297	64850.	2.09171E-02
1298	64900.	2.09171E-02
1299	64950.	2.09171E-02
1300	65000.	1.67913E-02
1301	65050.	1.40249E-02
1302	65100.	1.40249E-02
1303	65150.	1.40249E-02
1304	65200.	1.66059E-02
1305	65250.	1.66059E-02
1306	65300.	1.66059E-02

1307	65350.	1.66059E-02
1308	65400.	1.66059E-02
1309	65450.	1.66059E-02
1310	65500.	1.66059E-02
1311	65550.	1.04729E-02
1312	65600.	1.04729E-02
1313	65650.	1.04729E-02
1314	65700.	1.04729E-02
1315	65750.	1.04729E-02
1316	65800.	1.04729E-02
1317	65850.	1.04729E-02
1318	65900.	1.04729E-02
1319	65950.	1.04729E-02
1320	66000.	.00000
1321	66050.	.00000
1322	66100.	.00000
1323	66150.	.00000
1324	66200.	.00000
1325	66250.	.00000
1326	66300.	.00000
1327	66350.	.00000
1328	66400.	.00000
1329	66450.	.00000
1330	66500.	.00000
1331	66550.	.00000
1332	66600.	.00000
1333	66650.	.00000
1334	66700.	.00000
1335	66750.	.00000
1336	66800.	.00000
1337	66850.	.00000
1338	66900.	.00000
1339	66950.	.00000
1340	67000.	.00000
1341	67050.	.00000
1342	67100.	.00000
1343	67150.	.00000
1344	67200.	.00000
1345	67250.	.00000
1346	67300.	.00000
1347	67350.	.00000
1348	67400.	.00000
1349	67450.	.00000
1350	67500.	.00000
1351	67550.	.00000
1352	67600.	.00000
1353	67650.	.00000
1354	67700.	.00000
1355	67750.	.00000
1356	67800.	.00000
1357	67850.	.00000
1358	67900.	.00000
1359	67950.	.00000
1360	68000.	.00000
1361	68050.	.00000
1362	68100.	.00000
1363	68150.	.00000
1364	68200.	.00000
1365	68250.	.00000
1366	68300.	.00000
1367	68350.	.00000
1368	68400.	.00000
1369	68450.	.00000
1370	68500.	.00000
1371	68550.	.00000
1372	68600.	.00000
1373	68650.	.00000
1374	68700.	.00000
1375	68750.	.00000
1376	68800.	.00000
1377	68850.	.00000
1378	68900.	.00000
1379	68950.	.00000
1380	69000.	.00000
1381	69050.	.00000
1382	69100.	.00000
1383	69150.	.00000
1384	69200.	.00000
1385	69250.	.00000
1386	69300.	.00000
1387	69350.	5.24125E-03
1388	69400.	5.24125E-03
1389	69450.	5.24125E-03
1390	69500.	5.24125E-03
1391	69550.	5.24125E-03
1392	69600.	5.24125E-03
1393	69650.	5.24125E-03
1394	69700.	5.24125E-03
1395	69750.	5.24125E-03
1396	69800.	5.24125E-03
1397	69850.	5.24125E-03
1398	69900.	5.24125E-03
1399	69950.	5.24125E-03
1400	70000.	7.98212E-03
1401	70050.	7.98212E-03
1402	70100.	6.36343E-03
1403	70150.	6.36343E-03
1404	70200.	6.36343E-03
1405	70250.	6.36343E-03
1406	70300.	6.36343E-03
1407	70350.	6.36343E-03
1408	70400.	3.92881E-03
1409	70450.	3.92881E-03
1410	70500.	3.98861E-03
1411	70550.	3.98861E-03
1412	70600.	3.98861E-03
1413	70650.	3.98861E-03
1414	70700.	3.98861E-03
1415	70750.	3.98861E-03
1416	70800.	3.98861E-03
1417	70850.	6.44164E-03
1418	70900.	6.44164E-03
1419	70950.	6.44164E-03
1420	71000.	6.44164E-03
1421	71050.	9.78348E-03
1422	71100.	9.78348E-03
1423	71150.	9.78348E-03
1424	71200.	9.78348E-03
1425	71250.	9.78348E-03
1426	71300.	9.78348E-03

1427	71350.	9.78348E-03
1428	71400.	9.78348E-03
1429	71450.	9.78348E-03
1430	71500.	8.18492E-03
1431	71550.	8.18492E-03
1432	71600.	8.18492E-03
1433	71650.	8.18492E-03
1434	71700.	8.18492E-03
1435	71750.	6.51971E-03
1436	71800.	6.51971E-03
1437	71850.	6.51971E-03
1438	71900.	6.51971E-03
1439	71950.	6.51971E-03
1440	72000.	8.22957E-03
1441	72050.	8.22957E-03
1442	72100.	8.22957E-03
1443	72150.	8.22957E-03
1444	72200.	8.22957E-03
1445	72250.	8.22957E-03
1446	72300.	8.22957E-03
1447	72350.	8.22957E-03
1448	72400.	8.22957E-03
1449	72450.	8.22957E-03
1450	72500.	8.22957E-03
1451	72550.	8.22957E-03
1452	72600.	8.22957E-03
1453	72650.	8.22957E-03
1454	72700.	8.22957E-03
1455	72750.	8.22957E-03
1456	72800.	6.43944E-03
1457	72850.	6.43944E-03
1458	72900.	6.43944E-03
1459	72950.	6.43944E-03
1460	73000.	6.43944E-03
1461	73050.	6.43944E-03
1462	73100.	6.43944E-03
1463	73150.	6.43944E-03
1464	73200.	6.43944E-03
1465	73250.	3.98692E-03
1466	73300.	3.98692E-03
1467	73350.	3.98692E-03
1468	73400.	3.98692E-03
1469	73450.	3.98692E-03
1470	73500.	8.42549E-02
1471	73550.	8.42549E-02
1472	73600.	8.42549E-02
1473	73650.	8.42549E-02
1474	73700.	8.42549E-02
1475	73750.	8.42549E-02
1476	73800.	8.42549E-02
1477	73850.	8.42549E-02
1478	73900.	8.42549E-02
1479	73950.	8.42549E-02
1480	74000.	8.42549E-02
1481	74050.	8.42549E-02
1482	74100.	.10034
1483	74150.	.10034
1484	74200.	.00000
1485	74250.	.00000
1486	74300.	.00000
1487	74350.	.00000
1488	74400.	7.79794E-02
1489	74450.	7.79794E-02
1490	74500.	.10291
1491	74550.	.10291
1492	74600.	.10291
1493	74650.	.10291
1494	74700.	.10291
1495	74750.	.10291
1496	74800.	.10291
1497	74850.	.10291
1498	74900.	.10291
1499	74950.	.10291
1500	75000.	.10291
1501	75050.	.10291
1502	75100.	.10291
1503	75150.	.10291
1504	75200.	.10291
1505	75250.	.10291
1506	75300.	.10291
1507	75350.	.10291
1508	75400.	.10291
1509	75450.	.10291
1510	75500.	9.90925E-02
1511	75550.	9.90925E-02
1512	75600.	9.90925E-02
1513	75650.	9.90925E-02
1514	75700.	.17135
1515	75750.	.17135
1516	75800.	.17135
1517	75850.	.17135
1518	75900.	.17135
1519	75950.	.17135
1520	76000.	.17135
1521	76050.	.17135
1522	76100.	.17135
1523	76150.	.17135
1524	76200.	.14432
1525	76250.	.14432
1526	76300.	.14432
1527	76350.	.14432
1528	76400.	.14432
1529	76450.	.14432
1530	76500.	.14432
1531	76550.	.14432
1532	76600.	.14432
1533	76650.	.14432
1534	76700.	.14432
1535	76750.	.11892
1536	76800.	.14432
1537	76850.	.14432
1538	76900.	.14432
1539	76950.	.14432
1540	77000.	.14432
1541	77050.	.14432
1542	77100.	.14432
1543	77150.	.14432
1544	77200.	.14432
1545	77250.	.17087
1546	77300.	.17087

1547	77350.	.17087	1607	80350.	2.11510E-02
1548	77400.	.17087	1608	80400.	2.11510E-02
1549	77450.	.17087	1609	80450.	2.11510E-02
1550	77500.	.17087	1610	80500.	2.11510E-02
1551	77550.	.17087	1611	80550.	2.11510E-02
1552	77600.	.17087	1612	80600.	2.11510E-02
1553	77650.	.17087	1613	80650.	2.11510E-02
1554	77700.	.17087	1614	80700.	2.11510E-02
1555	77750.	.17087	1615	80750.	2.11510E-02
1556	77800.	.17087	1616	80800.	2.14639E-02
1557	77850.	.17087	1617	80850.	2.14639E-02
1558	77900.	.17087	1618	80900.	2.14639E-02
1559	77950.	.14375	1619	80950.	2.14639E-02
1560	78000.	.14375	1620	81000.	2.14639E-02
1561	78050.	.14375	1621	81050.	2.14639E-02
1562	78100.	.14375	1622	81100.	2.53643E-02
1563	78150.	.14375	1623	81150.	2.53643E-02
1564	78200.	.14375	1624	81200.	2.53643E-02
1565	78250.	.14375	1625	81250.	2.53643E-02
1566	78300.	.00000	1626	81300.	2.53643E-02
1567	78350.	.00000	1627	81350.	2.53643E-02
1568	78400.	.00000	1628	81400.	2.53643E-02
1569	78450.	.00000	1629	81450.	2.53643E-02
1570	78500.	.00000	1630	81500.	2.15113E-02
1571	78550.	.00000	1631	81550.	2.15113E-02
1572	78600.	.00000	1632	81600.	2.15113E-02
1573	78650.	.00000	1633	81650.	2.15113E-02
1574	78700.	.00000	1634	81700.	2.15113E-02
1575	78750.	.00000	1635	81750.	2.15113E-02
1576	78800.	.00000	1636	81800.	2.15113E-02
1577	78850.	.00000	1637	81850.	2.15113E-02
1578	78900.	.00000	1638	81900.	2.15113E-02
1579	78950.	.00000	1639	81950.	2.15113E-02
1580	79000.	.00000	1640	82000.	2.15113E-02
1581	79050.	.00000	1641	82050.	1.76208E-02
1582	79100.	.00000	1642	82100.	2.20923E-02
1583	79150.	.00000	1643	82150.	1.89564E-02
1584	79200.	.00000	1644	82200.	2.96052E-02
1585	79250.	.00000	1645	82250.	2.96052E-02
1586	79300.	.00000	1646	82300.	2.96052E-02
1587	79350.	.00000	1647	82350.	2.96052E-02
1588	79400.	.00000	1648	82400.	2.96052E-02
1589	79450.	.00000	1649	82450.	2.96052E-02
1590	79500.	.00000	1650	82500.	2.96052E-02
1591	79550.	.00000	1651	82550.	2.96052E-02
1592	79600.	.00000	1652	82600.	2.96052E-02
1593	79650.	.00000	1653	82650.	2.96052E-02
1594	79700.	.00000	1654	82700.	2.96052E-02
1595	79750.	.00000	1655	82750.	2.96052E-02
1596	79800.	.00000	1656	82800.	2.96052E-02
1597	79850.	.00000	1657	82850.	9.80151E-02
1598	79900.	.00000	1658	82900.	9.80151E-02
1599	79950.	.00000	1659	82950.	9.80151E-02
1600	80000.	.00000	1660	83000.	9.80151E-02
1601	80050.	.00000	1661	83050.	9.80151E-02
1602	80100.	.00000	1662	83100.	9.80151E-02
1603	80150.	.00000	1663	83150.	9.80151E-02
1604	80200.	.00000	1664	83200.	9.80151E-02
1605	80250.	2.11510E-02	1665	83250.	7.95720E-02
1606	80300.	2.11510E-02	1666	83300.	7.95720E-02

1667	83350.	7.95720E-02
1668	83400.	.10096
1669	83450.	.10096
1670	83500.	.10096
1671	83550.	.10096
1672	83600.	.10096
1673	83650.	.10096
1674	83700.	.10096
1675	83750.	.10096
1676	83800.	.10096
1677	83850.	.10096
1678	83900.	.10096
1679	83950.	.10096
1680	84000.	.10096
1681	84050.	.10096
1682	84100.	.10096
1683	84150.	3.08486E-02
1684	84200.	3.08486E-02
1685	84250.	.00000
1686	84300.	.00000
1687	84350.	.00000
1688	84400.	.00000
1689	84450.	.00000
1690	84500.	.10563
1691	84550.	.10563
1692	84600.	.10563
1693	84650.	.10563
1694	84700.	.10563
1695	84750.	.10563
1696	84800.	.10563
1697	84850.	.10563
1698	84900.	.10563
1699	84950.	.10563
1700	85000.	.10563
1701	85050.	.10563
1702	85100.	.10563
1703	85150.	.10563
1704	85200.	.10563
1705	85250.	.10563
1706	85300.	.10563
1707	85350.	.10563
1708	85400.	.10563
1709	85450.	.10563
1710	85500.	.10563
1711	85550.	.15536
1712	85600.	.15536
1713	85650.	.15536
1714	85700.	.15536
1715	85750.	.15536
1716	85800.	.15536
1717	85850.	.15536
1718	85900.	.11353
1719	85950.	.11353
1720	86000.	.11353
1721	86050.	.11353
1722	86100.	.15536
1723	86150.	.15536
1724	86200.	.10357
1725	86250.	.10357
1726	86300.	.10357
1727	86350.	.10357
1728	86400.	.10357
1729	86450.	.10357
1730	86500.	.10357
1731	86550.	.10357
1732	86600.	.10357
1733	86650.	.10357
1734	86700.	.10357
1735	86750.	.10357
1736	86800.	.10357
1737	86850.	.10357
1738	86900.	.10357
1739	86950.	.10357
1740	87000.	.10357
1741	87050.	.10357
1742	87100.	.10357
1743	87150.	.10357
1744	87200.	7.87914E-02
1745	87250.	.18201
1746	87300.	.18201
1747	87350.	.18201
1748	87400.	.18201
1749	87450.	.18201
1750	87500.	.18201
1751	87550.	.18201
1752	87600.	.18201
1753	87650.	.18201
1754	87700.	.18201
1755	87750.	.18201
1756	87800.	.14466
1757	87850.	.14466
1758	87900.	.14466
1759	87950.	.12003
1760	88000.	.12003
1761	88050.	.10592
1762	88100.	.10592
1763	88150.	.10592
1764	88200.	.10592
1765	88250.	.10592
1766	88300.	.10592
1767	88350.	.10592
1768	88400.	.10592
1769	88450.	.10592
1770	88500.	6.97721E-02
1771	88550.	6.97721E-02
1772	88600.	6.97721E-02
1773	88650.	6.97721E-02
1774	88700.	6.97721E-02
1775	88750.	6.08371E-02
1776	88800.	6.08371E-02
1777	88850.	6.08371E-02
1778	88900.	6.08371E-02
1779	88950.	6.08371E-02
1780	89000.	6.08371E-02
1781	89050.	6.08371E-02
1782	89100.	6.08371E-02
1783	89150.	5.22678E-02
1784	89200.	5.22678E-02
1785	89250.	4.76232E-02
1786	89300.	4.76232E-02

1787	89350.	4.76232E-02
1788	89400.	4.76232E-02
1789	89450.	4.76232E-02
1790	89500.	4.76232E-02
1791	89550.	4.76232E-02
1792	89600.	4.76232E-02
1793	89650.	4.76232E-02
1794	89700.	4.76232E-02
1795	89750.	4.76232E-02
1796	89800.	4.76232E-02
1797	89850.	4.76232E-02
1798	89900.	4.76232E-02
1799	89950.	4.76232E-02
1800	90000.	4.76232E-02
1801	90050.	4.76232E-02
1802	90100.	4.76232E-02
1803	90150.	4.76232E-02
1804	90200.	4.76232E-02
1805	90250.	4.10915E-02
1806	90300.	4.10915E-02
1807	90350.	4.10915E-02
1808	90400.	4.10915E-02
1809	90450.	4.10915E-02
1810	90500.	4.10915E-02
1811	90550.	4.10915E-02
1812	90600.	4.10915E-02
1813	90650.	4.10915E-02
1814	90700.	4.10915E-02
1815	90750.	4.10915E-02
1816	90800.	4.10915E-02
1817	90850.	4.10915E-02
1818	90900.	4.10915E-02
1819	90950.	4.10915E-02
1820	91000.	4.10915E-02
1821	91050.	4.10915E-02
1822	91100.	4.10915E-02
1823	91150.	4.10915E-02
1824	91200.	4.10915E-02
1825	91250.	4.10915E-02
1826	91300.	3.88696E-02
1827	91350.	3.88696E-02
1828	91400.	3.88696E-02
1829	91450.	3.88696E-02
1830	91500.	3.88696E-02
1831	91550.	3.88696E-02
1832	91600.	3.88696E-02
1833	91650.	3.43567E-02
1834	91700.	3.43567E-02
1835	91750.	3.43567E-02
1836	91800.	3.43567E-02
1837	91850.	3.43567E-02
1838	91900.	3.43567E-02
1839	91950.	3.43567E-02
1840	92000.	3.43567E-02
1841	92050.	2.97491E-02
1842	92100.	2.97491E-02
1843	92150.	2.97491E-02
1844	92200.	2.97491E-02
1845	92250.	2.97491E-02
1846	92300.	2.97491E-02
1847	92350.	2.97491E-02
1848	92400.	2.97491E-02
1849	92450.	2.97491E-02
1850	92500.	2.30635E-02
1851	92550.	1.90291E-02
1852	92600.	1.90291E-02
1853	92650.	1.90291E-02
1854	92700.	1.90291E-02
1855	92750.	1.90291E-02
1856	92800.	1.60425E-02
1857	92850.	8.76472E-03
1858	92900.	8.76472E-03
1859	92950.	8.76472E-03
1860	93000.	8.76472E-03
1861	93050.	8.76472E-03
1862	93100.	8.76472E-03
1863	93150.	8.76472E-03
1864	93200.	8.76472E-03
1865	93250.	8.76472E-03
1866	93300.	8.76472E-03
1867	93350.	8.76472E-03
1868	93400.	1.84433E-02
1869	93450.	1.84433E-02
1870	93500.	1.84433E-02
1871	93550.	2.54369E-02
1872	93600.	2.54369E-02
1873	93650.	2.54369E-02
1874	93700.	2.54369E-02
1875	93750.	2.54369E-02
1876	93800.	2.54369E-02
1877	93850.	2.54369E-02
1878	93900.	2.54369E-02
1879	93950.	2.54369E-02
1880	94000.	2.54369E-02
1881	94050.	2.54369E-02
1882	94100.	2.54369E-02
1883	94150.	2.54369E-02
1884	94200.	2.54369E-02
1885	94250.	2.54369E-02
1886	94300.	2.64013E-02
1887	94350.	2.64013E-02
1888	94400.	2.64013E-02
1889	94450.	2.64013E-02
1890	94500.	2.64013E-02
1891	94550.	2.64013E-02
1892	94600.	2.64013E-02
1893	94650.	2.64013E-02
1894	94700.	2.64013E-02
1895	94750.	2.64013E-02
1896	94800.	2.64013E-02
1897	94850.	2.64013E-02
1898	94900.	2.64013E-02
1899	94950.	2.64013E-02
1900	95000.	2.64013E-02
1901	95050.	1.80448E-02
1902	95100.	5.59361E-03
1903	95150.	5.59361E-03
1904	95200.	5.59361E-03
1905	95250.	.00000
1906	95300.	.00000

1907	95350.	.00000
1908	95400.	.00000
1909	95450.	.00000
1910	95500.	.00000
1911	95550.	.00000
1912	95600.	.00000
1913	95650.	.00000
1914	95700.	.00000
1915	95750.	.00000
1916	95800.	.00000
1917	95850.	.00000
1918	95900.	.00000
1919	95950.	.00000
1920	96000.	.00000
1921	96050.	.00000
1922	96100.	.00000
1923	96150.	.00000
1924	96200.	.00000
1925	96250.	.00000
1926	96300.	.00000
1927	96350.	.00000
1928	96400.	.00000
1929	96450.	.00000
1930	96500.	.00000
1931	96550.	9.47956E-03
1932	96600.	2.02379E-02
1933	96650.	2.02379E-02
1934	96700.	2.02379E-02
1935	96750.	2.02379E-02
1936	96800.	2.02379E-02
1937	96850.	2.02379E-02
1938	96900.	2.02379E-02
1939	96950.	2.02379E-02
1940	97000.	2.02379E-02
1941	97050.	2.02379E-02
1942	97100.	2.02379E-02
1943	97150.	2.02379E-02
1944	97200.	2.02379E-02
1945	97250.	2.02379E-02
1946	97300.	2.02379E-02
1947	97350.	2.02379E-02
1948	97400.	2.02379E-02
1949	97450.	2.02379E-02
1950	97500.	2.02379E-02
1951	97550.	2.02379E-02
1952	97600.	2.02379E-02
1953	97650.	1.10114E-02
1954	97700.	1.10114E-02
1955	97750.	1.10114E-02
1956	97800.	1.10114E-02
1957	97850.	1.10114E-02
1958	97900.	1.10114E-02
1959	97950.	1.10114E-02
1960	98000.	1.10114E-02
1961	98050.	1.10114E-02
1962	98100.	1.10114E-02
1963	98150.	1.10114E-02
1964	98200.	1.10114E-02
1965	98250.	1.10114E-02
1966	98300.	1.10114E-02
1967	98350.	1.10114E-02
1968	98400.	1.10114E-02
1969	98450.	1.10114E-02
1970	98500.	1.10114E-02
1971	98550.	1.42626E-02
1972	98600.	1.42626E-02
1973	98650.	1.42626E-02
1974	98700.	1.42626E-02
1975	98750.	1.42626E-02
1976	98800.	1.42626E-02
1977	98850.	1.10114E-02
1978	98900.	1.10114E-02
1979	98950.	1.10114E-02
1980	99000.	7.70431E-03
1981	99050.	7.70431E-03
1982	99100.	7.70431E-03
1983	99150.	7.70431E-03
1984	99200.	7.70431E-03
1985	99250.	7.70431E-03
1986	99300.	7.70431E-03
1987	99350.	7.70431E-03
1988	99400.	7.70431E-03
1989	99450.	7.70431E-03
1990	99500.	7.70431E-03
1991	99550.	6.00334E-03
1992	99600.	6.00334E-03
1993	99650.	6.00334E-03
1994	99700.	6.00334E-03
1995	99750.	4.74752E-03
1996	99800.	4.74752E-03
1997	99850.	4.74752E-03
1998	99900.	4.74752E-03
1999	99950.	4.74752E-03
2000	1.00000E+05	.00000

UNC
P.O. Box 3077
Gallup, New Mexico 87305-3077

Telephone (505) 722-6651
Fax: (505) 722-6654

December 10, 1998

'98 JUN 20 P1:12

40-8907

U.S. Nuclear Regulatory Commission
Region IV
Attn: Ross Scarano, Director
Division of Radiation Safety and Safeguards
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-4351

Gentlemen:

Pursuant to License Condition 28A of our License SUA-1475, submitted herewith are the results of our ALARA Audit conducted on December 10, 1998

If you have any questions, please advise.

Sincerely yours,

Edward M. Morales
General Manager and
Radiation Safety Officer

EMM:r

Enclosure

cc: J. Velasquez, UNC
USNRC, Div. of Waste Management

1/1

W7

EXHIBIT
2-J

ENVIRONMENTAL MONITORING SUMMARY DATA

For 4th-Q 1997 to 3rd-Q 1998

Environmental Monitoring	Required Analysis	Highest Result Obtained	Allowable
° Qtly Air Sample Composite:	U-Nat. $(\frac{\mu ci}{ml})$	$2.82E^{-16}$	$9.00E^{-14}$ (Effluent)
(Also note: Alara Goal is 10-20% or less of effluent limit depending on circumstances)	Th-230 $(\frac{\mu ci}{ml})$	$2.99E^{-16}$	$3.00E^{-14}$ (Effluent)
	RA-226 $(\frac{\mu ci}{ml})$	$3.94E^{-16}$	$9.00E^{-13}$ (Effluent)
	PB-210 $(\frac{\mu ci}{ml})$	$1.55E^{-14}$	$6.00E^{-13}$ (Effluent)
° Qtly Ambient Radon:	RN-222 $(\frac{\mu ci}{ml})$ (-Daughter)	$1.50E^{-9}$	$1.00E^{-8}$ (Effluent)
(Also note: Annual Average- $1.03E^{-9}$ µci/ml at the site with the high result)			
° Semi-Annual Area TLD:	Gamma $(\frac{mrem}{yr})$	*14.9	25 (Clean-up Std.) 100 (TEDE Annual Limit)
° Qtly Ground Water GW-Wells:	U-Nat $(\frac{mg}{l})$	0.073 (dissolved)	0.30 (NRC) 5.0 (ARAR)
(Also Note: 2 of 4 qtly. dissolved analysis = ≤1.0 pci/l and the LLD = 1.0 pci/l for Po-210 analysis. Annual average= ≤3.7 pci/l).	Th-230 $(\frac{pci}{l})$	≤0.20 (dissolved)	5.0 (NRC) 15.0 (ARAR)
	RA-226 $(\frac{pci}{l})$	1.30 (dissolved)	5.0 (NRC) 5.0 (ARAR)
	PB-210 $(\frac{pci}{l})$	≤1.0 (dissolved)	1.0 (NRC)
	PO-210 $(\frac{pci}{l})$	9.60 (dissolved)	1.0 (NRC)
	PH (units)	7.20	6-9 (NMED)

* Based on the combined summation of high results (i.e. at Site F 2nd Half of 97 = 12.0 mrem and at Site F 1st half of 98 = 6.0 mrem) above Site D's background results.

^Qtly Domestic Water Well:	U-Nat ($\frac{mg}{l}$)	0.0028 (dissolved)	0.30 (NRC)	5.0 (ARAR)
	Th-230 ($\frac{pci}{l}$)	≤0.20 (dissolved)	5.0 (NRC)	15.0 (ARAR)
(Also note: 3 of 4 qtly. dissolved analysis = ≤1.0 pci/l and the LLD=1.0 pci/l for Po-210 analysis. Annual average = ≤5.6 pci/l).	RA-226 ($\frac{pci}{l}$)	1.60 (dissolved)	5.0 (NRC)	5.0 (ARAR)
	PB-210 ($\frac{pci}{l}$)	≤1.0 (dissolved)	1.0 (NRC)	
	PO 210 ($\frac{pci}{l}$)	19.2(dissolved)	1.0 (NRC)	

Other Environmental Item

° Surface Alpha: (as needed)	All material of equipment sold or released met the requirements for unrestricted use	Removable ≤1000 $\frac{dpm}{100cm^2}$ Fixed Average ≤5000 $\frac{dpm_2}{cm}$ Where Area is ≠1m^2 Gamma is ≤40 ur/hr

TEXAS DEPARTMENT OF HEALTH

AUSTIN TEXAS

INTER-OFFICE

ATTACHMENT

THRU: David K. Lacker, Chief
Bureau of Radiation Control

THRU: Edgar D. Bailey, C.H.P., P.E., Director
Division of Licensing, Registration, and Standards

FROM Joseph F. Thiel, Director
Division of Environmental Programs

TO License File #8-2704

SUBJECT Recommended Radiological Restoration Values for Uranium Resources Inc.'s (URI) Benavides and Longoria Projects

Environmental Programs staff have reviewed the request from the TWC to specify radiological parameters to be included in amended restoration tables for URI's Benavides (PA No. 1) and Longoria (PA Nos. 1 and 2) projects. We make the following recommendations:

Uranium: 2mg/l.

Although the recommended value is above baseline average values for all three production areas, it is equal to or less than many uranium drinking water standards. Moreover, the average quality of the production zone water is considered only marginally suitable for drinking purposes (average TDS content ranges from about 1100 to 1900 mg/l).

Radium 226: Benavides No. 1, 83 pCi/l; Longoria No. 1, 97 pCi/l; Longoria No. 2, 37 pCi/l.

The recommended Ra-226 values are baseline levels.

Attachment

SDE/cal
cc: Board/JFT/SDE/CDR/Inspector's File (#8-2704)

SDE 5/04

EXHIBIT
2-K

FIGURE 6

SIGNED Joseph F. Thiel

DATE May 4, 1987

FORM NO. A(

May 20, 1999

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD PANEL

Before Administrative Judge Peter B. Bloch

In the Matter of	)	
HYDRO RESOURCES, INC. 2929 Coors Road Suite 101 Albuquerque, NM 87120	)	Docket No. 40-8968-ML ASLBP No. 95-706-01-ML

RESPONSE AFFIDAVIT OF DR. SPENCER G. LUCAS

I, Spencer G. Lucas, being duly sworn, make the following statement in response to Hydro Resources, Inc.'s Reply to April 21, 1999 Memorandum and Order (Questions) (May 11, 1999) and to the Affidavit of Craig S. Bartels ("Bartels Affidavit"), attached thereto, with respect to Questions 2 and 8:

1. My name is Spencer G. Lucas. I obtained a Ph.D. in geology from Yale University in 1984. I am currently the Curator of Paleontology and Geology at the New Mexico Museum of Natural History, a position that I have held since 1988. In addition, I have served as an Adjunct Professor of Geology at the University of New Mexico since 1988.

2. I have extensive knowledge of the geology for which Hydro Resources, Inc. ("HRI") proposes the Crownpoint Uranium Project. The Westwater Canyon Member Aquifer in the Morrision Formation was deposited in Late Jurassic time. I began to conduct field studies of Jurassic strata in New Mexico in 1983. In 1988, this research program expanded to a regional study of Jurassic stratigraphy,

EXHIBIT
3

paleontology and sedimentation in the Four Corners states. As a result of my research, I co-led three field conferences of the New Mexico Geological Society (in 1985, 1989 and 1997) in which a major focus was the Jurassic rocks. I have published several dozen articles and abstracts on Jurassic strata in New Mexico, which encompass a major re-interpretation of Middle-Late Jurassic stratigraphy, deposition and paleogeography in the American Southwest. Further details of my professional qualifications are set forth in my curriculum vitae, which is attached as Exhibit A, and in my scientific bibliography, which is attached as Exhibit B.

3. In preparation of this affidavit I reviewed the following materials:

-Intervenors' Amended Written Presentation in Opposition to Hydro Resources, Inc.'s Application for a Materials License with Respect to: Groundwater Protection and Exhibits (January 18, 1999);

-Hydro Resources, Inc.'s Response to Intervenors' Brief in Opposition to Hydro Resources, Inc.'s Application for a Materials License with Respect to Groundwater Issues, Lichnovsky Affidavit (February 19, 1999);

-The Presiding Officer's April 21, 1999 Memorandum and Order (Questions);

-Hydro Resources, Inc.'s Reply to April 21, 1999 Memorandum and Order (Questions) (May 11, 1999) and the attached Affidavit of Craig S. Bartels;

-Campbell, C. V., 1976, Reservoir geometry of a fluvial sheet sandstone: American Association of Petroleum Geologists Bulletin, v. 60, p. 1009-1020;

-Cowan, E. J. 1991. The large-scale architecture of the fluvial Westwater Canyon Member, Morrison Formation (Upper Jurassic), San Juan Basin, New Mexico: SEPM Concepts in Sedimentology and Paleontology 3, p. 80-93;

-Walker, R. G., 1992, Facies, facies models and modern stratigraphic concepts; in Walker, R. G. and James, N. P., eds., Facies models: Geological Association of Canada, St. John's, Newfoundland, p. 1-14.

4. Question 2 of the April 21, 1999 Order asks:

Based on local geology, what assurance is there concerning the likelihood of the existence of shears, fractures, and joints that could transmit appreciable quantities of water above or below the Westwater aquifer? How much greater assurance may reasonably be anticipated prior to commencing ISL operations at Churchrock Section 8? What environmental costs may reasonably be expected to result from foreseeable difficulties at Churchrock Section 8?

Michael G. Wallace responds to HRI's Response to this question in his affidavit. The following comments are intended to supplement his response.

5. HRI claims (citing the FEIS) that the mine zone in the Westwater is confined by good aquitards, with good overlying clays and underlying shale. HRI Response at 8. Specifically, HRI claims that there is little risk of excursion into the underlying Cow Springs aquifer because of the thickness of the Recapture shale. HRI Response at 10. I concur with the January 11, 1999, testimony of Mr. Wallace that the Recapture Shale is not a confining layer in this region because the Recapture is a fluvial deposit in the southern part of the San Juan Basin. The nomenclature used in this instance is misleading and outdated.

6. The rock section immediately below the Westwater Canyon Member is not shale – it is a mixture of sandstone, siltstone and thin gypsum beds that overlie the gypsum beds of the upper Todilto Formation. These gypsum beds regionally are known to be very ductile and soluble. Thus, they are easily deformed or dissolved, and this produces numerous fractures in the subsurface and at the surface. These fractures are well documented because they are conduits for groundwater flow and also sometimes serve as the loci of uranium mineralization.

7. Mr. Bartels refers to the overlying layers at Church Rock as the Poison Canyon and Dakota formations. Bartels Affidavit at 9. In fact, the Poison Canyon is the

designation of an ore horizon in the Ambrosia Lake/Laguna region of New Mexico. The overlying layers at Church Rock about the Westwater are the Brushy Basin B sand and the Dakota formations. This is a remarkable error, which undermines confidence in HRI's ability to understand the details of geologic conditions in Church Rock.

8. Question 8 of the April 21, 1999 Order asks:

> Intervenors Groundwater Exhibit L quotes Cowan (1991), who states that near Church Rock, channelways "15-30 m. thick" occur "which would affect fluid flow." SRIC/ENDAUM will please promptly provide a reference for the citation so that we may discover whether Cowan says anything about the width of these channelways.

9. The citation is correct in that the Cowan study identifies channelways within the channel system which conduct fluid flow along channel boundaries. HRI's attorney criticizes the Cowan study as "mostly a two dimensional study..." that is "based on a very small portion of the Westwater Canyon Member." HRI Response at 41. These criticisms are unfounded. HRI's statement that "Cowan's description of the Westwater Canyon as made up of coalesced sand sheets precludes the existence of confined elongated channels" is also a misreading of the article. HRI Response at 41.

10. Cowan is a state-of-the-art scientific study designed to reconstruct the fluvial architecture of the Westwater Canyon Member of the Morrison Formation in west-central New Mexico. In a sedimentological study such as that of Cowan, an architectural element is defined as a "morphological subdivision of a particular depositional system that emphasizes the three dimensional geometry of the facies

[rock environment] associations" (Walker, 1992, p. 2, 5). In other words, the term architecture is used by sedimentologists to mean the three dimensional geometry of a rock body formed in a particular environment. Indeed, both the text and the illustrations of Cowan's article (see especially his figure 18, Exhibit C) make it clear that the goal is to reconstruct, in three dimensions, the fluvial system which deposited the Westwater Canyon Member.

11. Therefore, HRI's statement that Cowan's article "is mostly a two-dimensional study..." is misleading.

12. Cowan (1991) re-evaluates an important study of Westwater Canyon Member deposition by Campbell (1976), who concluded that deposition took place in channel systems 1.6 to 34 km wide by a braided river system composed of many smaller channels with widths of 30 to 366 m. Cowan argues that the channel systems identified by Campbell are not primary depositional features, but instead are "post-depositional aquifer conduits, or permeability-pathway components" (p. 80). Cowan concludes that Westwater Canyon deposition was in channel belts one to several km wide composed of numerous, smaller channels. Cowan's article thus well documents the lithologic heterogeneity of the Westwater Canyon Member at the scale of the small channels (which are associated with lenticular bar and overbank deposits) and the continuity of long, nearly linear channel belts. A modern analogy is the depositional development of the Rio Grande and upper-middle reaches of the Mississippi Rivers, as they change course and sediments accumulate, forming sandbars. Therefore, the statement of HRI's attorney that "Cowan's description of the Westwater Canyon as made up of coalesced sand

sheets precludes the existence of confined elongated channels" is a misreading of the article.

13. What HRI fails to appreciate is that at a "small scale" (channel widths of tens to hundreds of meters), the Westwater Canyon is a three-dimensionally very complex amalgamation of many coalesced channel, bar and overbank deposits. But, at a "large scale" (widths of hundreds of meters to a few kms) the Westwater Canyon Member consists of long, discrete channel belts, just like those produced by modern braided rivers. Thus, at the small scale the Westwater Canyon is lithologically heterogeneous, consisting of numerous, interlaced ribbon-like sandstone bodies and lenses of conglomerate and mudrock, but only at the large scale can each channel belt be superficially characterized as sandstone, because the majority of the deposit is sandstone.

14. Cowan's article can be used to conclude there must be at least two levels of permeability/porosity in the Westwater Canyon Member: (1) the small scale (averaging 30 meters (100 feet)) of complex conduits; and (2) large scale conduits that correspond to the channel belts. There must also be a third scale of permeability as well according to Cowan, at the scale of Campbell's (1976) channel systems, which is up to 34 km in width. With these superimposed levels (scales) of permeability/porosity, small channel effects greatly complicate the understanding of groundwater flow in the larger channels.

15. HRI also attempts to dismiss the significance of Cowan's study by stating it is "based on a very small portion of the Westwater Canyon Member." However, Cowan's study is placed in a basinal context and examines in detail an outcrop

belt characteristic of the Westwater Canyon Member. This is standard sedimentological procedure, and there is no reason to believe that Cowan's conclusions do not apply to the Westwater Canyon throughout its depositional extent. Indeed, Cowan's study area is just east of Gallup near Red Rock State Park, only a few miles west of Church Rock. Any competent geologist would readily extend Cowan's conclusions into the Church Rock area, given the vast scale of the Westwater Canyon Member river system.

AFFIRMATION

I declare on this 20th day of May, 1999, at Albuquerque, New Mexico, under penalty of perjury that the foregoing is true and correct to the best of my knowledge, and the opinions expressed herein are based on my best professional judgment.

Spencer G. Lucas

Sworn and subscribed before me, the undersigned, a Notary Public in and for the State of New Mexico, on this 20th day of May, 1999.

Notary Public

My Commission expires on:

10-22-2002.

CURRICULUM VITAE

NAME

Spencer George Lucas
Born April 25,1955
Minneapolis, Minnesota
U.S. Citizen

ADDRESS

New Mexico Museum of Natural History and Science
1801 Mountain Road, N. W., Albuquerque,
New Mexico 87104 USA
Telephone: (505) 841-2873
FAX: (505) 841-2866
E-MAIL: LUCAS@DARWIN.NMMNH-ABQ.MUS.NM.US

EDUCATION

1976 - B.A. (summa cum laude and with honors) University of New Mexico (Anthropology)
1979 - M.S. Yale University (Geology)
1979 - M. Phil. Yale University (Geology)
1984 - Ph.D. Yale University (Geology)

EMPLOYMENT

1988 - present Curator of Paleontology and Geology, New Mexico Museum of Natural History
1989 - 1991 Chairman, Science Department, New Mexico Museum of Natural History.
1988 - present Adjunct Associate Professor of Geology, University of New Mexico.
1984 - 1988 Curator and Adjunct Assistant Professor of Geology,University of New Mexico.
1982-1983 Geologist, Esca-Tech Corporation, Albuquerque, New Mexico

PROFESSIONAL ORGANIZATIONS

Albuquerque Geological Society (Vice President, **1990**)
New Mexico Geological Society (Managing Editor, **1987-1990**; General Chairman, Annual Fall Field Conferences, **1985, 1987, 1992**); elected Honorary Member, 1994
New Mexico Academy of Science (Life Member; President elect, **1991**, President, **1992**, Past-President, **1993**)
Paleontological Society (President, Rocky Mountain Section, **1991**)
Society of Vertebrate Paleontology (Member, Government Liaison Committee, **1989-1994**)

EXHIBIT
A

Voting member, **Subcommission on Triassic Stratigraphy,** International Union of Geological Sciences **(1990-present)**

GRANTS, AWARDS AND FELLOWSHIPS

1976 - Sigma XI Grant-in-Aid-of-Research "Studies of Early Tertiary Vertebrate Fossils" [$150].

1977 - Yale University Graduate Fellowship.

1978 - Sigma XI Grant-in-Aid-Research "Taphonomy of Drought" [$300]; James Dwight Dana Fellowship in Geology, Yale University.

1979 - National Science Foundation Doctoral Dissertation Improvement Grant DEB-7919681: "Species-level evolution of *Coryphodon* " [$6,000]; Alan Bateman Fellowship in Geology, Yale University.

1980 - James Dwight Dana Fellowship in Geology, Yale University

1982 - Swedish National Science Foundation Grant for Study of fossil vertebrates from China housed in the Paleontologiska Institution, Uppsala University, Sweden [$3,000]; Philip M. Orville Prize for outstanding research by a graduate student in geology, Yale University; Contract YA-553-CTI-129 from U.S. Bureau of Land Management for Paleontological Resource Inventory of White River Resource Area, northwestern Colorado [$150,000].

1984 - University of New Mexico Foundation for renovation of UNM Geology Museum (with R.C. Ewing and B.S. Kues) [$15,000]; New Mexico Natural Resources Department for preparation of museum exhibit for Elephant Butte State Park, New Mexico [$1,000].

1989 - *Coelophysis* Society Research Award, New Mexico Museum of Natural History.

1989 - 1991- Petrified Forest Museum Association (with K.K. Kietzke) for studies of late Triassic microfossils [$3,500].

1991 - Petrified Forest Museum Association (with A. P. Hunt) for studies of Late Triassic amphibians [$1,000]

1991-1993 - National Geographic Society (with A. P. Hunt) to study Upper Triassic stratigraphy and paleontology in Wyoming-Idaho [$10,000].

1992-1994 - National Geographic Society (with F. S. Szalay) to study early Cenozoic mammals of Soviet Central Asia [$20,000].

1992-1993 - Petrified Forest Museum Association, to support the Nonmarine Triassic Symposium [$10,000].

1994 - BLM Contract to study Early Permian footprints [$65,000]; CONACYT grant to study Triassic-Jurassic of northern Mexico [$60,000].

1995 - National Geographic Society (with R. J. Emry) to study early Cenozoic stratigraphy and biostratigraphy of the Zaysan basin, Kazakhstan [$43,000]; Petrified Forest Museum Association to study Triassic stratigraphy [$2,000]; Dinosaur Society to study Cretaceous dinosaurs of Kazakhstan [$4,000]

TEACHING EXPERIENCE

1983-1995 University of New Mexico, Departments of Geology and Anthropology: taught Geology 101 (Physical Geology), 102 (Historical Geology), 210 (Earth Environment), 211 (Dinosaurs), 520 (Vertebrate Paleontology), 540 (Advanced Stratigraphy/ Sedimentology) , Geology 470/Anthro 470 (Paleontological field techniques), Anthro 450 (Primate evolution).

I have served on 6 M.S. thesis committees (3 as co-advisor) and 4 Ph.D. committees (4 as co-advisor) and teach Geology 211 as an adjunct faculty member.

Spencer G. Lucas

Scientific Bibliography

AUTHORED BOOKS

1993

Dinosaurs of New Mexico. Albuquerque, New Mexico Academy of Science [New Mexico Journal of Science, v. 32], 130 pp.

1994

Dinosaurs the Textbook. Dubuque, Wm. C. Brown Publishers, 290 pp.

Instructor's Manual to Accompany Dinosaurs the Textbook. Dubuque, Wm. C. Brown Publishers, 73 pp.

1997

Dinosaurs: The Textbook. Second edition. DuBuque, Wm. C. Brown Publishers, 292 pp.

Instructor's Manual. Dinosaurs: The Textbook. Second Edition. DuBuque, Wm. C. Brown Publishers, 74 pp.

EDITED BOOKS

1981

Advances in San Juan Basin Paleontology. Albuquerque, University of New Mexico Press, 393 pp. (edited by S.G. Lucas, J.K. Rigby, Jr., and B.S. Kues).

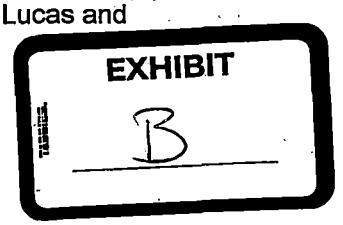
1985

Santa Rosa — Tucumcari region [New Mexico Geological Society, Guidebook, 36th Annual Field Conference]. Socorro, New Mexico Geological Society, 344 pp. (edited by S.G. Lucas and J. Zidek).

Studies of Chinese Fossil Vertebrates. Bulletin of the Geological Institutions of the University of Uppsala, New Series, 11, 150 pp. (edited by S.G. Lucas and N.J. Mateer).

1987

Northeastern New Mexico [New Mexico Geological Society, Guidebook, 38th Field Conference]. Socorro, New Mexico Geological Society, 354 pp. (edited by S.G. Lucas and A.P. Hunt).



1988

Cretaceous and Laramide Tectonic Evolution of Southwestern New Mexico [New Mexico Geological Society, Guidebook, 39th Annual Field Conference]. Socorro, New Mexico Geological Society, 216 pp. (edited by G.H. Mack, T.F. Lawton and S.G. Lucas).

1989

Dawn of The Age of Dinosaurs in The American Southwest. Albuquerque, New Mexico Museum of Natural History, 414 pp. (edited by S.G. Lucas and A.P. Hunt).

Energy Frontiers in the Rockies. Albuquerque, Albuquerque Geological Society, 188 pp. (edited by J.C. Lorenz and S.G. Lucas).

Southeastern Colorado Plateau [New Mexico Geological Society, Guidebook, 40th Field Conference]. Socorro, New Mexico Geological Society, 346 pp. (edited by O.J. Anderson, S.G. Lucas, D.W. Love and S.M. Cather).

1990

Tectonic Development of the Southern Sangre de Cristo Mountains, New Mexico. [New Mexico Geological Society, Guidebook, 41st Field Conference]. Socorro, New Mexico Geological Society, 450 pp. (edited by P.W. Bauer, S.G. Lucas, C.K. Mawer and W.C. McIntosh).

1991

Geology of the Sierra Blanca, Sacramento and Capitan Ranges, New Mexico [New Mexico Geological Society, Guidebook, 42nd Field Conference]. Socorro, New Mexico Geological Society, 361 pp. (edited by J.M. Barker, B.S. Kues, G.S. Austin and S.G. Lucas)

1992

San Juan Basin IV [New Mexico Geological Society, Guidebook, 43rd Field Conference]. Socorro, New Mexico Geological Society, 412 pp. (edited by S.G. Lucas, B.S. Kues, T.E. Williamson and A.P. Hunt).

1993

Vertebrate paleontology in New Mexico: New Mexico Museum of Natural History and Science, Bulletin 2, 338 pp. (edited by S. G. Lucas and J. Zidek).

The Nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, 544 pp. (edited by S. G. Lucas and M. Morales).

1995

Early Permian footprints and facies: New Mexico Museum of Natural History and Science, Bulletin 6, 301 pp. (edited by S. G. Lucas and A. B. Heckert).

1997

Late Palaeozoic and early Mesozoic circum-Pacific events and their global correlation. Cambridge, Cambridge University Press, 245 pp. (Edited by J. M. Dickins, Z. Yang, H. Yin, S. G. Lucas and S. K. Acharyya).

Mesozoic Geology and Paleontology of the Colorado Plateau [New Mexico Geological Society Guidebook 48]: Socorro, New Mexico Geological Society (edited by O. J. Anderson, B. S. Kues and S. G. Lucas), 288 pp.

New Mexico's Fossil Record 1: New Mexico Museum of Natural History and Science Bulletin 11, 143 pp. (edited by S. G. Lucas, J. W. Estep, T. E. Williamson and G. S. Morgan).

Late Paleozoic and early Mesozoic circum-Pacific events: Biostratigraphy, tectonics and ore deposits of Primoryie (Far East Russia): Mémoires de Géologie (Lausanne), no. 30, 202 pp. (edited by A. Baud, I. Popova, J. M. Dickins, S. G. Lucas and Y. Zakharov).

1998

Permian stratigraphy and paleontology of the Robledo Mountains, New Mexico: New Mexico Museum of Natural History and Science Bulletin 12, 98 pp. (edited by S. G. Lucas, J. W. Estep and J. M. Hoffer).

Lower and Middle Cretaceous Terrestrial Ecosystems: New Mexico Museum of Natural History and Science Bulletin 14, 330 pp. (edited by S. G. Lucas, J. I. Kirkland and J. W. Estep).

The Permian-Triassic boundary and global Triassic correlations: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 143, p. 195-384 (edited by S. G. Lucas and H. Yin).

Late Paleocene-early Eocene climatic and biotic events in the marine and terrestrial records. New York: Columbia University Press, 513 pp. (edited by M-P. Aubry, S. G. Lucas and W. A. Berggren).

ARTICLES IN SCIENTIFIC JOURNALS

1979

Comment on "Biostratigraphy and magnetostratigraphy of Paleocene terrestrial deposits, San Juan Basin, New Mexico." Geology , v. 7, p. 323–327 (S.G. Lucas and J.K. Rigby, Jr.).

Comment on "Geologic implications of the relationship between mammalian faunal similarity and geographic distance." Geology , v. 7, p. 327–328 (S.G.Lucas and S.M. Raza).

New discoveries of fossil primates from the type Torrejonian (middle Paleocene) of New Mexico. Folia Primatologica , v. 32, p. 1–7 (C.B. Wood, G.C. Conroy and S.G. Lucas).

1980

Taxonomic status of *Eohyus* Marsh, 1894. Postilla [Yale Peabody Museum of Natural History] , no. 182, 6 pp.

1981

Occurrence of *Pantolambda* (Mammalia; Pantodonta) in the Torrejonian *Deltatherium* "zone," San Juan Basin, New Mexico. American Journal of Science , v. 281, p. 187–191 (S.G. Lucas and F.M. O'Neill).

Akanthosuchus langstoni, a new crocodile from the Nacimiento Formation (Paleocene, Torrejonian) of New Mexico: Journal of Paleontology, v. 55, p. 340–352 (F.M. O'Neill, S.G. Lucas and B.S. Kues).

The systematics of *Forstercooperia*, a middle to late Eocene hyracodontid (Perissodactyla, Rhinocerotoidea) from Asia and western North America. Journal of Paleontology , v. 55, p. 826–841 (S.G. Lucas, R.M. Schoch and E. Manning).

A mosasaur from the Upper Cretaceous Lewis Shale in northwestern New Mexico. New Mexico Geology , v. 3, p. 37–40 (S.G. Lucas and P.K. Reser).

Cope, Marsh and the type of *Lystrosaurus "frontosus,"* a mammal-like reptile from the Triassic of South Africa. Discovery [Yale Peabody Museum of Natural History], v. 15, p. 28–33 (S.G. Lucas and R.M. Schoch).

The systematics of *Stylinodon* , an Eocene taeniodont from western North America. Journal of Vertebrate Paleontology , v. 1, p. 175–183 (R.M. Schoch and S.G. Lucas).

New conoryctines (Mammalia; Taeniodonta) from the middle Paleocene (Torrejonian) of western North America. Journal of Mammalogy, v. 62, p. 683–691 (R.M. Schoch and S.G. Lucas).

The systematics of *Rhodopagus*, a late Eocene hyracodontid (Perissodactyla; Rhinocerotoidea) from China. Bulletin of the Geological Institutions of the University of Uppsala, v. 9, p. 843–850 (S.G. Lucas and R.M. Schoch).

A new species of *Conoryctella* (Mammalia; Taeniodonta) from the Paleocene of the San Juan Basin, New Mexico and a revision of the genus. Postilla [Yale Peabody Museum of Natural History], no. 185, 23 pp. (R.M. Schoch and S.G. Lucas).

Basalina , a tillodont from the Eocene of Pakistan. Mitteilungen der Bayerische Staatssammlung , v. 21, p. 89–95 (S.G. Lucas and R.M. Schoch).

Cenozoic continental deposits of New Mexico: an overview. Geological Society of American Bulletin, Part I, v. 92, p. 917–932 (S.G. Lucas and R.V. Ingersoll).

The Eocene biostratigraphy of New Mexico. Geological Society of America Bulletin, Part I, v. 92, p. 951–967 (S.G. Lucas, R.M. Schoch, E. Manning and C. Tsentas).

Lexicon of Cenozoic rock-stratigraphic units of New Mexico, 1869–1980. Geological Society of America Bulletin, Part II, v. 92, p. 1807–1981 (S.G. Lucas and R.V. Ingersoll).

Annotated bibliography of the Eocene paleontology and stratigraphy of New Mexico: Geological Society of America Bulletin, Part II, v. 92, p. 2268–2307 (S.G. Lucas, R.M. Schoch, E. Manning and C. Tsentas).

1982

A middle Eocene titanothere from the Baca Formation, south-central New Mexico. Journal of Paleontology , v. 56, p. 542–545 (S.G. Lucas, D.L. Wolberg, A.P. Hunt and R.M. Schoch).

An occurrence of *Ichthyornis* in the Late Cretaceous Mancos Shale (Juana Lopez Member), northwestern New Mexico. Journal of Paleontology , v. 56, p. 545–547 (S.G. Lucas and R.M. Sullivan).

Duchesneodus , a new name for some titanotheres (Perissodactyla: Brontotheriidae) from the late Eocene of western North America. Journal of Paleontology, v. 56, p. 1018–1023 (S.G. Lucas and R.M. Schoch).

Discussion — magnetic polarity zonation and biostratigraphy of Late Cretaceous and Paleocene continental deposits, San Juan Basin, New Mexico. American Journal of Science, v. 282, p. 920–927 (S.G. Lucas and R.M. Schoch).

Vertebrate paleontology, stratigraphy and biostratigraphy of Eocene Galisteo Formation, north-central New Mexico. New Mexico Bureau of Mines and Mineral Resources, Circular 186, 34 pp.

Bibliography of papers published by E.D. Cope on the Paleocene of the San Juan Basin, New Mexico. New Mexico Journal of Science, v. 22, p. 52–55.

1983

The taxonomic status of *Australopithecus afarensis* Johanson in Hinrichsen 1978 (Mammalia, Primates). Haliksa'i [UNM Contributions to Anthropology], v. 2, p. 16–27 (T.R. Logan, S.G. Lucas and J.C. Sobus).

Pathologic vertebra of a Late Cretaceous mosasaur from northwestern New Mexico. New Mexico Journal of Science, v. 23, p. 28–32 (S.G. Lucas and P.K. Reser).

Endocranial cast of a Puercan (early Paleocene) crocodilian from the San Juan Basin, New Mexico. Copeia, v. 1983, p. 842–845 (G.W. Storrs, S.G. Lucas and R.M. Schoch).

Glyptosaurine lizard from Eocene Baca Formation, south-central New Mexico. New Mexico Geology, v. 5, p. 77–78 (S.G. Lucas, R.M. Sullivan and T.R. Logan).

Vertebrate paleoecology of the late Campanian (Cretaceous) Fruitland Formation, San Juan Basin, New Mexico (U.S.A.). Acta Palaeontologica Polonica, v. 28, p. 195–204 (S.G. Lucas and N.J. Mateer).

Aphelops and other Miocene vertebrates collected from the Tesuque Formation (Espanola basin, New Mexico) by the Wheeler Survey in 1873. New Mexico Journal of Science, v. 23, p. 28–36 (S.G. Lucas and R.M.Schoch).

Protitanotherium (Mammalia, Perissodactyla) from the Eocene Baca Formation, west-central New Mexico. New Mexico Journal of Science, v. 23, p. 39–47.

Comments on two species of the Eocene artiodactyl *Homacodon* and the taxonomic status of *Nanomeryx caudatus* Marsh, 1894. New Mexico Journal of Science, v. 23, p. 48–56.

1984

A new look at the discovery of "Peking Man." Haliksa'i [UNM Contributions to Anthropology], v. 3, p. 148–154 (S.G. Lucas and J.C. Sobus).

Early Paleocene vertebrates, stratigraphy and biostratigraphy, West Fork of Gallegos Canyon, San Juan Basin, New Mexico. New Mexico Geology, v. 6, p. 56–60.

Late Cretaceous (Lancian) dinosaurs from the McRae Formation, Sierra County, New Mexico. New Mexico Geology, v. 6., p. 72–77 (R.P. Lozinsky, A.P. Hunt, D.L. Wolberg and S.G. Lucas).

Choeropsis Leidy, 1852 (Artiodactyla): proposed conservation under the plenary powers. Z.N.(S.) 2407. Bulletin of Zoological Nomenclature, v. 41, p. 94–96 (R.M. Schoch and S.G. Lucas).

Pleistocene horse from the Albuquerque area, New Mexico: New Mexico Journal of Science, v. 24, p. 29–32 (S.G. Lucas and T.R. Logan).

Synopsis of the species of *Coryphodon* (Mammalia, Pantodonta). New Mexico Journal of Science, v. 24, p. 33–42.

Leptotomus (Mammalia, Rodentia) from the Eocene "Baca" Formation, south-central New Mexico. New Mexico Journal of Science, v. 24, p. 43–46.

Taxonomic status of *Titanoides simpsoni* Simons, 1860 and some observations on *Pantolambda* Cope, 1882 (Mammalia, Pantodonta). New Mexico Journal of Science, v. 24, p. 46–52.

1985

Shark vertebrae from the Upper Cretaceous Pierre Shale, northeastern New Mexico. New Mexico Bureau of Mines and Mineral Resources, Circular 195, p. 21–23 (S.G. Lucas, P.K. Reser and D.L. Wolberg).

Dinosaurs from the Upper Jurassic Morrison Formation in New Mexico. New Mexico Journal of Science, v. 25, p. 1–12 (S.G. Lucas and A.P. Hunt).

Discussion: a critique [of] chronostratigraphy. American Journal of Science, v. 285, p. 764–766.

Mosasaur remains from the Lewis Shale (Upper Cretaceous), southwestern Colorado. Journal of Paleontology , v. 59, p. 1395–1406 (B.S. Kues and S.G. Lucas).

Water column for concentrating microvertebrate fossils. New Mexico Journal of Science, v. 25, p. 32–35 (K.K. Kietzke, S.G. Lucas and W. Oakes).

1986

Annotated list of lower vertebrates from the Paleocene Nacimiento Formation (Puercan-Torrejonian), San Juan Basin, New Mexico. Journal of Herpetology, v. 20, p. 202–209 (R.M. Sullivan and S.G. Lucas).

Proper syntax when using aff. and cf. in taxonomic statements. Journal of Vertebrate Paleontology, v. 6, p. 202.

The first Oligocene mammal from New Mexico: Journal of Paleontology, v. 60, p. 1274–1276.

Pyrothere systematics and a Caribbean route for land-mammal dispersal during the Paleocene. Revista Geologica de America Central, v. 5, p. 1–33.

Leidyosuchus (Reptilia, Crocodilia) from the Paleocene Nacimiento Formation, San Juan Basin, New Mexico. New Mexico Journal of Science, v. 26, p. 31–38 (S.G. Lucas and R.M. Sullivan).

Taxonomic status of *Oxyacodon tecumsae* , a Paleocene mammal from the San Juan Basin, New Mexico. New Mexico Journal of Science, v. 26, p. 39–40.

Coryphodon anthracoideus (de Blainville, 1846) from the Upper Paleocene of Orp-le-Grand, Belgium. Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, v. 56, p. 373–381.

Cretaceous stratigraphy and biostratigraphy, Clayton Lake State Park, Union County, New Mexico. New Mexico Geology, v. 8, p. 60–65 (S.G. Lucas, A.P. Hunt, K.K. Kietzke and D.L. Wolberg).

A new coryphodontid (Mammalia, Pantodonta) from the Eocene of China. Journal of Vertebrate Paleontology, v. 7, p. 362–372 (S.G. Lucas and Y. Tong).

Type section of the Triassic Correo Sandstone Bed, Chinle Formation, Cibola County, New Mexico. New Mexico Journal of Science, v. 27, p. 87–93 (S.G. Lucas, B.D. Allen and S.N. Hayden).

Newberry's locality for Cretaceous plant fossils at Whetstone Creek, New Mexico. New Mexico Journal of Science, v. 27, p. 95–98 (S.G. Lucas, A.P. Hunt and K. Martini)

1987

Paleopathology of early Cenozoic *Coryphodon* (Mammalia; Pantodonta). Journal of Vertebrate Paleontology , v. 7, p. 145–154 (S.G. Lucas and R.M. Schoch).

Southernmost outcrops of the Morrison Formation in the Carthage area, Socorro County, New Mexico. New Mexico Geology , v. 9, p. 58–62 (A.P. Hunt and S.G. Lucas).

American mastodont from the Sandia Mountains, New Mexico. New Mexico Journal of Science, v. 27, p. 29–32.

1988

Navajosuchus is *Allognathosuchus*. Journal of Herpetology, v. 22, p. 121–125 (R.M. Sullivan, S.G. Lucas and C. Tsentas).

A late Triassic cynodont from the American South-west. Palaeontology , v. 31, p. 445–449 (S.G. Lucas and W. Oakes).

Spots before our eyes. Terra [Los Angeles County Natural History Museum], v. 26, p. 17–19 (R.M. Sullivan and S.G. Lucas).

Fossil Squamata from the San Jose Formation, early Eocene, San Juan Basin, New Mexico. Journal of Paleontology , v. 62, p. 631–639 (R.M. Sullivan and S.G. Lucas).

Late Pleistocene (Rancholabrean) mammals from the Edith Formation, Albuquerque, New Mexico. New Mexico Journal of Science, v. 28, p. 51–58 (S.G. Lucas, T. Williamson and J.C. Sobus).

Some Late Cretaceous reptiles from New Mexico. New Mexico Bureau of Mines and Mineral Resources, Bulletin 122, p. 49–60 (S.G. Lucas, A.P. Hunt and R. Pence).

Type and reference sections of the Tucumcari, Mesa Rica and Pajarito formations, Cretaceous of east-central New Mexico. New Mexico Geology, v. 10, p. 82–89 (S.G. Lucas and M.J. Kisucky).

Color pattern on the selmacryptodiran turtle *Neurankylus* from the early Paleocene (Puercan) of the San Juan Basin, New Mexico. Contributions in Science, Natural History Museum of Los Angeles County, no. 401, p. 1–9. (R.M. Sullivan, S.G. Lucas, A.P. Hunt and T. Fritts).

Eocene Crocodilia from the San Jose Formation, San Juan Basin, New Mexico. New Mexico Journal of Science, v. 28, p. 93–98.

Late Triassic fauna from the Los Esteros Member of the Santa Rosa Formation, Santa Fe County, New Mexico, and its biochronological implications. New Mexico Journal of Science, v. 28, p. 107–116 (A.P. Hunt and S.G. Lucas).

1989

Coryphodon (Mammalia, Pantodonta) from the Hannold Hill Formation, Eocene of Trans-Pecos, Texas. The Pearce-Sellards Series [Texas Memorial Museum, The University of Texas at Austin], no. 46, 16 pp.

Stratigraphy, paleontology, and depositional systems of the Eocene Cub Mountain Formation, Lincoln County, New Mexico — a preliminary report. New Mexico Geology , v. 11, p. 11–17 (S.G. Lucas, S.M. Cather, P. Sealey and J.H. Hutchison).

Fossil primates from New Mexico and the early adaptive radiation of the Adapidae. Journal of Anthropological Research, v. 45, p. 67–75 (S.G. Lucas and J.W. Froehlich).

Gryphaea pitcheri Morton, 1834 (currently *Texigryphaea pitcheri* ; Mollusca, Bivalvia): proposed conservation: Bulletin of Zoological Nomenclature, v. 46, p. 226–228 (B.S. Kues and S.G. Lucas).

Haplocanthosaurus Hatcher, 1903 (Reptilia, Saurischia): proposed conservation: Bulletin of Zoological Nomenclature,v. 46, p. 262–263 (S.G. Lucas and A.P. Hunt).

Paleontology and vertebrate biochronology of the Upper Triassic Garita Creek Formation, east-central New Mexico: New Mexico Journal of Science, v. 29, p. 61–68 (A.P. Hunt, S.G. Lucas and P.L. Sealey).

1990

A bighorn sheep, *Ovis canadensis* , from the late Pleistocene of Mesa del Oro, Cibola County, New Mexico: Texas Journal of Science, v. 42, p. 107–109. (R.A. Smartt, D.J. Hafner and S.G. Lucas).

The rise of the dinosaur dynasty. New Scientist, v. 128, no. 1737, p. 44–46.

Ontogenetic studies of early Cenozoic *Coryphodon* (Mammalia, Pantodonta). Journal of Paleontology, v. 64, p. 831–841 (S.G. Lucas and R.M. Schoch).

Toward a vertebrate biochronology of the Triassic. Albertiana, v. 8, p. 36–41.

Fossil *Bison* in New Mexico: New Mexico Journal of Science, v. 30, p. 7–15 (J.A. Effinger and S.G. Lucas).

Paleontology and biochronology of the Petrified Forest Member of the Upper Triassic Chinle Formation near San Ysidro, Sandoval County, New Mexico: New Mexico Journal of Science, v. 30, p. 17–26 (A.P. Hunt and S.G. Lucas).

Late Cretaceous vertebrates from the Mulatto Tongue of the Mancos Shale, central New Mexico: New Mexico Journal of Science, v. 30, p. 27–34 (T.E. Williamson and S.G. Lucas).

Middle Eocene mammal from the base of the Baca Formation, west-central New Mexico: New Mexico Journal of Science, v. 35, p. 35–39.

The oldest mammal: New Mexico Journal of Science, v. 30, p. 41–49 (S.G. Lucas and A.P. Hunt).

Re-evaluation of "*Typothorax*" *meadei*, a Late Triassic aetosaur from the United States. Paläontologische Zeitschrift, v. 64, p. 317–328 (A.P. Hunt and S.G. Lucas).

Late Cretaceous dinosaurs from the Ringbone Formation, southwestern New Mexico, U.S.A.: Cretaceous Research, v. 11, p. 343–349 (S.G. Lucas, G. Basabilvazo and T.F. Lawton).

Reporte preliminar sobre dinosaurios del Cretacico tardio de la cuenca de Cabullona: Boletin del Departmento de Geologia, Universidad Sonora, v. 7, no. 1–2, p. 1–6 (S.G. Lucas and C. Gonzalez-Leon).

1991

Type section of the Permian Bernal Formation and the Permian-Triassic boundary in north-central New Mexico: New Mexico Geology, v. 13, p. 9–15 (S.G. Lucas and S.N. Hayden).

The giant bison (*Bison latifrons*) from the middle Rio Grande Valley of New Mexico: The Southwestern Naturalist, v. 36, p. 136–137 (R.A. Smartt, S.G. Lucas and D.J. Hafner).

Correlation of Triassic strata of the Colorado Plateau and southern High Plains, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Bulletin 137, p. 47–56.

Late Pennsylvanian stratigraphy and paleontology of the Kinney Brick Quarry, Manzanita Mountains, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Bulletin 137, p. 79–85 (S.G. Lucas and P. Huber).

Ostracoda from the Upper Triassic (Carnian) Tecovas Formation near Kalgary, Crosby County, Texas: Texas Journal of Science, v. 43, p. 191–197 (K.K. Kietzke and S.G. Lucas).

Stratigraphy, sedimentology, and paleontology of the lower Eocene San Jose Formation in the central portion of the San Juan Basin, northwestern New Mexico: New Mexico Bureau of Mines and Mineral Resources, Bulletin 126, 44 pp. (L.N. Smith and S.G. Lucas).

The *Paleorhinus* biochron and the correlation of the non-marine Upper Triassic of Pangaea: Palaeontology, v. 34, p. 487–501 (A.P. Hunt and S.G. Lucas).

Riorribasaurus , a new name for a Late Triassic dinosaur from New Mexico (USA). Paläontologische Zeitschrift, v. 65, p. 191–198 (A.P. Hunt and S.G. Lucas).

Paleomagnetism of the Moenkopi and Chinle Formations in central New Mexico: implications for the North American apparent polar wander path and Triassic magnetostratigraphy: Journal of Geophysical Research, v. 96, no. B9, p. 14239–14262 (R.S. Molina-Garza, J.W. Geissman, R.Van der Voo, S.G. Lucas and S.N. Hayden).

Dinosaurs and Mesozoic biochronology: Modern Geology, v. 16, p. 127–138.

Late Cretaceous(?) plesiosaurs from Cajon Pass, California: San Bernardino County Museum Association Quarterly, v. 38, p. 52–53 (S.G. Lucas and R.E. Reynolds).

Sequence stratigraphic correlation of nonmarine and marine Late Triassic biochronologies, western United States: Albertiana, no. 9, p. 11–18.

The Cretaceous elasmobranch *Ptychodus decurrens* Agassiz from North America. Geobios, no. 24, p. 595–599 (T.E. Williamson, S.G. Lucas and J.I. Kirkland).

A new rhynchosaur from the Upper Triassic of West Texas, and the biochronology of Late Triassic rhynchosaurs: Palaeontology, v. 34, p. 927–938 (A.P. Hunt and S.G. Lucas).

Early Eocene *Pelycodus danielsae* : largest adapid in the oldest lemuriform adaptive radiation: Folia Primatologica, v. 57, p. 115–120 (J.W. Froehlich and S.G. Lucas)

A new aetosaur from the Redonda Formation (Late Triassic: Middle Norian) of east-central New Mexico, USA: Neues Jahrbuch für Geologie und Paläontologie Monatshafte, v. 1991, p. 728–736 (A. P. Hunt and S. G. Lucas).

El hallazgo mas austral de un *Mammut americanum* : el caso del mastodonte de San Pedro Sula, Honduras: Revista Geologica de America Central, v. 13, p. 85–89 (S.G. Lucas and G.E. Alvarado).

Comentario sobre la clasificacion del Mastodonte de Bama Honda (= Rio Nacaome), Guanacaste, Costa Rica: Revista Geologica de America Central, v. 13, p. 97–98 (S.G. Lucas and G.E. Alvarado).

1992

Ichthyoliths from the Devonian-Carboniferous boundary in the Sacramento Mountains, south-central New Mexico, USA: Ichthyolith Issues, no. 8, p. 16–21 (K.K. Kietzke and S.G. Lucas).

Eocene mammal from the Bobcat Hill conglomerate, Peloncillo Mountains, southwestern New Mexico: New Mexico Geology, v. 14, p. 9–12.

Late Triassic, not Liassic, originations: Modern Geology , v. 16, p. 389–391 (S.G. Lucas and A.P. Hunt).

Case 2807 *Dinodontosaurus* Romer, 1943 (Reptilia, Synapsida): proposed conservation: Bulletin of Zoological Nomenclature, v. 49, p. 52–54.

The oldest dinosaurs. Naturwissenschaften, v. 79, p. 171–172 (S.G. Lucas, A.P. Hunt and R.A. Long).

Meniscotherium (Mammalia, "Condylarthra") from the Paleocene-Eocene of western North America: Bulletin of the New Mexico Museum of Natural History and Science, no. 1, 75 pp. (T.E. Williamson and S.G. Lucas).

The first occurrence of the aetosaur *Paratypothorax andressi* (Reptilia, Aetosauria) in the western United States and its biochronological significance. Paläontologische Zeitschrift, v. 66, p. 147–157 (A.P. Hunt and S.G. Lucas).

A nonmarine standard for part of Late Triassic time. Park Science [National Park Service U.S. Department of the Interior], v. 12, no. 3, p. 18–19.

Paleopathology of a mastodont molar. Texas Journal of Science, v. 44, p. 357–359.

A Middle Triassic paleomagnetic pole for North America: Geological Society of America Bulletin, v. 104, p. 993–998 (M.B. Steiner and S.G. Lucas).

The Middle Jurassic Summerville Formation, northern New Mexico: New Mexico Geology, v. 14, p. 79-92 (O. J. Anderson and S. G. Lucas).

Nonmarine standards for Triassic time: Albertiana, no. 10, p. 35-41.

Extinction and the definition of the Class Mammalia: Systematic Biology, v. 41, p. 370-371.

1993

A new taeniodont from the Paleocene of the San Juan Basin, New Mexico: Journal of Mammalogy, v. 74, p. 175-179 (S. G. Lucas and T. E. Williamson).

Barysoma lenzii (Synapsida: Dicynodontia) from the Middle Triassic of Brazil, a synonym of *Stahleckeria potens* : Journal of Paleontology, v. 67, p. 318-321.

Fukangolepis Yang, 1978 from the Triassic of China is not an aetosaur: Journal of Vertebrate Paleontology, v. 13, p. 145-147 (S. G. Lucas and A. P. Hunt).

A review of Triassic labyrinthodont amphibians from China: Geobios, v. 26, p. 121-128. (S. G. Lucas and A. P. Hunt).

Putative Paleocene plesiosaurs from Cajon Pass, California, U. S. A.: Cretaceous Research, v. 14, p. 107-111 (S. G. Lucas and R. E. Reynolds).

Selachians from the Greenhorn cyclothem ("Middle" Cretaceous: Cenomanian-Turonian), Black Mesa, Arizona, and the paleogeographic distribution of Late Cretaceous selachians: Journal of Paleontology, v. 67, p. 447-474 (T. E. Williamson, J. I. Kirkland and S. G. Lucas).

Plio-Pleistocene stratigraphy, paleoecology, and mammalian biochronology, Tijeras Arroyo, Albuquerque area, New Mexico: New Mexico Geology, v. 15, p. 1-8 (S. G. Lucas, T. E. Williamson and J. Sobus).

Laramide stratigraphy of the Little Hatchet Mountains, southwestern New Mexico: New Mexico Geology, v. 15, p. 9-15 (T. F. Lawton, G. T. Basabilvazo, S. A. Hodgson, D. A. Wilson, G. H. Mack, W. C. McIntosh, S. G. Lucas and K. K. Kietzke).

The *Shansiodon* biochron, Middle Triassic of Pangaea: Albertiana, no. 11, p. 40-42.

A Pleistocene horse from Connecticut: The Mosasaur, v. 5, p. 43-46.

Freshwater selachians from the early Palaeocene of the San Juan Basin, north-western New Mexico, USA: Tertiary Research, v. 14, p. 97-105.

Comments on a proposed neotype for *Coelophysis bauri* (Cope, 1887) (Reptilia, Saurischia): Bulletin of Zoological Nomenclature, v. 50, p. 147-150 (A. P. Hunt and S. G. Lucas).

Magnetostratigraphy and paleomagnetic poles from Late Triassic-earliest Jurassic strata of the Newark basin: discussion: Geological Society of America Bulletin, v. 103, p. 1648-1662 (S. G. Lucas, M. B. Steiner, P. Huber and A. P. Hunt).

Adelobasileus from the Upper Triassic of West Texas: the oldest mammal: Journal of Vertebrate Paleontology, v. 13, p. 309-334. (S. G. Lucas and Z. Luo)

Vertebrate biochronology of the Jurassic-Cretaceous boundary, North American Western Interior: Modern Geology, v. 18, p. 371-390.

Calcareous microfossils from the Upper Triassic of Petrified Forest National Park, Arizona: Journal of the Arizona-Nevada Academy of Science, v. 27, p. 55-68 (S. G. Lucas and K. K. Kietzke).

Taxonomy and stratigraphic distribution of Late Triassic metoposaurid amphibians from Petrified Forest National Park, Arizona: Journal of the Arizona-Nevada Academy of Science, v. 27, p. 89-96 (A. P. Hunt and S. G. Lucas).

Revised age and correlation of the Upper Triassic Chatham Group (Deep River Basin, Newark Supergroup), North Carolina: Southeastern Geology, v. 33, p. 171-193 (P. Huber, S. G. Lucas and A. P. Hunt).

The Middle Jurassic Summerville Formation, northern New Mexico - a rebuttal of Condon, 1993: New Mexico Geology, v. 15, p. 66-70 (S. G. Lucas and O. J. Anderson).

1994

Marine Upper Triassic strata at Sierra la Flojera, Sonora, Mexico: Neues Jahrbuch fur Geologie und Palaontologie Monatshafte, v. 1994, p. 34-40 (S. G. Lucas and C. Gonzalez-Leon).

Toward a nonmarine Triassic timescale: Albertiana, no. 13, p. 43-49.

The Camp Springs Member, base of the Late Triassic Dockum Formation in West Texas: West Texas Geological Society Bulletin, v. 34, no. 2, p. 1-15 (S. G. Lucas and O. J. Anderson).

Recently published numerical ages from the nonmarine Upper Triassic: Albertiana, no. 14, p. 66-69.

Pliocene microfossils from the Monticello Point maar, Sierra County, New Mexico: New Mexico Geology, v. 16, p. 41-48 (S. G. Lucas and K. K. Kietzke).

1995

A fossil specimen of the long-nosed snake *Rhinocheilus* from the Pliocene of southern New Mexico: Texas Journal of Science, v. 47, p. 9-12. (S. G. Lucas, A. P. Heckert and P. L. Sealey)

Ostracoda and Gastropoda from the Kayenta Formation (Lower Jurassic) of Arizona, U.S.A.: Journal of the Arizona-Nevada academy of Science, v. 28, p. 23-32 (K. K. Kietzke and S. G. Lucas).

Late Cretaceous pliosaurs (Euryapsida: Plesiosauroidea) from the Black Mesa Basin, Arizona, U.S.A.: Journal of the Arizona-Nevada Academy of Science, v. 28, p. 41-45.

Evolutionary origins of the mammalian promontorium and cochlea: Journal of Vertebrate Paleontology, v. 15, p. 113-121 (Z. Luo, A. W. Crompton and S. G. Lucas).

Dockum (Upper Triassic) stratigraphy and nomenclature: West Texas Geological Society Bulletin, v. 34, no. 7, p. 5-11. (S. G. Lucas and O. J. Anderson)

The Thornton Beach mammoth and the antiquity of *Mammuthus* in North America: Quaternary Research, v. 43, p. 263-264.

Systematic position and biochronological significance of *Yuodon* and *Palasiodon,* supposed Paleocene "condylarths" from China: Neues Jahrbuch fur Geologie und Palaontologie Abhandlungen, v. 196, p. 93-107. (S. G. Lucas and T. E. Williamson)

Biochronological significance of aetosaurs and phytosaurs (Reptilia, Archosauromorpha) in the Triassic Zarzaitine Series of Algeria: Neues Jahrbuch fur Geologie und Palaontologie Monatshefte, v. 1995, p. 73-181. (N. Jalil, S. G. Lucas and A. P. Hunt)

A Middle Triassic dicynodont from Germany and the biochronology of Triassic dicynodonts: Stuttgarter Beitrage zur Naturkunde, v. 220, p. 1-16. [S. G. Lucas and R. Wild]

Biochronology of Triassic marine reptiles: Albertiana, no. 15, p. 92-97.

Triassic stratigraphy and chronology in New Mexico: New Mexico Geology, v. 17, p. 8-13, 17.

Early Oligocene entelodont from the Zaysan basin, east Kazakhstan: Selevinia, v. 2., no. 3, p. 3-6 (R. J. Emry, S. G. Lucas and B. U. Bayshashov).

El proboscideao *Rhynchotherium blicki* (Mioceno Tardio) del oriente de Guatemala: Revista Geologica de America Central, v. 18, p. 19-24 (S. G. Lucas and G. E. Alvarado).

1996

A new herpetotheriine didelphid (Marsupialia) from the Oligocene of Central Asia: Journal of Vertebrate Paleontology, v. 15, p. 850-854 (R. J. Emry, S. G. Lucas, F. S. Szalay and P. A. Tleuberdina).

Dunkleosteus: Devonian denizen of the deep: Natural History Notes of the State Museum of Pennsylvania, no. 1, 12 pp (K. A. Randall, R. M. Sullivan and S. G. Lucas].

The postcranial morphology of Paleocene *Chriacus* and *Mixodectes* and the phylogenetic relationships of archontan mammals: New Mexico Museum of Natural History and Science, Bulletin 7, 47 pp. (F. S. Szalay and S. G. Lucas).

The type locality of *Coelophysis*, a Late Triassic dinosaur from north-central New Mexico (USA): Palaontologische Zeitschrift, v. 70, p. 245-255 (R. M. Sullivan, S. G. Lucas, A. Heckert and A. P. Hunt).

A new conodont from the uppermost Lamar Limestone of the Delaware basin of West Texas: Texas Journal of Science, v. 48, p. 95-106 (H. Kozur and S. G. Lucas).

Late Triassic aetosaur biochronology: Albertiana, no. 17, p. 57-64 (S. G. Lucas and A. B. Heckert).

Paleomagnetism and magnetostratigraphy of Triassic strata in the Sange de Cristo Mountains and Tucumcari basin, New Mexico, USA: Geophysical Journal International, v. 124, p. 935-953 (R. S. Molina-Garza, J. W. Geissman, S. G. Lucas and R. Van der Voo).

Tetrapod biochronology supports three-epoch Permian: Permophiles, no. 28, p. 39-44.

Biochronological significance of Amynodontidae (Mammalia, Perissodactyla) from the Paleogene of Kazakhstan: Journal of Paleontology, v. 70, p. 691-696 (S. G. Lucas and R. J. Emry).

The Thornton Beach mammoth: consistency of numerical age and morphology: Quaternary Research, v. 45, p. 332-333.

Marine fossil shark (Chondrichthyes) from nonmarine Eocene sediments, northeastern Kazakhstan: Proceedings of the Biological Society of Washington, v. 109, p. 349-352 (S. G. Lucas, R. J. Emry & R. W. Purdy).

Early record of indricothere (Mammalia: Perissodactyla: Hyracodontidae) from the Aral Sea region of western Kazakhstan: Proceedings of the Biological Society of Washington, v. 109, p. 391-396 (S. G. Lucas & R. J. Emry).

Late Eocene entelodonts (Mammalia: Artiodactyla) from Inner Mongolia, China: Proceedings of the Biological Society of Washington, v. 109, p. 397-405 (S. G. Lucas & R. J. Emry).

Pleistocene vertebrates from the Pecos River valley near Roswell, Chaves County, New Mexico: New Mexico Geology, v. 18, p. 93-96 (S. G. Lucas and G. S. Morgan).

The giant rhinoceros *Paraceratherium* from the late Oligocene at Aktau Mountain, southeastern Kazakhstan, and its biochronological significance: Neues Jahrbuch für Geologie und Paläontologie Monatshefte, v. 1996, p. 539-548 (S. G. Lucas and B. U. Bayshashov).

Megalesthonyx hopsoni (Mammalia: Tillodontia) from the early Bridgerian (Gardnerbuttean) of the Wind River Formation, northeastern Wind River basin, Wyoming: Proceedings of the Denver Museum of Natural History, series 3, no. 13, p. 1-3 (T. E. Williamson, S. G. Lucas and R. K. Stucky).

The Pliocene proboscidean *Rhynchotherium* (Mammalia: Gomphotheriidae) from south-central New Mexico: Texas Journal of Science, v. 48, p. 311-318. (S. G. Lucas and G. S. Morgan)

A new amphibamid (Amphibia: Temnospondyli) from the Late Pennsylvanian (Middle Stephanian) of central New Mexico, USA: Paläontologische Zeitschrift, v. 70, p. 555-565 (A. P. Hunt, S. G. Lucas and D. S. Berman).

Taxonomic and biochronological significance of specimens of the Triassic dicynodont *Dinodontosaurus* Romer, 1943 in the Tübingen collection: Paläontologische Zeitschrift, v. 70, p. 603-622 (S. G. Lucas and S. K. Harris).

Redescription of *Redondasuchus reseri*, a Late Triassic aetosaur (Reptilia: Archosauria) from New Mexico (U.S.A.), and the biochronology and phylogeny of aetosaurs: Geobios, v. 29, p. 619-632 (A. B. Heckert, A. P. Hunt and S. G. Lucas).

Palaeoscincosaurus middletoni, new genus and species (Squamata:?Scincidae) from the early Paleocene (Puercan) Denver Formation, Colorado: Journal of Vertebrate Paleontology, v. 16, p. 666-672 (R. M. Sullivan and S. G. Lucas).

Reconsideration of Dalongkou as an auxiliary GSSP for the Permian-Triassic boundary: Albertiana, no. 18, p. 10-11 (S. G. Lucas, H. Kozur, R. Molina-Garza and J. Geissman).

Edestus (Chondrichthyes, Elasmobranchii) from the Upper Carboniferous of Xinjiang, China: Neues Jahrbuch für Geologie und Paläontologie Monatshefte, v. 1996, p. 701-707 (Z. Cheng, S. G. Lucas and J. Zidek).

Dinosaurios del Cretácico Tardío del Grupo Cabullona, Sonora: Geología del Noroeste, v. 1, p. 20-25 (S. G. Lucas and C. González-León).

Zaisanamynodon, a late Eocene amynodontid (Mammalia, Perissodactyla) from Kazakhstan and China: Tertiary Research, v. 17, p. 51-58 (S. G. Lucas, R. J. Emry and B. U. Bayshashov)

The Arizpe mammoth, Pleistocene of Sonora, Mexico--taxonomic re-evaluation: Revista Mexicana de Cinecias Geológicas, v. 13, p. 90-93 (S. G. Lucas and C. M. González-León).

Early Pleistocene (Irvingtonian) plants from the Albuquerque area, New Mexico: The Southwestern Naturalist, v. 41, p. 207-217 (P. J. Knight, S. G. Lucas and A. Cully).

Vertebrate biochronology of the Mesozoic of China: Memoirs of Beijing Museum of Natural History, v. 55, p. 109-148.

Eocene $^{40}Ar/^{39}$Arage data of supposed Cretaceous volcanics (rhyolite tuff formation) in northeastern Sonora, Mexico: Revista Mexicana de Ciencias Geologicas, v. 13, p. 184-187 (S. G. Lucas, W. C. McIntosh and C. Gonzalez-Leon).

1997

Radiocarbon-dated *Bison* from Taos County, northern New Mexico: The Texas Journal of Science, v. 49, p. 78-79 (S. G. Lucas, M. O'Neill and G. S. Morgan).

Stratigraphy and biochronological significance of the Late Triassic *Placerias* quarry, eastern Arizona (U.S.A.): Neues Jahrbuch für Geologie und Paläontologie Abhandlungen, v. 203, p. 23-46 (S. G. Lucas, A. B. Heckert and A. P. Hunt).

A Late Eocene eomyid rodent from the Zaysan basin of Kazakhstan: Journal of Vertebrate Paleontology, v. 17, p. 229-234 (R. J. Emry, B. Wang, L. A. Tjutkova and S. G. Lucas).

Eocene Perissodactyla from the Shinzhaly River, eastern Kazakhstan: Journal of Vertebrate Paleontology, v. 17, p. 235-246 (S. G. Lucas, R. J. Emry and B. U. Bayshashov).

Catopsalis (Mammalia: Multituberculata) from the Paleocene of New Mexico and Utah: Taxonomy and biochronological significance: Journal of Paleontology, v. 71, p. 484-493 (S. G. Lucas, T. E. Williamson and M. D. Middleton).

Ochoa as a lithostratigraphic unit, not a chronostratigraphic unit of the Permian: West Texas Geological Society Bulletin, v. 36, no. 9, p. 5-10. (S. G. Lucas and O. J. Anderson)

Triassic stratigraphy and paleontology on the Fort Wingate quadrangle, west-central New Mexico: New Mexico Geology, v. 19, p. 33-42 (S. G. Lucas, A. B. Heckert and O. J. Anderson).

The *Aetosaurus* biochron, early-middle Norian of Pangea: Albertiana, no. 19, p. 41-47 (S. G. Lucas, A. B. Heckert and P. Huber).

A new genus of rhinocerotoid from the Eocene of Utah and the status of North American "*Forstercooperia*": Journal of Vertebrate Paleontology, v. 17, p. 384-396 (L. T. Holbrook and S. G. Lucas)

The Pleistocene mammals of Costa Rica: Journal of Vertebrate Paleontology, v. 17, p. 413-427 (S. G. Lucas, G. E. Alvarado and E. Vega).

Type locality of *Liodon dyspelor* Cope (Reptilia: Mosasauridae): Proceedings of the Academy of Natural Sciences of Philadelphia, v. 147, p. 193-203 (D. C. Parris, B. S. Grandstaff, R. K. Denton, Jr. and S. G. Lucas).

Giant entelodont (Mammalia, Artiodactyla) from the early Miocene of southern California: Natural History Museum of Los Angeles County, Contributions in Science, no. 466, 9 pp. (S. G. Lucas, D. P. Whistler and H. M. Wagner)

Fossils provide a Pennsylvania standard for part of Late Triassic time: Pennsylvania Geology, v. 27, no. 4, pp. 8-14. (S. G. Lucas and R. M. Sullivan)

Mesozoic stratigraphic constraints on Laramide right slip on the east end of the Colorado Plateau: Geology, v. 25, p. 843-846 (L. A. Woodward, O. J. Anderson and S. G. Lucas).

Rhynchotherium (Mammalia, Proboscidea) de San José de Pimnas, Sonora: Geología del Noroeste, v. 2, no. 1, p. 7-8 (S. G. Lucas, G. S. Morgan and C. González-León).

Cuvieronius (Mammalia, Proboscidea) de Oquitoa, Sonora: Geología del Noroeste, v. 2, no. 1, p. 12-13 (S. G. Lucas and C. González-León).

The American mastodont (*Mammut americanum*) in New Mexico: The Southwestern Naturalist, v. 42, p. 312-317 (S. G. Lucas and G. S. Morgan).

Early Triassic ammonites and conodonts from Sonora, northwestern Mexico: Neues Jahrbuch für Geologie und Paläontologie Monatshefte, v. 1997, p. 562-574 (S. G. Lucas, J. W. Estep, C. M. González-León, R. K. Paull, N. J. Silberling, M. B. Steiner and J. E. Marzolf).

Proboscidea (Mammalia) from the early Miocene of Kazakhstan. Neues Jahrbuch für Geologie und Paläontologie Monatshefte, 1997: 659-673 (S. G. Lucas and O. G. Bendukidze).

Mammalian biochronology of the Paleogene-Neogene boundary of the Paleogene-Neogene boundary at Aktau Mountain, eastern Kazakhstan: Palaontologische Zeitschrift, v. 71, p. 305-314 (S. G. Lucas, B. U. Bayshasho, L. A. Tyutkova, A. K. Zhamangara and B. Z. Aubekerov)

First use of ornithischian dinosaurs for biostratigraphic zonation of the Upper Triassic: Albertiana, no. 20, p. 58-63 (A. B. Heckert and S. G. Lucas).

Permian-Triassic boundary at El Antimonio, Sonora, Mexico: Revista Mexicana de Ciencias Geológicas, v. 14, p. 149-154 (S. G. Lucas, B. S. Kues, J. W. Estep and C. M. González-León).

Middle Triassic ammonites from Sonora, Mexico: Revista Mexicana de Ciencias Geológicas, v. 14, p. 155-159 (J. W. Estep, S. G. Lucas and C. M. González-León).

1998

Biostratigraphical distribution and biochronological significance of European Paleogene *Coryphodon* (Mammalia, Pantodonta): Strata [Actes du Laboratoire de Geologie Sedimentaire et Paleontologie de l'Universte Paul-Sabatier Toulouse] 9: 83-86 (S. G. Lucas and J. J. Hooker).

Presencia de un ejemplar de *Camelops* del Pleistoceno tardío en el desierto de Sonora: Geologia del Noroeste, v. 2, no. 2, p. 29-30 (S. G. Lucas and B. Ortega Guerrero)

A reassessment of the taxonomic affinities of the enigmatic tetrapod *Anisodontosaurus greeri* Welles 1947 from the Middle Triassic of western North America: Neues Jahrbuch für Geologie und Paläontologie Monatshefte, v. 1998, p. 212-222 (A. P. Hunt, S. G. Lucas and P. S. Spencer).

The aetosaur *Longosuchus* from the Triassic of Morocco and its biochronological significance: Compte Rendus de l'Académie des Science Paris, v. 326, p. 589-594.

The late Albian ammonite *Engonoceras* from southwest New Mexico: New Mexico Geology, v. 20, p. 78-82 (S. G. Lucas and J. W. Estep).

Placerias (Reptilia, Dicynodontia) from the Upper Triassic of the Newark Supergroup, North Carolina, USA, and its biochronological significance: Neues Jahrbuch für Geologie und Paläontologie Monatshefte 1998, p. 432-448.

Permian tetrapod biochronology: Permophiles, no. 32, p. 17-23.

Redefinition of Morrison Formation (Upper Jurassic) and related San Rafael Group strata, southwestern U. S.: Modern Geology, v. 22, p. 39-69 (O. J. Anderson and S. G. Lucas).

Preliminary report on Conchostraca from the Upper Jurassic Morrison Formation, western United States: Modern Geology, v. 22, p. 415-422 (S. G. Lucas and J. I. Kirkland).

Dyoplax O. Fraas, a Triassic sphenosuchian from Germany: Stuttgarter Beiträge zur Naturkunde B, no. 263, 13 pp. (S. G. Lucas, R. Wild and A. P. Hunt).

Eocene charophytes from the Shinzhaly River, eastern Kazakhstan: Tertiary Research, v. 18, p. 85-93 (A. K. Zhamangara and S. G. Lucas).

Taxonomy and distribution of *Daeodon*, an Oligocene-Miocene entelodont (Mammalia: Artiodactyla) from North America: Proceedings of the Biological Society of Washington, v. 111, p. 425-435 (S. G. Lucas, R. J. Emry and S. E. Foss).

Franconictis (Mammalia: Carnivora) from the late Oligocene of eastern Kazakstan: Proceedings of the Biological Society of Washington, v. 111, p. 504-510 (S. G. Lucas, R. J. Emry and P. A. Tleuberdina).

Taxonomy and stratigraphic and facies significance of vertebrate coprolites of the Upper Triassic Chinle Group, western United States: Ichnos, v. 5, pp. 225-234 (A. P. Hunt, S. G. Lucas and M. G. Lockley).

Late Triassic dinosaurs from the western United States: Geobios, v. 31, p. 511-531 (A. P. Hunt, S. G. Lucas, A. B. Heckert and R. M. Sullivan).

Global Triassic tetrapod biostratigraphy and biochronology: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 143, p. 347-384.

First occurrence of *Aetosaurus* (Reptilia: Archosauria) in the Upper Triassic Chinle Group (USA) and its biochronological significance. Neues Jahrbuch für Geologie und Paläontologie Monatshefte, v. 1998, p. 604-612 (A. B. Heckert and S. G. Lucas).

Jurassic stratigraphy and correlation in New Mexico: New Mexico Geology, v. 20, p. 97-104 (S. G. Lucas and O. J. Anderson).

Dinosaur skin impressions and associated skeletal remains from the upper Campanian of southwestern New Mexico: New data on the integument morphology of hadrosaurs: Journal of Vertebrate Paleontology, v. 18, p. 739-745 (B. G. Anderson, S. G. Lucas, R. E. Barrick, A. B. Heckert and G. T. Basabilvazo).

Aetosaurus (Archosauromorpha) from the Upper Triassic of the Newark Supergroup, eastern United States, and its biochronological significance: Palaeontology, v. 41, p. 1215-1230 (S. G. Lucas, A. B. Heckert and P. Huber).

1999

A new aetosaur (Reptilia: Archosauria) from the Upper Triassic of Texas and the phylogeny of aetosaurs: Journal of Vertebrate Paleontology, v. 19, p. 50-68 (A. B. Heckert and S. G. Lucas).

Eucoelophysis baldwini, a new theropod dinosaur from the Upper Triassic of New Mexico, and the status of the original types of *Coelophysis*: Journal of Vertebrate Paleontology, v. 19, p. 81-90 (R. M. Sullivan and S. G. Lucas).

Taxonomy and biochronological significance of *Paraentelodon*, a giant entelodont (Mammalia, Artiodactyla) from the late Oligocene of Eurasia: Journal of Vertebrate Paleontology, v. 19, p. 160-168 (S. G. Lucas and R. J. Emry).

A tetrapod-based Triassic timescale: Albertiana, no. 22, p. 31-40.

ARTICLES IN EDITED BOOKS

1977

Vertebrate paleontology of the San Jose Formation, east-central San Juan Basin, New Mexico; in Fassett, J.E. and James, H.L., eds., Guidebook of San Juan Basin III Northwestern New Mexico [New Mexico Geological Society, Guidebook, 28th Field Conference]: Socorro, New Mexico Geological Society, p. 221–225.

Fossil mammals from the Ojo Alamo Sandstone; in Fassett, J.E. and James, H.L., eds., Guidebook of San Juan Basin III Northwestern New Mexico [New Mexico Geological Society, Guidebook, 28th Field Conference] Supplement: Socorro, New Mexico Geological Society, p. 55–56 (J.K. Rigby, Jr. and S.G. Lucas).

1979

Vertebrate biostratigraphy of the Eocene Galisteo Formation, north-central New Mexico; in Ingersoll, R.V., Woodward, L.A. and James, H.L., eds., Guidebook of Santa Fe Country [New Mexico Geological Society, Guidebook, 30th Field Conference]: Socorro, New Mexico Geological Society, p. 225–229 (S.G. Lucas and B.S. Kues).

Summary of the paleontology of the Santa Fe Group (Mio-Pliocene), north-central New Mexico; in Ingersoll, R.V., Woodward, L.A. and James, H.L. eds., Guidebook of Santa Fe Country [New Mexico Geological Society, Guidebook, 30th Field Conference]: Socorro, New Mexico Geological Society, p. 237–241 (B.S. Kues and S.G. Lucas).

1981

Dinosaur communities of the San Juan Basin: a case for lateral variations in the composition of Late Cretaceous dinosaur communities; in Lucas, S.G., Rigby, J.K. Jr., and Kues, B.S., eds., Advances in San Juan Basin Paleontology: Albuquerque, University of New Mexico Press, p. 337–393.

1982

The phylogeny and composition of the order Pantodonta (Mammalia, Eutheria). Third North American Paleontological Convention Proceedings, v. 2, p. 337–342.

A review of Chinese uintatheres and the origin of the Dinocerata. Third North American Paleontological Convention Proceedings, v. 2, p. 551–556 (Y. Tong and S.G. Lucas).

Lexicon of Phanerozoic stratigraphic units used in the Albuquerque area; in Grambling, J.A., Wells, S.G. and Callender, J.F., eds., Albuquerque Country II [New Mexico Geological Society, Guidebook, 33rd Field Conference]: Socorro, New Mexico Geological Society, p. 125–138 (B.S. Kues, S.G. Lucas and R.V. Ingersoll).

1983

The Baca Formation and the Eocene-Oligocene boundary in New Mexico; in Chapin, C.E. and Callender, J.F., eds., Socorro Region II [New Mexico Geological Society, Guidebook, 34th Field Conference]: Socorro, New Mexico Geological Society, p. 187–192.

1984

Correlation of Eocene rocks of the northern Rio Grande rift and adjacent areas: implications for Laramide tectonics; in Baldridge, W.S., Dickerson, P.W., Riecker, R.E. and Zidek, J., eds., Rio Grande rift: northern New Mexico [New Mexico Geological Society, Guidebook, 35th Field Conference]: Socorro, New Mexico Geological Society, p. 123–128.

1985

Paleogene stratigraphy, sedimentation and volcanism of New Mexico; in, Flores, R.M. and Kaplan, S.S., eds., Cenozoic paleogeography of the west-central United States: Denver, Rocky Mountain Section, SEPM, p. 293–315 (L.N. Smith, S.G. Lucas and W.E. Elston).

Neocalamites forest in the Upper Triassic of Bull Canyon, New Mexico; in Lucas, S.G. and Zidek, J., eds., Santa Rosa — Tucumcari region [New Mexico Geological Society, Guidebook, 36th Field Conference]: Socorro, New Mexico Geological Society, p. 8–12 (S.G. Lucas, A.P. Hunt and K.K. Kietzke).

Middle Triassic amphibian from basal Santa Rosa Formation, east-central New Mexico; in Lucas, S.G. and Zidek, J., eds., Santa Rosa — Tucumcari region [New Mexico Geological Society, Guidebook, 36th Field Conference]: Socorro, New Mexico Geological Society, p. 56–58 (S.G. Lucas and M. Morales).

Stratigraphic nomenclature and correlation of Triassic rocks of east-central New Mexico: a preliminary report; in Lucas, S.G. and Zidek, J., eds., Santa Rosa — Tucumcari region [New Mexico Geological Society, Guidebook, 36th Field Conference]: Socorro, New Mexico Geological Society, p. 171–184 (S.G. Lucas, A.P. Hunt and M. Morales).

Triassic vertebrates from east-central New Mexico in the Yale Peabody Museum; in Lucas, S.G. and Zidek, J., eds., Santa Rosa — Tucumcari region [New Mexico Geological Society, Guidebook, 36th Field Conference]: Socorro, New Mexico Geological Society, p. 199–203 (S.G. Lucas, A.P. Hunt and S.C. Bennet).

Triassic microvertebrate locality, Chinle Formation, east-central New Mexico; in Lucas, S.G. and Zidek, J., eds., Santa Rosa — Tucumcari region [New Mexico Geological Society, Guidebook, 36th Field Conference]: Socorro, New Mexico Geological Society, p. 205–212 (S.G. Lucas, W. Oakes and J.W. Froehlich).

The Jurassic System in east-central New Mexico; in Lucas, S.G. and Zidek, J., eds., Santa Rosa — Tucumcari region [New Mexico Geological Society, Guidebook, 36th Field Conference]: Socorro, New Mexico Geological Society, p. 213–242 (S.G. Lucas, K.K. Kietzke and A.P. Hunt).

Synopsis of Tucumcari Shale, Mesa Rica Sandstone and Pajarito Shale paleontology, Cretaceous of east-central New Mexico; in Lucas, S.G. and Zidek, J., eds., Santa Rosa — Tucumcari region [New Mexico Geological Society, Guidebook, 36th Field

Conference]: Socorro, New Mexico Geological Society, p. 261–281 (B.S. Kues, S.G. Lucas, K.K. Kietzke and N.J. Mateer).

Stratigraphic nomenclature and correlation chart for east-central New Mexico; in Lucas, S.G. and Zidek, J., eds., Santa Rosa — Tucumcari region [New Mexico Geological Society, Guidebook, 36th Field Conference]: Socorro, New Mexico Geological Society, p. 341–344 (S.G. Lucas and B.S. Kues).

Swedish vertebrate palaeontology in China: a history of the Lagrelius Collection; in Lucas, S.G. and Mateer, N.J., eds., Studies of Chinese fossil vertebrates. Bulletin of the Geological Institutions of the University of Uppsala, New Series, v. 11, p. 1–24 (N.J. Mateer and S.G. Lucas).

The phylogeny and classification of the Dinocerata (Mammalia, Eutheria); in Lucas, S.G. and Mateer, N.J., eds., Studies of Chinese fossil vertebrates. Bulletin of the Geological Institutions of the University of Uppsala, New Series, v. 11, p. 31–58 (R.M. Schoch and S.G. Lucas).

The Mesozoic reptiles of China; in Lucas, S.G. and Mateer, N.J., eds., Studies of Chinese fossil vertebrates. Bulletin of the Geological Institutions of the University of Uppsala, New Series, v. 11, p. 133–150 (S. Zhen, B. Zhen, N.J. Mateer and S.G. Lucas).

1986

New Mexico's geological panorama; in Hsi, D. and Panitz, J., eds., From sundaggers to space exploration — significant scientific contributions to science and technology in New Mexico: Albuquerque, New Mexico Academy of Science [New Mexico Journal of Science, v. 26], p. 209–260 (B.S. Kues, C.T. Smith, R.M. North, S.G. Lucas, S.A. Northrop, C.L. Balk and R.W. Eveleth).

Stratigraphy and petroleum potential of the Jurassic Todilto Formation in northeastern New Mexico; in Ahlen, J.L., Hanson, M.E. and Zidek, J., eds., Southwest section of AAPG transactions and guidebook of 1986 convention Ruidoso, New Mexico: Socorro, New Mexico Bureau of Mines and Mineral Resources, p. 121–127 (S.G. Lucas and K.K. Kietzke).

Pliocene (Blancan) vertebrates from the Palomas Formation, south-central New Mexico; in Clemons, R.E., King, W.E., Mack, G.H. and Zidek, J., eds., Truth or Consequences Region [New Mexico Geological Society, Guidebook, 37th Field Conference]: Socorro, New Mexico Geological Society, p. 249–255 (S.G. Lucas and W. Oakes).

Oligocene mammals from the Black Range, southwestern New Mexico; in Clemons, R.E., King, W.E., Mack, G.H. and Zidek, J., eds., Truth or Consequences Region [New Mexico Geological Society, Guidebook, 37th Field Conference]: Socorro, New Mexico Geological Society, p. 261–263.

1987

Dinosaurs, pollen and spores, and the age of the Ojo Alamo Sandstone, San Juan Basin, New Mexico; in Fassett, J.E. and Rigby, J.K., Jr., eds., The Cretaceous-Tertiary boundary in the San Juan and Raton basins, New Mexico and Colorado: Geological Society of America, Special Paper 209, p. 17–34 (J.E. Fassett, S.G. Lucas and F.M. O'Neill).

Dinosaurs, the age of the Fruitland and Kirtland Formations and the Cretaceous-Tertiary boundary in the San Juan Basin, New Mexico; in Fassett, J.E. and Rigby, J.K., Jr., eds., The Cretaceous-Tertiary boundary in the San Juan and Raton basins, New Mexico and Colorado: Geological Society of America, Special Paper 209, p. 35–50 (S.G. Lucas, N.J. Mateer, A.P. Hunt and F.M. O'Neill).

Upper Cretaceous-Paleocene sequence, northwestern New Mexico: in Beus, S.S., ed., Rocky Mountain Section of the Geological Society of America, Centennial Field Guide, Volume 2: Boulder, Geological Society of America, p. 417–420 (B.S. Kues and S.G. Lucas).

Black Mesa mining district; in Lucas, S.G. and Hunt, A.P., eds., Northeastern New Mexico [New Mexico Geological Society, Guidebook, 38th Field Conference]: Socorro, New Mexico Geological Society, p. 14–15.

Type section of Exeter Member of Entrada Sandstone, Jurassic of northeastern New Mexico; in Lucas, S.G. and Hunt, A.P., eds., Northeastern New Mexico [New Mexico Geological Society, Guidebook, 38th Field Conference]: Socorro, New Mexico Geological Society, p. 17–18 (S.G. Lucas, A.P. Hunt and S.N. Hayden).

Dinosaur footprints from the Cretaceous Pajarito Formation, Harding County, New Mexico; in Lucas, S.G. and Hunt, A.P., eds., Northeastern New Mexico [New Mexico Geological Society, Guidebook, 38th Field Conference]: Socorro, New Mexico Geological Society, p. 31–32 (S.G. Lucas, J. Holbrook, R.M. Sullivan and S.N. Hayden).

The Triassic System in the Dry Cimarron Valley, New Mexico, Colorado and Oklahoma; in Lucas, S.G. and Hunt, A.P., eds., Northeastern New Mexico [New Mexico Geological Society, Guidebook, 38th Field Conference]: Socorro, New Mexico Geological Society, p. 97–117 (S.G. Lucas, A.P. Hunt and S.N. Hayden).

J.W. Stovall and the Mesozoic of the Cimarron Valley, Oklahoma and New Mexico; in Lucas, S.G. and Hunt, A.P., eds., Northeastern New Mexico [New Mexico Geological Society, Guidebook, 38th Field Conference]: Socorro, New Mexico Geological Society, p. 139–151 (A.P. Hunt and S.G. Lucas).

Stromatolites of the Morrison Formation (Upper Jurassic), Union County, New Mexico: a preliminary report; in Lucas, S.G. and Hunt, A.P., eds., Northeastern New Mexico [New Mexico Geological Society, Guidebook, 38th Field Conference]: Socorro, New Mexico Geological Society, p. 153–159 (K.R. Neuhauser, S.G. Lucas, J.S. de Albuquerque, R.J. Louden, S.N. Hayden, K.K. Kietzke, W. Oakes and D. Des Marais).

Cretaceous stratigraphy and paleontology in the Dry Cimarron Valley, New Mexico, Colorado and Oklahoma; in Lucas, S.G. and Hunt, A.P., eds., Northeastern New Mexico [New Mexico Geological Society, Guidebook, 38th Field Conference]: Socorro, New Mexico Geological Society, p. 167–198 (B.S. Kues and S.G. Lucas).

Stratigraphic nomenclature and correlation chart for northeastern New Mexico; in Lucas, S.G. and Hunt, A.P., eds., Northeastern New Mexico [New Mexico Geological Society, Guidebook, 38th Field Conference]: Socorro, New Mexico Geological Society, p. 351–354 (S.G. Lucas, A.P. Hunt and B.S. Kues).

Fossils and formations; in, Bisti photographs by David Scheinbaum: Albuquerque, University of New Mexico Press, p. 1–17.

Stratigraphy of the Anton Chico and Santa Rosa Formations, Triassic of east-central New Mexico; in Morales, M. and Elliott, D.K., eds., Triassic continental deposits of the American Southwest: Journal of the Arizona-Nevada Academy of Science , v. 22(, p. 21–33.

1988

The "Deming dinosaur" was a mammoth; in Mack, G.H., Lawton, T.F. and Lucas, S.G., eds., Cretaceous and Laramide tectonic evolution of southwestern New Mexico [New Mexico Geological Society, Guidebook, 39th Field Conference]: Socorro, New Mexico Geological Society, p. 12–13.

Cretaceous stratigraphy and biostratigraphy, Cooke's Range, Luna County, New Mexico; in Mack, G.H., Lawton, T.F. and Lucas, S.G., eds., Cretaceous and Laramide tectonic evolution of southwestern New Mexico [New Mexico Geological Society, Guidebook, 39th Field Conference]: Socorro, New Mexico Geological Society, p. 143–167 (S.G. Lucas, B.S. Kues, S.N. Hayden, B.D. Allen, K.K. Kietzke, T.E. Williamson, P. Sealey and R. Pence).

1989

Vertebrate biochronology of the Cretaceous-Tertiary boundary, San Juan Basin, New Mexico; in Finch, W.I., Huffman, A.C., Jr. and Fassett, J.E., eds., Coal, uranium, and oil and gas in Mesozoic rocks of the San Juan Basin: anatomy of a giant energy-rich basin. Washington, D.C., American Geophysical Union, p. 47–51.

Dedication to Dr. Joseph T. Gregory; in Lucas, S.G. and Hunt, A.P., eds., Dawn of the age of dinosaurs in the American Southwest. Albuquerque, New Mexico Museum of Natural History, p. 1–10 (A.P. Hunt and S.G. Lucas).

Charles Camp: collecting Late Triassic vertebrates in the American Southwest during the 1920's and 1930's; in Lucas, S.G. and Hunt, A.P., eds., Dawn of the age of dinosaurs in the American Southwest. Albuquerque, New Mexico Museum of Natural History, p. 65–71 (R.A. Long, S.G. Lucas, A.P. Hunt and R.T. McCrea).

Late Triassic vertebrate localities in New Mexico; in Lucas, S.G. and Hunt, A.P., eds., Dawn of the age of dinosaurs in the American Southwest. Albuquerque, New Mexico Museum of Natural History, p. 72–101 (A.P. Hunt and S.G. Lucas).

Revised Triassic stratigraphy in the Tucumcari basin, east-central New Mexico; in Lucas, S.G. and Hunt, A.P., eds., Dawn of the age of dinosaurs in the American Southwest. Albuquerque, New Mexico Museum of Natural History, p. 150–170 (A.P. Hunt and S.G. Lucas).

New genotype designations for the phytosaurs Mystriosuchus and Rutiodon with a discussion of the taxonomic status of Mystriosuchus, Clepsysaurus and Rutiodon; in Lucas, S.G. and Hunt, A.P., eds., Dawn of the age of dinosaurs in the American Southwest. Albuquerque, New Mexico Museum of Natural History, p. 340–348 (A.P. Hunt and S.G. Lucas).

Stratigraphy and age of Cretaceous dinosaur footprints in northeastern New Mexico and northwestern Oklahoma; in Gillette, D.D. and Lockley, M.G., eds., Dinosaur tracks and

traces. Cambridge, Cambridge University Press, p. 217–221 (S.G. Lucas, K.K. Kietzke and A.P. Hunt).

Dinosaur footprints from the Redonda Member of the Chinle Formation (Upper Triassic), east-central New Mexico; in Gillette, D.D. and Lockley, M.G., eds., Dinosaur tracks and traces. Cambridge, Cambridge University Press, p. 277–280 (A.P Hunt, S.G. Lucas and K.K. Kietzke).

The Jurassic section in the Hagan basin, Sandoval County, New Mexico; in Lorenz, J.C. and Lucas, S.G., eds., Energy frontiers in the Rockies. Albuquerque, Albuquerque Geological Society, p. 3–5 (C. Pigman and S.G. Lucas).

Middle Triassic Moenkopi Formation, Nacimiento Mountains, north-central New Mexico; in Lorenz, J.C. and Lucas, S.G., eds., Energy frontiers in the Rockies. Albuquerque, Albuquerque Geological Society, p. 16–17 (S.G. Lucas and S.N. Hayden).

Jurassic-Cretaceous boundary in west-central New Mexico; in Anderson, O.J., Lucas, S.G., Love, D.W. and Cather, S.M., eds., Southeastern Colorado Plateau [New Mexico Geological Society, Guidebook, 40th Field Conference]: Socorro, New Mexico Geological Society, p. 6–7.

Triassic stratigraphy and paleontology, Mesa del Oro, Valencia County, New Mexico; in Anderson, O.J., Lucas, S.G., Love, D.W. and Cather, S.M., eds., Southeastern Colorado Plateau [New Mexico Geological Society, Guidebook, 40th Field Conference]: Socorro, New Mexico Geological Society, p. 8–9 (A.P. Hunt, S.G. Lucas, K. Martini and T. Martini).

Stratigraphy of the Triassic Moenkopi Formation, west-central New Mexico; in Anderson, O.J., Lucas, S.G., Love, D.W. and Cather, S.M., eds., Southeastern Colorado Plateau [New Mexico Geological Society, Guidebook, 40th Field Conference]: Socorro, New Mexico Geological Society, p. 59–60 (S.N. Hayden and S.G. Lucas).

Stratigraphy and paleontology of a San Andres Formation (Permian, Leonardian) outlier, Zuni Indian Reservation, New Mexico; in Anderson, O.J., Lucas, S.G., Love, D.W. and Cather, S.M., eds., Southeastern Colorado Plateau [New Mexico Geological Society, Guidebook, 40th Field Conference]: Socorro, New Mexico Geological Society, p. 167–176 (B.S. Kues and S.G. Lucas).

Triassic stratigraphy of west-central New Mexico; in Anderson, O.J., Lucas, S.G., Love, D.W. and Cather, S.M., eds., Southeastern Colorado Plateau [New Mexico Geological Society, Guidebook, 40th Field Conference]: Socorro, New Mexico Geological Society, p. 191–211 (S.G. Lucas and S.N. Hayden).

Selachians from the Hosta Tongue of the Point Lookout Sandstone (Upper Cretaceous, Santonian), central New Mexico; in Anderson, O.J., Lucas, S.G., Love, D.W. and Cather, S.M., eds., Southeastern Colorado Plateau [New Mexico Geological Society, Guidebook, 40th Field Conference]: Socorro, New Mexico Geological Society, p. 239–245 (T.E. Williamson, S.G. Lucas and R. Pence).

Alamosaurus and the sauropod hiatus in the Cretaceous of the North American Western Interior; in Farlow, J.O., ed., Paleobiology of the dinosaurs. Boulder, Geological Society of America, Special Paper 238, p. 75–85 (S.G. Lucas and A.P. Hunt).

The systematics of indricotheres; in Prothero, D.R. and Schoch, R.M., eds., The evolution of perissodactyls: New York, Oxford University Press, p. 358–378 (S.G. Lucas and J.C. Sobus).

Taxonomy and biochronology of *Eomoropus* and *Grangeria* , Eocene chalicotheres from the Western United States and China; in Prothero, D.R. and Schoch, R.M., eds., The evolution of perissodactyls: New York, Oxford University Press, p. 422–437 (S.G. Lucas and R.M. Schoch).

European brontotheres; in Prothero, D.R. and Schoch, R.M., eds., The evolution of perissodactyls: New York, Oxford University Press, p. 485–489 (S.G. Lucas and R.M. Schoch).

Taxonomy of *Duchesneodus* (Brontotheriidae) from the late Eocene of North America; in Prothero, D.R. and Schoch, R.M., eds., The evolution of perissodactyls: New York, Oxford University Press, p. 490–503 (S.G. Lucas and R.M. Schoch).

1990

Biostratigraphy; in Magill, F.N., ed., Magill's survey of science: earth science series: Pasadena, Salem Press, p. 173–177.

The Cretaceous-Tertiary boundary; in Magill, F.N., ed., Magill's survey of science: earth science series: Pasadena, Salem Press, p. 303–308.

Stratigraphic correlation; in Magill, F.N., ed., Magill's survey of science: earth science series: Pasadena, Salem Press, p. 2485–2489.

Early Permian footprint fauna from the Sangre de Cristo Formation of northeastern New Mexico; in Bauer, P.W., Lucas, S.G., Mawer, C.K. and McIntosh, W.C., eds., Tectonic development of the southern Sangre de Cristo Mountains, New Mexico [New Mexico Geological Society, Guidebook, 41st Field Conference]: Socorro, New Mexico Geological Society, p. 291–303 (A.P. Hunt, S.G. Lucas and P. Huber).

Triassic stratigraphy in the Sangre de Cristo Mountains, New Mexico; in Bauer, P.W., Lucas, S.G., Mawer, C.K. and McIntosh, W.C., eds., Tectonic development of the southern Sangre de Cristo Mountains, New Mexico [New Mexico Geological Society, Guidebook, 41st Field Conference]: Socorro, New Mexico Geological Society, p. 305–318 (S.G. Lucas, A.P. Hunt and P. Huber).

Jurassic dinosaur footprints from New Mexico; in Bauer, P.W., Lucas, S.G., Mawer, C.K. and McIntosh, W.C., eds., Tectonic development of the southern Sangre de Cristo Mountains, New Mexico [New Mexico Geological Society, Guidebook, 41st Field Conference]:Socorro, New Mexico Geological Society, p. 319–321 (S.G. Lucas, A.P. Hunt and P. Huber).

Type and reference sections of the Romeroville Sandstone (Dakota Group), Cretaceous of northeastern New Mexico; in Bauer, P.W., Lucas, S.G., Mawer, C.K. and McIntosh, W.C., eds., Tectonic development of the southern Sangre de Cristo Mountains, New Mexico [New Mexico Geological Society, Guidebook, 41st Field Conference]: Socorro, New Mexico Geological Society, p. 323–326.

1991

Southeasternmost outcrops of the Morrison Formation, Capitan, Lincoln County, New Mexico; in Barker, J.M., Kues, B.S., Austin, G.S. and Lucas S.G., eds., Geology of the Sierra Blanca, Sacramento and Capitan Ranges, New Mexico [New Mexico Geological Society, Guidebook, 42nd Field Conference]: Socorro, New Mexico Geological Society, p. 41.

Triassic stratigraphy, paleontology and correlation, south-central New Mexico; in Barker, J.M., Kues, B.S., Austin, G.S. and Lucas S.G., eds., Geology of the Sierra Blanca, Sacramento and Capitan Ranges, New Mexico [New Mexico Geological Society, Guidebook, 42nd Field Conference]: Socorro, New Mexico Geological Society, p. 243–259.

Cretaceous Dakota Group outlier, Sacramento Mountains, Otero County, New Mexico; in Barker, J.M., Kues, B.S., Austin, G.S. and Lucas S.G., eds., Geology of the Sierra Blanca, Sacramento and Capitan Ranges, New Mexico [New Mexico Geological Society, Guidebook, 42nd Field Conference]: Socorro, New Mexico Geological Society, p. 261–264.

Mammuthus from Lincoln County and a review of the mammoths from the Pleistocene of New Mexico; in Barker, J.M., Kues, B.S., Austin, G.S. and Lucas S.G., eds., Geology of the Sierra Blanca, Sacramento and Capitan Ranges, New Mexico [New Mexico Geological Society, Guidebook, 42nd Field Conference]: Socorro, New Mexico Geological Society, p. 277–282 (S.G. Lucas and J.A. Effinger).

Revised Upper Triassic stratigraphy in the San Rafael Swell, Utah; in Chidsey, T.C., Jr., ed., Geology of east-central Utah: Salt Lake City, Utah Geological Association Publication, 19, p. 1–8.

1992

Triassic stratigraphy and correlation, West Texas and eastern New Mexico; in Cromwell, D.W., Moussa, M.T. and Mazzullo, L.J. eds., Transactions Southwest Section American Association of Petroleum Geologists, 1992 Convention: Midland, WTGS, [WTGS Publ. SWS 92–90], p. 201–207 (S.G. Lucas and O.J. Anderson).

Overview of Upper Pennsylvanian stratigraphy and paleontology, Kinney Quarry, Manzanita Mountains, New Mexico; in Zidek, J., ed., Geology and paleontology of the Kinney Brick Quarry, Late Pennsylvanian, central New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 138, p. 1–11 (B.S. Kues and S.G. Lucas).

Sedimentation patterns in Pennsylvanian strata at the Kinney Brick Company Quarry, Bernalillo County, New Mexico; in Zidek, J., ed., Geology and paleontology of the Kinney Brick Quarry, Late Pennsylvanian, central New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 138, p. 13–19 (J.C. Lorenz, G.A. Smith and S.G. Lucas).

Preliminary report on Late Pennsylvanian Conchostraca from the Kinney Brick Quarry, Manzanita Mountains, New Mexico; in Zidek, J., ed., Geology and paleontology of the Kinney Brick Quarry, Late Pennsylvanian, central New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 138, p. 123–126 (H. Kozur, S.G. Lucas and A.P. Hunt).

The Late Pennsylvanian amphibian fauna of the Kinney Quarry, central New Mexico; in Zidek, J., ed., Geology and paleontology of the Kinney Brick Quarry, Late Pennsylvanian,

central New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 138, p. 211–220 (A.P. Hunt, S.G. Lucas and D.S. Berman).

Redefinition of the Duchesnean land mammal "age," late Eocene of western North America; in Prothero, D.R. and Berggren, W.A., eds., Eocene-Oligocene Climatic and Biotic Evolution: Princeton University Press, p. 88–105.

Nonmarine Jurassic-Cretaceous boundary in western North America; in Mateer, N.J. and Chen, P.J., eds., Aspects of Nonmarine Cretaceous Geology: Beijing, China Ocean Press, p. 15–30 (N.J. Mateer, S.G. Lucas and A.P. Hunt).

Selachian fauna from the Upper Cretaceous (Coniacian) El Vado Sandstone Member of the Mancos Shale, San Juan Basin, New Mexico; in San Juan Basin IV [New Mexico Geological Society, Guidebook, 43rd Field Conference]: Socorro, New Mexico Geological Society, p. 17–20 (T.E. Williamson and S.G. Lucas).

Preliminary report on invertebrate fossils from the Lewis Shale near Mesa Portales, Sandoval County, New Mexico; in San Juan Basin IV [New Mexico Geological Society, Guidebook, 43rd Field Conference]: Socorro, New Mexico Geological Society, p. 24–26 (S.G. Lucas and P.L. Sealey).

Vertebrate fauna from the Upper Cretaceous (Campanian) Pictured Cliffs Sandstone, Mesa Portales, New Mexico; in San Juan Basin IV [New Mexico Geological Society, Guidebook, 43rd Field Conference]: Socorro, New Mexico Geological Society, p. 26–29 (T.E. Williamson and S.G. Lucas).

Silcretes of the Paleocene Nacimiento Formation; in San Juan Basin IV [New Mexico Geological Society, Guidebook, 43rd Field Conference]: Socorro, New Mexico Geological Society, p. 38–42 (T.E. Williamson, L.J. Crossey and S.G. Lucas).

The paleoflora of the lower Cutler Formation (Pennsylvanian, Desmoinesian?) in El Cobre Canyon, New Mexico, and its biochronological significance; in San Juan Basin IV [New Mexico Geological Society, Guidebook, 43rd Field Conference]: Socorro, New Mexico Geological Society, p. 145–150 (A.P. Hunt and S.G. Lucas).

Triassic stratigraphy and paleontology, Chama basin and adjacent areas, north-central New Mexico; in San Juan Basin IV [New Mexico Geological Society, Guidebook, 43rd Field Conference]: Socorro, New Mexico Geological Society, p. 151–172 (S.G. Lucas and A.P. Hunt).

Stratigraphy, paleontology and age of the Fruitland and Kirtland Formations (Upper Cretaceous), San Juan Basin, New Mexico; in San Juan Basin IV [New Mexico Geological Society, Guidebook, 43rd Field Conference]: Socorro, New Mexico Geological Society, p. 217–239 (A.P. Hunt and S.G. Lucas).

Charles H. Sternberg and the collection of Late Cretaceous vertebrate fossils from the San Juan Basin, New Mexico; in San Juan Basin IV [New Mexico Geological Society, Guidebook, 43rd Field Conference]: Socorro, New Mexico Geological Society, p. 241–250 (A.P. Hunt, S.G. Lucas and N.J. Mateer).

Cretaceous-Eocene crocodilians from the San Juan Basin, New Mexico; in San Juan Basin IV [New Mexico Geological Society, Guidebook, 43rd Field Conference]: Socorro, New Mexico Geological Society, p. 257–264.

Stratigraphy and mammalian biostratigraphy of the Paleocene Nacimiento Formation, southern San Juan Basin, New Mexico; in San Juan Basin IV [New Mexico Geological Society, Guidebook, 43rd Field Conference]: Socorro, New Mexico Geological Society, p. 265–296 (T.E. Williamson and S.G. Lucas).

Fossil mammals and the early Eocene age of the San Jose Formation, San Juan Basin, New Mexico; in San Juan Basin IV [New Mexico Geological Society, Guidebook, 43rd Field Conference]: Socorro, New Mexico Geological Society, p. 311–316 (S.G. Lucas and T.E. Williamson).

1993

Lithostratigraphy, sedimentation, and sequence stratigraphy of Upper Triassic Dockum Formation, West Texas; in Crick, R. E., ed., 1993 Southwest section geological convention American Association of Petroleum Geologists transactions and abstracts: Arlington, University of Texas at Arlington, p. 55-65 (S. G. Lucas and O. J. Anderson).

Stratigraphy and paleontology of the Late Cretaceous Cabullona basin, northeastern Sonora, Mexico: III Simposio de la Geologia de Sonora y Areas Adyacentes Libro de Resumenes, p. 37-41 (C. Gonzalez-Leon, S. G. Lucas and B. S. Kues).

Late Cretaceous charophytes from the Cabullona Group, northeastern Sonora, Mexico: III Simposio de la Geologia de Sonora y Areas Adyacentes Libro de Resumenes, p. 63-65 (K. K. Kietzke, S. G. Lucas and C. Gonzalez-Leon).

The Triassic-Jurassic boundary section in the Sierra del Alamo, northwestern Sonora: III Simposio de la Geologia de Sonora y Areas Adyacentes Libro de Resumenes, p. 66-68.

Stratigraphy and sequence stratigraphic interpretation of Upper Triassic strata in Nevada; in Dunn, G. and McDougall, K., eds., Mesozoic paleogeography of the western United States - II: Pacific Section SEPM Book 71, p. 375-378 (S. G. Lucas and J. E. Marzolf).

Pantodonts, tillodonts, uintatheres, and pyrotheres are not ungulates; in Szalay, F. S., Novacek, M. J. and McKenna, M. C., eds., Mammal phylogeny placentals: New York, Springer-Verlag, p. 182-194.

Cenozoic confusion, controversy and collapse at Pierce Canyon; in Love, D. W., Hawley, J. W., Kues, B. S., Adams, J. W., Austin, G. S. and Barker, J. M., eds., Carlsbad region, New Mexico and West Texas [New Mexico Geological Society, 44th Annual Field Conference Guidebook]: Socorro, New Mexico Geological Society, p. 33-34 (J. W. Hawley, D. Love and S. G. Lucas).

Stratigraphy of the Permian-Triassic boundary in southeastern New Mexico and West Texas; in Love, D. W., Hawley, J. W., Kues, B. S., Adams, J. W., Austin, G. S. and Barker, J. M., eds., Carlsbad region, New Mexico and West Texas [New Mexico Geological Society, 44th Annual Field Conference Guidebook]: Socorro, New Mexico Geological Society, p. 219-230 (S. G. Lucas and O. J. Anderson).

Triassic stratigraphy in southeastern New Mexico and southwestern Texas; in Love, D. W., Hawley, J. W., Kues, B. S., Adams, J. W., Austin, G. S. and Barker, J. M., eds., Carlsbad region, New Mexico and West Texas [New Mexico Geological Society, 44th Annual Field Conference Guidebook]: Socorro, New Mexico Geological Society, p. 231-235 (S. G. Lucas and O. J. Anderson).

Late Triassic vertebrates from the Dockum Formation near Otis Chalk, Howard County, Texas; in Love, D. W., Hawley, J. W., Kues, B. S., Adams, J. W., Austin, G. S. and Barker, J. M., eds., Carlsbad region, New Mexico and West Texas [New Mexico Geological Society, 44th Annual Field Conference Guidebook]: Socorro, New Mexico Geological Society, p. 237-244 (S. G. Lucas A. P. Hunt and R. Kahle).

Stratigraphy, paleontology and correlation of Lower Cretaceous exposures in southeastern New Mexico; in Love, D. W., Hawley, J. W., Kues, B. S., Adams, J. W., Austin, G. S. and Barker, J. M., eds., Carlsbad region, New Mexico and West Texas [New Mexico Geological Society, 44th Annual Field Conference Guidebook]: Socorro, New Mexico Geological Society, p. 245-260 (B. S. Kues and S. G. Lucas).

Early Permian tracksites in the Robledo Mountains, south-central New Mexico; in Lucas, S. G. and Zidek, J., eds., Vertebrate paleontology in New Mexico: New Mexico Museum of Natural History and Science, Bulletin 2, p. 23-31 (A. P. Hunt, M. G. Lockley, S. G. Lucas, J. P. MacDonald, N. Hotton III and J. Kramer).

Triassic vertebrate paleontology and biochronology of New Mexico; in Lucas, S. G. and Zidek, J., eds., Vertebrate paleontology in New Mexico: New Mexico Museum of Natural History and Science, Bulletin 2, p. 49-60 (A. P. Hunt and S. G. Lucas).

Stratigraphy and vertebrate paleontology of the Chinle Group (Upper Triassic), Chama basin, north-central New Mexico; in Lucas, S. G. and Zidek, J., eds., Vertebrate paleontology in New Mexico: New Mexico Museum of Natural History and Science, Bulletin 2, p. 61-69 (A. P. Hunt and S. G. Lucas).

Jurassic vertebrates of New Mexico; in Lucas, S. G. and Zidek, J., eds., Vertebrate paleontology in New Mexico: New Mexico Museum of Natural History and Science, Bulletin 2, p. 71-75 (A. P. Hunt and S. G. Lucas).

Cretaceous vertebrates of New Mexico; in Lucas, S. G. and Zidek, J., eds., Vertebrate paleontology in New Mexico: New Mexico Museum of Natural History and Science, Bulletin 2, p. 77-91 (A. P. Hunt and S. G. Lucas).

Late Cretaceous to early Eocene vertebrate biostratigraphy and biochronology of the San Juan Basin, New Mexico; in Lucas, S. G. and Zidek, J., eds., Vertebrate paleontology in New Mexico: New Mexico Museum of Natural History and Science, Bulletin 2, p. 93-104 (S. G. Lucas and T. E. Williamson).

Paleocene vertebrate paleontology of the San Juan Basin, New Mexico; in Lucas, S. G. and Zidek, J., eds., Vertebrate paleontology in New Mexico: New Mexico Museum of Natural History and Science, Bulletin 2, p. 105-135 (T. E. Williamson and S. G. Lucas).

Eocene vertebrates and late Laramide stratigraphy of New Mexico; in Lucas, S. G. and Zidek, J., eds., Vertebrate paleontology in New Mexico: New Mexico Museum of Natural History and Science, Bulletin 2, p. 145-158 (S. G. Lucas and T. E. Williamson).

Bibliography of New Mexico vertebrate paleontology; in Lucas, S. G. and Zidek, J., eds., Vertebrate paleontology in New Mexico: New Mexico Museum of Natural History and Science, Bulletin 2, p. 281-338 (B. S. Kues and S. G. Lucas).

Dedication [to S. P. Welles]; in, Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. i (M. Morales and S. G. Lucas).

Vertebrate biochronology of the Newark Supergroup Triassic, eastern North America; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. 179-186 (P. Huber, S. G. Lucas and A. P. Hunt).

Late Triassic microvertebrate localities in New Mexico (USA): implications for paleoecology; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. 187-191 (A. P. Hunt and S. G. Lucas).

A new phytosaur (Reptilia: Archosauria) genus from the uppermost Triassic of the western United States and its biochronological significance; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. 193-196 (A. P. Hunt and S. G. Lucas).

Vertebrate and inverstebrate tracks and trackways from Upper Triassic strata of the Tucumcari basin, east-central New Mexico, USA; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. 199-201 (A. P. Hunt, M. G. Lockley and S. G. Lucas).

Biochronological significance of the co-occurrence of the phytosaurs (Reptilia: Archosauria) *Angistorhinus* and *Rutiodon* in the Los Esteros Member of the Santa Rosa Formation, Santa Fe County, New Mexico; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. 203-204 (A. P. Hunt, S. G. Lucas and P. Bircheff).

Fossil limuloid trackways from Petrified Forest National Park, Arizona, USA; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. 205-207 (A. P. Hunt, S. G. Lucas and M. G. Lockley).

A complete skeleton of the stagonolepidid *Typothorax coccinarum* from the Upper Triassic Bull Canyon Formation of east-central New Mexico, USA; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. 209-212 (A. P. Hunt, S. G. Lucas and P. K. Reser).

Vertebrate biochronology of the Triassic of China; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. 301-306.

A phytosaur from the Upper Triassic Chinle Group in the San Rafael Swell, east-central Utah; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. 307-309 (S. G. Lucas, F. L. DeCourten and A. P. Hunt).

Revised internal correlation of the Newark Supergroup Triassic, eastern United States and Canada; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. 311-319 (S. G. Lucas and P. Huber).

A dicynodont from the Upper Triassic of New Mexico and its biochronological significance; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. 321-325 (S. G. Lucas and A. P. Hunt).

Tetrapod biochronology of the Chinle Group (Upper Triassic), western United States; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. 327-329 (S. G. Lucas and A. P. Hunt).

Late Carnian-early Norian magnetostratigraphy from nonmarine strata, Chinle Group, New Mexico. Contributions to the Triassic magnetic polarity timescale and the correlation of nonmarine and marine Triassic faunas; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. 345-352 (R. S. Molina-Garza, J. N. Geissman and S. G. Lucas).

The Upper Triassic Chinle Group, western United States; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. G2-G3.

Tetrapod footprints from the Upper Triassic Moenkopi Formation, west-central New Mexico; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. G20 (A. P. Hunt and S. G. Lucas).

McGaffey Member of Upper Triassic Bluewater Creek Formation, west-central New Mexico; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. G30 (O. J. Anderson and S. G. Lucas).

Calcretes of the Upper Triassic Owl Rock Formation, Colorado Plateau; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. G32 (S. G. Lucas and O. J. Anderson).

Sequence stratigraphy and a tetrapod acme zone during the early Revueltian (Late Triassic: early Norian) of western North America; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. G46 (A. P. Hunt and S. G. Lucas).

Type section of Holbrook Member of Moenkopi Formation, northeastern Arizona; in Lucas S. G. and Morales, M., eds., The nonmarine Triassic: New Mexico Museum of Natural History and Science, Bulletin 3, p. G49.

Cranioskeletal morphology of archontans, and diagnoses of Chiroptera, Volitantia, and Archonta; in MacPhee, R. D. E., ed., Primates and their relatives in phylogenetic perspective: New York, Plenum Press, p. 187-226 (F. S. Szalay and S. G. Lucas).

The Chinle Group: revised stratigraphy and biochronology of Upper Triassic nonmarine strata in the western United States; in Morales, M., ed., Aspects of Mesozoic geology and paleontology of the Colorado Plateau: Museum of Northern Arizona Bulletin 59, p. 27-50.

Late Triassic fish assemblages of the North American Western Interior; in Morales, M., ed., Aspects of Mesozoic geology and paleontology of the Colorado Plateau: Museum of Northern Arizona Bulletin 59, p. 51-66 (P. Huber, S. G. Lucas and A. P. Hunt).

1994

Ochoan (Late Permian) stratigraphy and chronology, southeastern New Mexico and West Texas; in Ahlen, J., Peterson, J. and Bowsher, A. L., eds., Geologic activities in the 90s Southwest Section of AAPG 1994, Ruidoso, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Bulletin 150, p. 29-36 (S. G. Lucas and O. J. Anderson).

Triassic stratigraphy and correlations, southern High Plains of New Mexico-Texas; in Ahlen, J., Peterson, J. and Bowsher, A. L., eds., Geologic activities in the 90s Southwest Section of AAPG 1994, Ruidoso, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Bulletin 150, p. 105-126 (S. G. Lucas, O. J. Anderson and A. P. Hunt).

The role of Central America in land-vertebrate dispersal during the Late Cretaceous and Cenozoic; in Seyfried, H. and Hellmann, W., eds., Geology of an evolving island arc the isthmus of southern Nicaragua, Costa Rica, and western Panama: Profil, v. 7 [Universitat Stuttgart], p. 401-412 (S. G. Lucas and G. E. Alvarado).

Middle Jurassic stratigraphy, sedimntation and paleogeography in the southern Colorado Plateau and southern High Plains; in Caputo, M. V., Peterson, J. A. and Franczyk, K. J., eds., Mesozoic systems of the Rocky Mountain region, USA: Denver: Rocky Mountain Section, Society for Sedimentary Geology, p. 299-314 (O. J. Anderson and S. G. Lucas).

Correlation and age of the Upper Jurassic Morrison Formation from magnetostratigraphic analysis; in Caputo, M. V., Peterson, J. A. and Franczyk, K. J., eds., Mesozoic systems of the

Rocky Mountain region, USA: Denver: Rocky Mountain Section, Society for Sedimentary Geology, p. 315-330 (M. B. Steiner, S. G. Lucas and E. M. Shoemaker).

Permian strata at Horse Mountain; in Chamberlin, R. M., Kues, B. S., Cather, S. M., Barker, J. M. and McIntosh, W. C., eds., Mogollon slope, west-central New Mexico and east-central Arizona [New Mexico Geological Society, 45th Field Conference Guidebook]: Socorro, New Mexico Geological Society, p. 106-108 (S. G. Lucas and B. S. Kues).

Triassic stratigraphy in the Lucero uplift, Cibola, Valencia and Socorro counties, New Mexico; in Chamberlin, R. M., Kues, B. S., Cather, S. M., Barker, J. M. and McIntosh, W. C., eds., Mogollon slope, west-central New Mexico and east-central Arizona [New Mexico Geological Society, 45th Field Conference Guidebook]: Socorro, New Mexico Geological Society, p. 241-254 (S. G. Lucas and A. B. Heckert).

Westward extension of Seboyeta bay, Late Cretaceous (Cenomanian) of west-central New Mexico; in Chamberlin, R. M., Kues, B. S., Cather, S. M., Barker, J. M. and McIntosh, W. C., eds., Mogollon slope, west-central New Mexico and east-central Arizona [New Mexico Geological Society, 45th Field Conference Guidebook]: Socorro, New Mexico Geological Society, p.255-257 (O. J. Anderson and S. G. Lucas).

Miocene proboscidean from the Fence Lake Formation, Catron County, New Mexico; in Chamberlin, R. M., Kues, B. S., Cather, S. M., Barker, J. M. and McIntosh, W. C., eds., Mogollon slope, west-central New Mexico and east-central Arizona [New Mexico Geological Society, 45th Field Conference Guidebook]: Socorro, New Mexico Geological Society, p. 277-278 (S. G. Lucas and O. J. Anderson).

The beginning of the age of dinosaurs in Wyoming; in Nelson, G. E., ed., The dinosaurs of Wyoming [Wyoming Geological Association 44th Annual Field Conference Guidebook]: Casper, Wyoming Geological Association, p. 105-113.

Middle Jurassic stratigraphy, sedimentation and paleogeography in the southwestern United States; Canadian Society of Petroleum Geologists, Memoir 17, p. 255-264 (O. J. Anderson and S. G. Lucas).

Sequence stratigraphic correlation of Upper Triassic marine and nonmarine strata, western United States and Europe; in Pangea: global environments and resources: Canadian Society of Petroleum Geologists, Memoir 17, p. 241-254 (S. G. Lucas and P. Huber).

Triassic tetrapod extinctions and the compiled correlation effect; i n Pangea: global environments and resources: Canadian Society of Petroleum Geologists, Memoir 17, p. 869-875.

Ornithischian dinosaurs from the Upper Triassic of the United States; in Fraser, N. C. and Sues, H.-D., eds., In the shadow of dinosaurs: early Mesozoic tetrapods: New York, Cambridge University Press, p. 227-241 (A. P. Hunt and S. G. Lucas).

The chronology and paleobiogeography of mammalian origins; in Fraser, N. C. and Sues, H.-D., eds., In the shadow of dinosaurs: early Mesozoic tetrapods: New York, Cambridge University Press, p. 335-351 (S. G. Lucas and A. P. Hunt).

1995

Geology of Early Permian tracksites, Robledo Mountains, south-central New Mexico; in Lucas, S. G. and Heckert, A. B., eds., Early Permian footprints and facies: New Mexico Museum of Natural History and Science, Bulletin 6, p. 13-32 (S.G. Lucas, O. J. Anderson, A. B. Heckert and A. P. Hunt).

The limestone facies of the Abo-Hueco transitional zone in the Robledo Mountains, southern New; in Lucas, S. G. and Heckert, A. B., eds., Early Permian footprints and facies: New Mexico Museum of Natural History and Science, Bulletin 6, p. 33-38 (K. Krainer and S. G. Lucas).

Some microfossils from the Robledo Mountains Member of the Hueco Formation, Doña Ana County, New Mexico; in Lucas, S. G. and Heckert, A. B., eds., Early Permian footprints and facies: New Mexico Museum of Natural History and Science, Bulletin 6, p. 57-62 (K. K. Kietzke and S. G. Lucas).

Wolfcampian (Early Permian) vertebrate tracks from Arizona and New Mexico; in Lucas, S. G. and Heckert, A. B., eds., Early Permian footprints and facies: New Mexico Museum of Natural History and Science, Bulletin 6, p. 135-165 (H. Haubold, A. P. Hunt, S. G. Lucas and M. G. Lockley).

Early Permian (late Wolfcampian) tetrapod tracks from the Robledo Mountains, south-central New Mexico; in Lucas, S. G. and Heckert, A. B., eds., Early Permian footprints and facies: New Mexico Museum of Natural History and Science, Bulletin 6, p. 167-180 (A. P. Hunt, S. G. Lucas, H. Haubold and M. G. Lockley).

Paleozoic tracksites of the western United States; in Lucas, S. G. and Heckert, A. B., eds., Early Permian footprints and facies: New Mexico Museum of Natural History and Science, Bulletin 6, p. 213-217 (A. P. Hunt, S. G. Lucas and M. G. Lockley).

Fossil footprints in the DeChelly Sandstone of Arizona: with paleoecological observations on the ichnology of dune facies; in Lucas, S. G. and Heckert, A. B., eds., Early Permian footprints and facies: New Mexico Museum of Natural History and Science, Bulletin 6, p. 225-233 (M. G. Lockley, A. P. Hunt, H. Haubold and S. G. Lucas).

Lacertoid footprints from Permian dune sandstones, Cornburg and DeChelly sandstones; in Lucas, S. G. and Heckert, A. B., eds., Early Permian footprints and facies: New Mexico Museum of Natural History and Science, Bulletin 6, p. 235-244 (H. Haubold, M. G. Lockley, A. P. Hunt and S. G. Lucas).

Early Permian vertebrate tracks from the Abo Formation, Socorro County, central New Mexico: a preliminary report; in Lucas, S. G. and Heckert, A. B., eds., Early Permian footprints and facies: New Mexico Museum of Natural History and Science, Bulletin 6, p. 263-268 (A. P. Hunt, S. G. Lucas, W. Cotton, J. Cotton and M. G. Lockley).

Vertebrate paleontology of the Robledo Mountains Member of the Hueco Formation, Doña Ana Mountains, New Mexico; in Lucas, S. G. and Heckert, A. B., eds., Early Permian footprints and facies: New Mexico Museum of Natural History and Science, Bulletin 6, p. 269-277 (S. G. Lucas, A. P. Hunt, A. B. Heckert and H. Haubold).

Preliminary report on paleontology of the Abo Formation, McLeod Hills, Sierra County, New Mexico; in Lucas, S. G. and Heckert, A. B., eds., Early Permian footprints and facies: New Mexico Museum of Natural History and Science, Bulletin 6, p. 279-285 (S. G. Lucas, A. P. Hunt and A. B. Heckert).

Stratigraphy and paleontology of the Lower Permian Earp Formation, Big Hatchet Mountains, Hidalgo County, New Mexico; in Lucas, S. G. and Heckert, A. B., eds., Early Permian footprints and facies: New Mexico Museum of Natural History and Science, Bulletin 6, p. 287-294 (S. G. Lucas and A. P. Hunt).

Tetrapod ichnofacies in Early Permian red beds of the American Southwest; in Lucas, S. G. and Heckert, A. B., eds., Early Permian footprints and facies: New Mexico Museum of Natural History and Science, Bulletin 6, p. 295-301 (A. P. Hunt, S. G. Lucas, M. G. Lockley, H. Haubold and S. Braddy).

The Triassic Sinbad Formation and correlation of the Moenkopi Group, Canyonlands National Park, Utah; in Santucci, V. L. and McClelland, L., eds., National Park Service Paleontological Research: Denver, National Park Service (Technical Report NPS/NRPO/NRTR-95/16), p. 54-57.

Dinosaur footprint from the Upper Triassic Rock Point Formation of the Chinle Group, Canyonlands National Park; in Santucci, V. L. and McClelland, L., eds., National Park Service Paleontological Research: Denver, National Park Service (Technical Report NPS/NRPO/NRTR-95/16), p. 58-59. (S. G. Lucas, A. P. Hunt and M. G. Lockley)

Two Late Triassic vertebrate faunas at Petrified Forest National Park; in Santucci, V. L. and McClelland, L., eds., National Park Service Paleontological Research: Denver, National Park Service (Technical Report NPS/NRPO/NRTR-95/16), p. 89-93. (A. P. Hunt and S. G. Lucas)

A simplified key to identifying isolated fossil teeth from Late Triassic rocks in Petrified Forest National Park; in Santucci, V. L. and McClelland, L., eds., National Park Service Paleontological Research: Denver, National Park Service (Technical Report NPS/NRPO/NRTR-95/16), p. 4-96. (A. P. Hunt, S. G. Lucas and V. L. Santucci)

Revised Upper Triassic stratigraphy, Petrified Forest National Park; in Santucci, V. L. and McClelland, L., eds., National Park Service Paleontological Research: Denver, National Park Service (Technical Report NPS/NRPO/NRTR-95/16), p. 102-105.

Stratigraphy across the Permian-Triassic disconformity in north-central New Mexico; in Bauer, P. W., Kues, B. S., Dunbar, N. W., Karlstrom, K. E. and Harrison, B., eds., Geology of the Santa Fe region [New Mexico Geological Society, Guidebook, 46th Field Conference]: Socorro, New Mexico Geological Society, p. 50-51.

The Jurassic section at Romeroville, San Miguel County, New Mexico; in Bauer, P. W., Kues, B. S., Dunbar, N. W., Karlstrom, K. E. and Harrison, B., eds., Geology of the Santa Fe region [New Mexico Geological Society, Guidebook, 46th Field Conference]: Socorro, New Mexico Geological Society, p. 51-53 (S. G. Lucas, O. J. Anderson and M. B. Steiner).

Triassic stratigraphy around the Sandia uplift, central New Mexico; in Bauer, P. W., Kues, B. S., Dunbar, N. W., Karlstrom, K. E. and Harrison, B., eds., Geology of the Santa Fe region [New Mexico Geological Society, Guidebook, 46th Field Conference]: Socorro, New Mexico Geological Society, p. 233-241 (S. G. Lucas and A. B. Heckert).

Vertebrate paleontology and biochronology of the lower Chinle Group (Upper Triassic), Santa Fe County, north-central New Mexico; in Bauer, P. W., Kues, B. S., Dunbar, N. W., Karlstrom, K. E. and Harrison, B., eds., Geology of the Santa Fe region [New Mexico Geological Society, Guidebook, 46th Field Conference]: Socorro, New Mexico Geological Society, p. 243-246 (A. P. Hunt and S. G. Lucas).

Jurassic stratigraphy in the Hagan basin, north-central New Mexico; in Bauer, P. W., Kues, B. S., Dunbar, N. W., Karlstrom, K. E. and Harrison, B., eds., Geology of the Santa Fe region [New Mexico Geological Society, Guidebook, 46th Field Conference]: Socorro, New Mexico Geological Society, p. 247-255 (S. G. Lucas, O. J. Anderson and C. Pigman).

A Late Cretaceous mosasaur from north-central New Mexico; in Bauer, P. W., Kues, B. S., Dunbar, N. W., Karlstrom, K. E. and Harrison, B., eds., Geology of the Santa Fe region [New Mexico Geological Society, Guidebook, 46th Field Conference]: Socorro, New Mexico Geological Society, p. 257-259 (S. G. Lucas, A. B. Heckert and B. S. Kues).

Ichthyosaurs from the Upper Triassic of Sonora and the biochronology of Triassic ichthyosaurs; in Jacques-Ayala, C., González-León, C. and Roldán-Quintana, J., eds.,

Studies on the Mesozoic of Sonora and adjacent areas: Geological Society of America Special Paper 301, p. 17-20 (S. G. Lucas and C. González-León).

Stratigraphy and paleontology of the Early Cretaceous Cerro de Oro Formation, central Sonora; in Jacques-Ayala, C., González-León, C. and Roldán-Quintana, J., eds., Studies on the Mesozoic of Sonora and adjacent areas: Geological Society of America Special Paper 301, p. 41-47 (C. González-León and S. G. Lucas).

Paleontology of the Upper Cretaceous Cabullona Group, northeastern Sonora; in Jacques-Ayala, C., González-León, C. and Roldán-Quintana, J., eds., Studies on the Mesozoic of Sonora and adjacent areas: Geological Society of America Special Paper 301, p. 143-165 (S.G. Lucas, B. S. Kues and C. González-León).

1996

Magnetic stratigraphy of the Duchesnean part of the Galisteo Formation, New Mexico; in Prothero, D. R. and Emry, R. J., eds., The terrestrial Eocene- Oligocene transition in North America: Cambridge, Cambridge University Press, p. 199-205 (D. R. Prothero & S. G. Lucas).

Stratigraphy and correlation of Triassic strata around the Nacimiento and Jemez uplifts, northern New Mexico; in Goff, F., Kues, B. S., Rogers, M. A., McFadden, L. D. and Gardner, J. N., eds., The Jemez Mountains Region [New Mexico Geological Society, Forty-Seventh Annual Field Conference Guidebook]: New Mexico Geological Society, Socorro, p. 199-204 (S. G. Lucas and A. B. Heckert).

Stratigraphy and depositional environments of Middle and Upper Jurassic rocks, southeastern San Juan Basin, New Mexico; in Goff, F., Kues, B. S., Rogers, M. A., McFadden, L. D. and Gardner, J. N., eds., The Jemez Mountains Region [New Mexico Geological Society, Forty-Seventh Annual Field Conference Guidebook]: New Mexico Geological Society, Socorro, p. 205-210 (O. J. Anderson and S. G. Lucas).

Vertebrate biochronology of the Jurassic of China; in Morales, M., ed., The continental Jurassic: Museum of Northern Arizona Bulletin 60, p. 23-33.

The thyreophoran dinosaur *Scelidosaurus* from the Lower Jurassic Lufeng Formation, Yunnan, China; in Morales, M., ed., The continental Jurassic: Museum of Northern Arizona Bulletin 60, p. 81-85.

Jurassic fossil vertebrates from New Mexico; in Morales, M., ed., The continental Jurassic: Museum of Northern Arizona Bulletin 60, p. 235-241 (S. G. Lucas, T. E. Williamson, J. W. Estep, A. P. Hunt and O. J. Anderson).

Vertebrate track assemblages from the Jurassic Summerville Formation and correlative deposits; in Morales, M., ed., The continental Jurassic: Museum of Northern Arizona Bulletin 60, p. 249-254 (M. G. Lockley, A. P. Hunt and S. G. Lucas).

Unionid bivalves from the Upper Jurassic Morrison Formation, east-central New Mexico; in Morales, M., ed., The continental Jurassic: Museum of Northern Arizona Bulletin 60, p. 325-327.

Lower Mesozoic sequences of the Colorado Plateau; in Morales, M., ed., The continental Jurassic: Museum of Northern Arizona Bulletin 60, p. 437-438 (J. E. Marzolf and S. G. Lucas).

The base of the Morrison Formation (Upper Jurassic) of northwestern New Mexico and adjacent areas; in Morales, M., ed., The continental Jurassic: Museum of Northern Arizona Bulletin 60, p. 443-456 (O. J. Anerson and S. G. Lucas).

The Middle Jurassic Todilto salina basin, American Southwest; in Morales, M., ed., The continental Jurassic: Museum of Northern Arizona Bulletin 60, p. 479-482 (S. G. Lucas and O. J. Anderson).

Correlation and tectonic significance of Lower Jurassic conglomerates in Sonora, Mexico; in Morales, M., ed., The continental Jurassic: Museum of Northern Arizona Bulletin 60, p. 497-501.

Vertebrate biochronology of the Late Triassic of Arizona: Fossils of Arizona [Mesa Southwest Museum, Mesa, Arizona], v. 4, p. 63-81 (S. G. Lucas and A. B. Heckert).

Fossil mammals and the age of the Changxindian Formation, northeastern China; in Godinot, M. and Gingerich, P. D., eds., Paleobiologie et evolution des mammiferes Paleogenes: Palaeovertebrata, v. 25, p. 133-140.

1997

Marine reptiles and Mesozoic biochronology; in Callaway, J. M. and Nicholls, E. L., eds., Ancient marine reptiles: San Diego, Academic Press, p. 423-434.

Permian and Triassic geologic events in Sonora, northwestern Mexico; in Dickins, J. M., Yang,Z., Yin, H., Lucas, S. G., and Acharyya, S. K., eds., Late Palaeozoic and early Mesozoic circum-Pacific events and their global correlation. Cambridge, Cambridge University Press, p. 20- 29 (C. González-León, S. G. Lucas and J. Roldán-Quintana).

Upper Triassic Chinle Group, western United States: A nonmarine standard for Late Triassic time; in Dickins, J. M., Yang,Z., Yin, H. , Lucas, S. G., and Acharyya, S. K., eds., Late Palaeozoic and early Mesozoic circum-Pacific events and their global correlation. Cambridge, Cambridge University Press, p. 209-228.

Lake T'oo'dichi' and the Brushy Basin Member of the Morrison Formation; in Anderson, O. J., Kues, B. S. and Lucas, S. G., eds., Mesozoic Geology and Paleontology of the Colorado Plateau [New Mexico Geological Society Guidebook 48]: Socorro, New Mexico Geological Society, pp. (O. J. Anderson and S. G. Lucas).

Lower Cretaceous stratigraphy on the Colorado Plateau; in Anderson, O. J., Kues, B. S. and Lucas, S. G., eds., Mesozoic Geology and Paleontology of the Colorado Plateau [New Mexico Geological Society Guidebook 48]: Socorro, New Mexico Geological Society, pp. (S. G. Lucas and O. J. Anderson).

Paleocene land-mammal "ages" of the San Juan Basin, New Mexico-Colorado; in Anderson, O. J., Kues, B. S. and Lucas, S. G., eds., Mesozoic Geology and Paleontology of the Colorado Plateau [New Mexico Geological Society Guidebook 48]: Socorro, New Mexico Geological Society, pp.

Tectonics of the Four Corners region of the Colorado Plateau; in Anderson, O. J., Kues, B. S. and Lucas, S. G., eds., Mesozoic Geology and Paleontology of the Colorado Plateau [New Mexico Geological Society Guidebook 48]: Socorro, New Mexico Geological Society, pp. (L. A. Woodward, O. J. Anderson and S. G. Lucas).

Stratigraphy, biostratigraphy, and sequence stratigraphy of the Upper Triassic Chinle Group, Four Corners region; in Anderson, O. J., Kues, B. S. and Lucas, S. G., eds., Mesozoic Geology and Paleontology of the Colorado Plateau [New Mexico Geological Society Guidebook 48]: Socorro, New Mexico Geological Society, pp. (S. G. Lucas, A. B. Heckert, J. W. Estep and O. J. Anderson).

The Jurassic San Rafael Group, Four Corners region; in Anderson, O. J., Kues, B. S. and Lucas, S. G., eds., Mesozoic Geology and Paleontology of the Colorado Plateau [New Mexico Geological Society Guidebook 48]: Socorro, New Mexico Geological Society, pp. (S. G. Lucas and O. J. Anderson).

The Upper Jurassic Morrison Formation in the Four Corners region; in Anderson, O. J., Kues, B. S. and Lucas, S. G., eds., Mesozoic Geology and Paleontology of the Colorado Plateau [New Mexico Geological Society Guidebook 48]: Socorro, New Mexico Geological Society, pp. (O. J. Anderson and S. G. Lucas).

Paleontology of nonmarine Cretaceous--not marine Triassic--limestone in the Salt anticline, southeastern Utah; in Anderson, O. J., Kues, B. S. and Lucas, S. G., eds., Mesozoic Geology and Paleontology of the Colorado Plateau [New Mexico Geological Society Guidebook 48]: Socorro, New Mexico Geological Society, pp. (S. G. Lucas, K. K. Kietzke and T. H. Goodspeed).

Paleontology, stratigraphy and biostratigraphy of the Upper Cretaceous Lewis Shale near Waterflow, San Juan County, New Mexico; in Anderson, O. J., Kues, B. S. and Lucas, S. G., eds., Mesozoic Geology and Paleontology of the Colorado Plateau [New Mexico Geological Society Guidebook 48]: Socorro, New Mexico Geological Society, pp. (P. L. Sealey and S. G. Lucas).

The Chico Springs locality, Nacimiento Formation, San Juan Basin, New Mexico; in Anderson, O. J., Kues, B. S. and Lucas, S. G., eds., Mesozoic Geology and Paleontology of the Colorado Plateau [New Mexico Geological Society Guidebook 48]: Socorro, New Mexico Geological Society, pp. (T. E. Williamson and S. G. Lucas).

Biostratigraphy; in Currie, P. J. and Padian, K., eds., Encyclopedia of dinosaurs: San Diego, Academic Press, p. 65-68.

Land-mammal ages; in Currie, P. J. and Padian, K., eds., Encyclopedia of dinosaurs: San Diego, Academic Press, p. 395-398.

Lower Chinle Group (Adamanian: latest Carnian) tetrapod biostratigraphy and biochronology, eastern Arizona and west-central New Mexico; in Anderson, B., Boaz, D. and McCord, R. D., eds., Southwest paleontological symposium proceedings volume 1: Mesa, Mesa Southwest Museum, p. 11-23 (A. B. Heckert and S. G. Lucas).

Stratigraphy, paleontology and biochronology of the Upper Triassic Chinle Group in east-central New Mexico; in Anderson, B., Boaz, D. and McCord, R. D., eds., Southwest paleontological symposium proceedings volume 1: Mesa, Mesa Southwest Museum, p. 25-40 (A. P. Hunt and S. G. Lucas).

Phytosaur from the Wingate Sandstone in southeastern Utah and the Triassic-Jurassic boundary on the Colorado Plateau; in Anderson, B., Boaz, D. and McCord, R. D., eds., Southwest paleontological symposium proceedings volume 1: Mesa, Mesa Southwest Museum, p. 49-59 (S. G. Lucas, A. B. Heckert, O. J. Anderson and J. W. Estep).

Theropod dinosaur eggshell from the Upper Jurassic of New Mexico; *in* Lucas, S. G., Estep, J. W., Williamson, T. E. and Morgan, G. S., eds., New Mexico's Fossil Record 1: New Mexico Museum of Natural History and Science Bulletin 11, pp. 41-43 (E. S. Bray and S. G. Lucas).

Middle Eocene (Bridgerian) mammals from the Hart Mine Formation, south-central New Mexico; *in* Lucas, S. G., Estep, J. W., Williamson, T. E. and Morgan, G. S., eds., New Mexico's Fossil Record 1: New Mexico Museum of Natural History and Science Bulletin 11, pp. 65-72.

Mesohippus (Mammalia, Perissodactyla, Equidae) from the Chadronian (late Eocene) of south-central New Mexico; *in* Lucas, S. G., Estep, J. W., Williamson, T. E. and Morgan, G. S., eds., New Mexico's Fossil Record 1: New Mexico Museum of Natural History and Science Bulletin 11, pp. 73-75 (S. G. Lucas, J. W. Estep and J. W. Froehlich).

Pliocene (latest Hemphillian and Blancan) vertebrate fossils from the Mangas basin, southwestern New Mexico; *in* Lucas, S. G., Estep, J. W., Williamson, T. E. and Morgan, G. S., eds., New Mexico's Fossil Record 1: New Mexico Museum of Natural History and Science Bulletin 11, pp. 97--128 (G. S. Morgan, P. L. Sealey, S. G. Lucas and A. B. Heckert).

Dicynodon and Late Permian Pangea; in Wang, N. and Remane, J., eds., Stratigraphy: Proceedings of the 30th International Geological Congress, v. 11: Utrecht: VSP International Science Publishers, p. 133-141.

Holarctic fossil mammals and Paleogene Series boundaries; in Wang, N. and Remane, J., eds., Stratigraphy: Proceedings of the 30th International Geological Congress, v. 11: Utrecht: VSP International Science Publishers, p. 189-199.

1998

The Ergilian-Shandgolian (Eocene-Oligocene) transition in the Zaysan basin, Kazakstan; in Beard, K. C. and Dawson, M. R., eds., Dawn of the age of mammals in Asia: Bulletin of the Carnegie Museum of Natural History. no. 34, p. 298-312 (R. J. Emry, S. G. Lucas, L. Tyutkova and B. Wang).

Oligocene stratigraphy, sequence stratigraphy, and mammalian biochronology north of the Aral Sea, western Kazakstan; in Beard, K. C. and Dawson, M. R., eds., Dawn of the age of mammals in Asia: Bulletin of the Carnegie Museum of Natural History. no. 34, p. 313-348 (S. G. Lucas, E. G. Kordikova and R. J. Emry).

Stratigraphy of Upper Pennsylvanian-Lower Permian rocks in New Mexico: An overview; in Lucas, S. G., Estep, J. W. and Hoffer, J. M., eds., Permian stratigraphy and paleontology of the Robledo Mountains, New Mexico: New Mexico Museum of Natural History and Science Bulletin 12, p. 9-27 (C. W. Cook, S. G. Lucas and J. W. Estep).

Stratigraphy, paleontology and depositional environments of the Lower Permian Robledo Mountains Formation of the Hueco Group, Robledo Mountains, New Mexico; in Lucas, S. G., Estep, J. W. and Hoffer, J. M., eds., Permian stratigraphy and paleontology of the Robledo Mountains, New Mexico: New Mexico Museum of Natural History and Science Bulletin 12, p. 29-41 (S. G. Lucas, A. B. Heckert, J. W. Estep, A. P. Hunt and O. J. Anderson).

Stratigraphy of the Lower Permian Hueco Group in the Robledo Mountains, Doña Ana County, New Mexico in Lucas, S. G., Estep, J. W. and Hoffer, J. M., eds., Permian stratigraphy and paleontology of the Robledo Mountains, New Mexico: New Mexico Museum of Natural History and Science Bulletin 12, p. 43-54 (S. G. Lucas, A. B. Heckert, J. W. Estep and C. W. Cook).

Implications of the cosmopolitanism of Permian tetrapod ichnofaunas in Lucas, S. G., Estep, J. W. and Hoffer, J. M., eds., Permian stratigraphy and paleontology of

the Robledo Mountains, New Mexico: New Mexico Museum of Natural History and Science Bulletin 12, p. 55-57 (A. P. Hunt and S. G. Lucas).

Ichnological evidence for vertebrate predation in the Paleozoic: Is there any? in Lucas, S. G., Estep, J. W. and Hoffer, J. M., eds., Permian stratigraphy and paleontology of the Robledo Mountains, New Mexico: New Mexico Museum of Natural History and Science Bulletin 12, p. 59-62 (A. P. Hunt and S. G. Lucas).

Vertebrate ichnofaunas of New Mexico and their bearing on Lower Permian vertebrate ichnofacies in Lucas, S. G., Estep, J. W. and Hoffer, J. M., eds., Permian stratigraphy and paleontology of the Robledo Mountains, New Mexico: New Mexico Museum of Natural History and Science Bulletin 12, p. 63-65 (A. P. Hunt and S. G. Lucas).

Vertebrate tracks and the myth of the belly-dragging, tail-dragging tetrapods of the late Paleozoic in Lucas, S. G., Estep, J. W. and Hoffer, J. M., eds., Permian stratigraphy and paleontology of the Robledo Mountains, New Mexico: New Mexico Museum of Natural History and Science Bulletin 12, p. 67-69 (A. P. Hunt and S. G. Lucas).

Toward a tetrapod biochronology of the Permian in Lucas, S. G., Estep, J. W. and Hoffer, J. M., eds., Permian stratigraphy and paleontology of the Robledo Mountains, New Mexico: New Mexico Museum of Natural History and Science Bulletin 12, p. 71-91

Archaic ungulates and ungulatelike mammals; in Janis, C. M., Scott, K. M. and Jacobs, L. L., eds., Evolution of Tertiary mammals of North America: Cambridge, Cambridge University Press, p. 247-259 (C. M. Janis, J. D. Archibald, R. L. Cifelli, S. G. Lucas, C. R. Schaff, R. M. Schoch and T. E. Williamson).

Taeniodonta; in Janis, C. M., Scott, K. M. and Jacobs, L. L., eds., Evolution of Tertiary mammals of North America: Cambridge, Cambridge University Press, p. 260-267 (S. G. Lucas, R. M. Schoch and T. E. Williamson).

Tillodontia; in Janis, C. M., Scott, K. M. and Jacobs, L. L., eds., Evolution of Tertiary mammals of North America: Cambridge, Cambridge University Press, p. 268-273 (S. G. Lucas and R. M. Schoch).

Pantodonta; in Janis, C. M., Scott, K. M. and Jacobs, L. L., eds., Evolution of Tertiary mammals of North America: Cambridge, Cambridge University Press, p. 274-283.

Dinocerata; in Janis, C. M., Scott, K. M. and Jacobs, L. L., eds., Evolution of Tertiary mammals of North America: Cambridge, Cambridge University Press, p. 284-291 (S. G. Lucas and R. M. Schoch).

Eutheria incertae sedis: *Mingotherium* and *Idiogenomys*; in Janis, C. M., Scott, K. M. and Jacobs, L. L., eds., Evolution of Tertiary mammals of North America: Cambridge, Cambridge University Press, p. 623-624 (S. G. Lucas and R. M. Schoch).

Vertebrate biostratigraphy and biochronology of the Cretaceous of China; in Lucas, S. G., Kirkland, J. I. and Estep, J. W., eds., Lower and Middle Cretaceous Terrestrial Ecosystems: New Mexico Museum of Natural History and Science Bulletin 14, p. 1-20 (S. G. Lucas and J. W. Estep).

Lithostratigraphy and biostratigraphy of the Lower-Middle Cretaceous Bisbee Group, southwestern New Mexico, USA; in Lucas, S. G., Kirkland, J. I. and Estep, J. W., eds., Lower and Middle Cretaceous Terrestrial Ecosystems: New Mexico Museum of Natural History and Science Bulletin 14, p. 39-56 (S. G. Lucas and J. W. Estep).

Stratigraphy and correlation of middle Cretaceous rocks (Albian-Cenomanian) from the Colorado Plateau to the southern High Plains, north-central New Mexico; in Lucas, S. G., Kirkland, J. I. and Estep, J. W., eds., Lower and Middle Cretaceous Terrestrial Ecosystems: New Mexico Museum of Natural History and Science Bulletin 14, p. 57-66 (S. G. Lucas, O. J. Anderson and J. W. Estep).

Cretaceous dinosaurs of the Colorado Plateau; in Lucas, S. G., Kirkland, J. I. and Estep, J. W., eds., Lower and Middle Cretaceous Terrestrial Ecosystems: New Mexico Museum of Natural History and Science Bulletin 14, p. 79-89 (J. I. Kirkland, S. G. Lucas and J. W. Estep).

Tetrapod ichnofaunas from the Lower Cretaceous of northeastern New Mexico, USA; in Lucas, S. G., Kirkland, J. I. and Estep, J. W., eds., Lower and Middle Cretaceous Terrestrial Ecosystems: New Mexico Museum of Natural History and Science Bulletin 14, p. 163-167 (A. P. Hunt and S. G. Lucas).

A new dinosaur track locality from the Dakota Sandstone (Upper Cretaceous: Cenomanian) in west-central New Mexico; in Lucas, S. G., Kirkland, J. I. and Estep, J. W., eds., Lower and Middle Cretaceous Terrestrial Ecosystems: New Mexico Museum of Natural History and Science Bulletin 14, p. 169-171 (A. B. Heckert and S. G. Lucas).

Stratigraphic distribution and age of petrified wood in Petrified Forest National Park, Arizona; in Santucci, V. L. and McClelland, L., eds., National Park Service paleontological research: U. S. Department of the Interior National Park Service, Technical; Report NPS/NRGRD/GRDTR-98/01, p. 125-129 (A. B. Heckert and S. G. Lucas).

The oldest Triassic strata exposed in the Petrified Forest National Park, Arizona; in Santucci, V. L. and McClelland, L., eds., National Park Service paleontological research: U. S. Department of the Interior National Park Service, Technical; Report NPS/NRGRD/GRDTR-98/01, p. 129-134 (A. B. Heckert and S. G. Lucas).

Key to identification of tetrapod footprints from Lower Permian red beds of southern New Mexico; in Mack, G. H., Austin, G. S. and Barker, J. M., eds., Las Cruces Country II [New Mexico Geological Society Guidebook, 49th Field Conference]: Socorro, New Mexico Geological Society, pp. 11-13 (S. G. Lucas and A. P. Hunt).

Early Pleistocene (early Irvingtonian) co-occurrence of the proboscideans *Cuvieronius*, *Stegomastodon*, and *Mammuthus* at Tortugas Mountain, Doña Ana County, New Mexico; in Mack, G. H., Austin, G. S. and Barker, J. M., eds., Las Cruces Country II [New Mexico Geological Society Guidebook, 49th Field Conference]: Socorro, New Mexico Geological Society, p. 34 (S. G. Lucas, G. S. Morgan and G. H. Mack).

Cretaceous stratigraphy and biostratigraphy in the southern San Andres Mountains, Doña Ana County, New Mexico; in in Mack, G. H., Austin, G. S. and Barker, J. M., eds., Las Cruces Country II [New Mexico Geological Society Guidebook, 49th Field Conference]: Socorro, New Mexico Geological Society, pp. 187-196 (S. G. Lucas and J. W. Estep).

Cretaceous stratigraphy and biostratratigraphy, western Franklin Mountains, El Paso, Texas; in Mack, G. H., Austin, G. S. and Barker, J. M., eds., Las Cruces Country II [New Mexico Geological Society Guidebook, 49th Field Conference]: Socorro, New Mexico Geological Society, pp. 197-203 (S. G. Lucas, L. L. Corbitt and J. W. Estep).

Corals from the Upper Cretaceous of south-central New Mexico; in Mack, G. H., Austin, G. S. and Barker, J. M., eds., Las Cruces Country II [New Mexico Geological Society

Guidebook, 49th Field Conference]: Socorro, New Mexico Geological Society, pp. 205-207 (S. G. Lucas and J. O. J. Anderson).

The ceratopsian dinosaur *Torosaurus* from the Upper Cretaceous McRae Formation, Sierra County, New Mexico; in Mack, G. H., Austin, G. S. and Barker, J. M., eds., Las Cruces Country II [New Mexico Geological Society Guidebook, 49th Field Conference]: Socorro, New Mexico Geological Society,pp. 223-227 (S. G. Lucas, G. H. Mack and J. W. Estep).

Pliocene (Blancan) vertebrate fossils from the Camp Rice Formation near Tonuco Mountain, Doña Ana County, southern New Mexico; in Mack, G. H., Austin, G. S. and Barker, J. M., eds., Las Cruces Country II [New Mexico Geological Society Guidebook, 49th Field Conference]: Socorro, New Mexico Geological Society, pp. 237-249 (G. S. Morgan, S. G. Lucas and J. W. Estep).

Late Paleocene-early Eocene climatic and biotic evolution: An overview; in Aubry, M-P., Lucas, S. G. and Berggren, W. A., eds., Late Paleocene-early Eocene climatic and biotic events in the marine and terrestrial records. New York: Columbia University Press, p. 1-17.

Fossil mammals and the Paleocene/Eocene series boundary in Europe, North America, and Asia; in Aubry, M-P., Lucas, S. G. and Berggren, W. A., eds., Late Paleocene-early Eocene climatic and biotic events in the marine and terrestrial records. New York: Columbia University Press, p. 451-500.

The scapulocoracoid complex of *Gyracanthus* (Acanthodii: Climatiiformes) and a reassessment of the pectoral region in the Gyracanthidae: Proceedings of the Academy of Natural Sciences of Philadelphia, v. 149, p. 99-108 (R. M. Sullivan, S. G. Lucas and K. A. Randall).

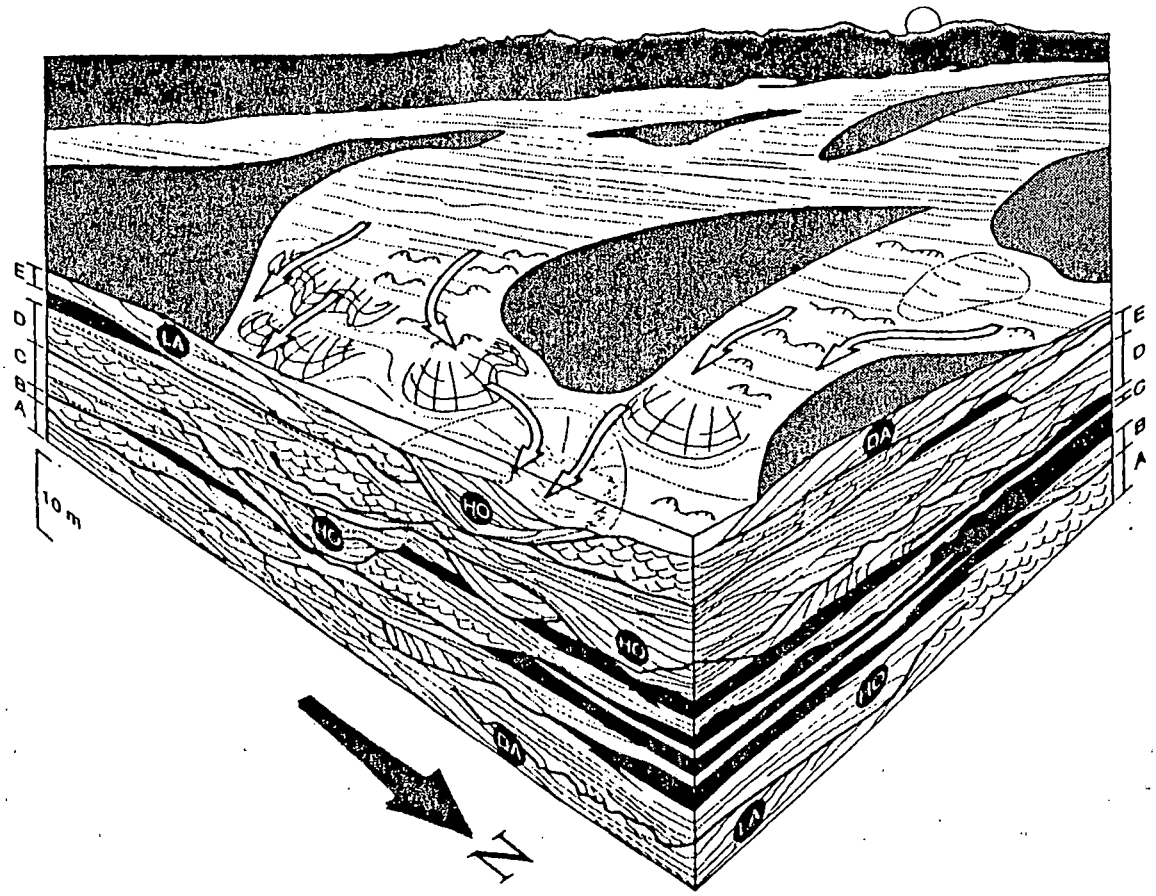


FIG. 18.—The large-scale architectural model of the Westwater Canyon Member fluvial system. The block diagram illustrates waning-stage flow, seen looking toward the southwest and the Late Jurassic magmatic arc. The sandstone units produced between each avulsive event of the channel belt are approximately 5 m thick, and are bounded by laterally-extensive fifth-order bounding surfaces. The width of the sandstone sheets is most likely >1 km. The sandstone bodies can be either single or composite channelbelt sandstones, depending on their vertical stacking, as shown by the examples of sandstone sheets A to E. The large hollows (labelled HO) within the sandstone sheets are interpreted as channel-confluence scours produced downstream of emergent channel sand bars, which in turn produce low-amplitude lateral accretion (LA) and downstream accretion (DA) deposits.

EXHIBIT

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD PANEL

Before Administrative Judge
Peter B. Bloch, Presiding Officer

In the Matter of:	)	
	)	Docket No. 40-8968-ML
HYDRO RESOURCES, INC.	)	
2929 Coors Road, Suite 101	)	ASLBP No. 95-706-01-ML
Albuquerque, NM 87120	)	
	)	

WRITTEN TESTIMONY OF MICHAEL F. SHEEHAN, Ph.D.

On behalf of Eastern Navajo Dine Against Uranium Mining ("ENDAUM") and the Southwest Research and Information Center ("SRIC"), Michael F. Sheehan, Ph.D., submits the following testimony responding to Hydro Resources, Inc.'s ("HRI's) and the NRC Staff's answers to Question 4 of the Presiding Officer's Memorandum and Order (Questions)(April 21, 1999). HRI's and the Staff's answers are set forth in Hydro Resources, Inc.'s Reply to April 21, 1999 Memorandum and Order (Questions)(May 11, 1999) ("HRI's Response"); and NRC Staff Response to Questions Posed in April 21 Order (May 11, 1999) ("NRC Staff Response"), including the attached Affidavit of Robert D. Carlson (May 11, 1999)("Carlson Affidavit").

May 1999

OSTERBERG & SHEEHAN
PUBLIC UTILITY ECONOMISTS

33126 S.W. CALLAHAN ROAD ** SCAPPOOSE, OREGON 97056
503-543-7172 ** 319-895-8731

EXHIBIT
4

TESTIMONY OF MICHAEL F. SHEEHAN

Q. PLEASE STATE YOUR NAME AND QUALIFICATIONS.

A. My name is Michael F. Sheehan. I am a partner in the firm of Osterberg & Sheehan, Public Utility Economists, of Scappoose, Oregon and Mount Vernon, Iowa. My qualifications and experience regarding issues related to finance, project economics, and environmental risk were set forth in the testimony I filed on February 11, 1999 in support of ENDAUM and SRIC. My resume was provided as Exhibit 1 to that testimony.

Q. HAVE YOU REVIEWED JUDGE BLOCH'S QUESTIONS AND THE STAFF'S AND HRI'S RESPONSES TO THOSE QUESTIONS?

A. Yes I have.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to respond to Question 4 presented in the April 21st Order in this docket in light of Hydro Resources Inc.'s Reply and Staff Exhibit 2 (May 11, 1999), Affidavit of Robert D. Carlson. My testimony is addressed to the secondary costs and benefits of the proposed project, and does not address the primary costs and benefits, such as whether the uranium to be supplied by the CUP is needed.

QUESTION 4

WHAT ARE THE ADJUSTED BENEFITS OF THE CUP FOR ONE

OSTERBERG & SHEEHAN
Public Utility Economists
33126 S.W. Callahan Road
Scappoose, Oregon 97056
503-543-7172 FAX 543-7172

OR TWO PRICES OF YELLOWCAKE THAT ARE AT OR ABOVE THE MINIMUM PRICE AT WHICH HRI WOULD COMMENCE WORK ON THIS PROJECT?

Q. HOW DO HRI AND THE NRC STAFF ARRIVE AT A MINIMUM PRICE AT WHICH HRI WOULD COMMENCE WORK ON THE CUP?

A. HRI and the Staff each respond differently to this question. HRI fails to address the question of what the price is at which it would enter the market. Instead, it compares the October 21, 1996 spot market price of $15.70 per pound (reported in the FEIS at Table 5.2) to Section 8 production costs of $14.50 per pound and declares that the "FEIS spot price of 15.70 $/lb would allow a reasonable overhead contingency of 8.2% and makes suitable break even production cost for the cost/benefit analysis."[1] HRI's Response at 19. Having identified its "breakeven production cost," HRI then describes the $15.70 per pound figure from the FEIS as "the breakeven price." HRI Reply at 20.

In its response, the Staff first disclaims any knowledge of the minimum price at which HRI would begin production:

> "The Staff does not know the minimum price that HRI would commence work on Section 8 or the rest of the mining project." Carlson Affidavit at 2.

---

[1] HRI claims that its figure of $14.50 per pound is "fixed cost." In economic and financial analysis "fixed costs" are those costs which do not vary with the number of pounds produced. The complement to fixed costs are "variable costs," i.e. those costs which do vary with the number of pounds produced. It is not immediately apparent here whether or not HRI's use of the term "fixed cost" is meant to convey that there are also "variable costs" which are separate and in addition to the $14.50 per pound, in which case the total cost per pound would be significantly higher.

OSTERBERG & SHEEHAN
Public Utility Economists
33126 S.W. Callahan Road
Scappoose, Oregon 97056
503-543-7172 FAX 543-7172

Having bypassed the key question of the price at which production would occur, the Staff then claims to evaluate the "adjusted benefits" of the CUP by using two "realistic" U308 prices (i.e "minimum prices"), by simply adopting the rounded range of production **costs** set forth in the FEIS at Table 5-1.

> "FEIS Table 5-1 indicates that HRI's production costs would vary from $9.38 to $11.83 per pound . . . Thus, a conservative estimate of benefits would be to assume prices of $9 and $12 per pound." Carlson Affidavit at 2.

The Staff uses these "minimum prices" together with the roughly identical cost figures to arrive at local economic benefits.

Q. IS THERE A PROBLEM WITH USING HRI'S $15.70 PER POUND PRICE?

A. The problem with HRI's use of the $15.70 price is that has no relationship with real-world market conditions. It is highly unlikely that uranium spot market prices will rise to anywhere near this "break even" level at any time in the foreseeable future. As I set forth at length in my February testimony, $15.70 per pound price lacks any empirical justification beyond the fact that it happened to be the spot price on October 21, 1996, a datum of no particular ongoing significance. The Staff placed it in FEIS Table 5-2, and then adopted it as a critical assumption for use in its presentation of the local economic benefits of the CUP. The Staff's use of the $15.70 figure in this way was especially odd in that the remainder of the estimated prices in Table 5-1 for various periods at least out to 2005 are one to several dollars lower. Moreover,

OSTERBERG & SHEEHAN
Public Utility Economists
33126 S.W. Callahan Road
Scappoose, Oregon 97056
503-543-7172 FAX 543-7172

actual spot prices since the publication of the FEIS have been much lower, with the spot price in the week of May 17, 1999 at $10.65 (CIS $8.50).[2] (See Exhibit MFS-1). The spot price has been below $11.00 since roughly March 1998, with prices below $10.00 and also below $9.00 for a significant portion of that time.

Q. WHAT POSITION DOES HRI TAKE WITH RESPECT TO THE LIKELIHOOD OF A SUBSTANTIAL INCREASE IN PRICES IN THE NEAR FUTURE?

A. HRI is generally in agreement that prices are not liable to change significantly any time soon:

> "The market price of uranium has fallen to levels that are currently below the Company's cost of uranium production. The outlook for uranium prices through the end of 1999 indicates that a price rebound during this period is not likely." URI, 10-Q SEC filing, Third Quarter 1998, p.9 attached as Exhibit BB to David Osterberg's January 7, 1999 testimony in this docket.

And even more recently (in URI's 1998 10-K filed March 31, 1999, at 5), HRI tells us:

> "The volatility of the uranium market saw spot prices that ranged from $12.00 per pound in January (1998) to lows at year-end of $8.75. The steady decline during the year,

---

[2] The CIS spot price is available only to those with special authority to purchase uranium from the former Soviet republics. Its significance is that given the very favorable price, a share of the general market is siphoned off, resulting in a general market demand lower than it would otherwise be with consequent downward pressure on prices. The Company reports that this "nontraditional" market is growing substantially. URI 10-K released March 31, 1999, at 13-14.

OSTERBERG & SHEEHAN
Public Utility Economists
33126 S.W. Callahan Road
Scappoose, Oregon 97056
503-543-7172 FAX 543-7172

which was attributed primarily to low utility demand, has begun to firm somewhat to the current (March 1999), but remains below the level needed by the Company to obtain the necessary financing to allow development of new production areas at its Kingsville Dome and Vasquez sites."

In sum, URI's statements in its financial reports to the SEC appear to be inconsistent with a belief that the $15.70 per pound price from a single day in 1996 is a reasonable estimate of likely prices in the near term. It is worth noting that $15.70 is roughly $5.00 per pound and roughly 50% higher than current prices.

Q. WHAT IS YOUR OPINION OF THE STAFF'S SUGGESTED RANGE OF $9.00 TO $12.00?

A. I disagree with the Staff's method for reaching this range. The Staff based its choice of price on its cost of production figures rather selecting prices reasonably likely to occur in the marketplace. Nevertheless, spot prices of $9.00 to $12 per pound are not unreasonable on their face given current conditions.

Q. WHAT PRICE RANGE WOULD YOU USE IF YOU WERE DOING THE COST BENEFIT ANALYSIS?

A. The minimum price for evaluating the costs and benefits of the CUP should be a realistic price that HRI has a reasonable expectation of receiving. An estimate for price in the $10 to $11 range over the near term appears to have a reasonable empirical foundation and to be within the range mentioned by the Company (URI 1998 10-K at 5) and the Staff, as noted above. See also Exhibit

OSTERBERG & SHEEHAN
Public Utility Economists
33126 S.W. Callahan Road
Scappoose, Oregon 97056
503-543-7172 FAX 543-7172

MFS-1, presenting spot market quotes from the Ux Consulting Company, as also cited by Carlson at 2.

Q. IF A PRICE ESTIMATE IN THE $10 TO $11 PER POUND RANGE IS ACCEPTED, WHAT IMPACT WILL THAT HAVE ON CUPS' GENERATION OF BENEFITS AND COSTS?

A. As we have seen above, HRI appears to concede cost per pound at Section 8 of roughly $14.50 per pound.[3] HRI further tells us that $15.70 per pound is a "breakeven price." Prices in the $10 to $11 range are $3.50 to $4.50 per pound too low (i.e. under HRI's stated $14.50 per pound "fixed costs") to reach HRI's stated breakeven point. With prices so far below cost HRI will not undertake development and production and there will be no benefits. If HRI cannot get past the breakeven point then the project is not feasible. Current prices will not support production; and we can see this fact in action when URI tells us it is drastically cutting back expenditures on its New Mexico operations.

> "The Company is also implementing cost reduction initiatives to reduce expenditures below 1998 levels throughout the Company. These include a targeted 33% reduction in total corporate overhead. Expenditures in New Mexico are projected to be reduced by between 60% - 70% to those levels consistent with remaining permitting and land holding costs." URI 1998 10-K filed March 31, 1999 at 5.

---

[3] Adding the same royalty, tax and restoration figure used by HRI for Section 8 ($1.15 + $2.00) to the equivalent Unit 1 and Crownpoint figures from FEIS Table 5-1 gives corresponding costs of $13.61 and $12.61 per pound, respectively. HRI Response at 19. In both cases these costs are outside the Staff's $9 to $12 price range. If HRI cannot cover even these costs, production is not feasible.

OSTERBERG & SHEEHAN
Public Utility Economists
33126 S.W. Callahan Road
Scappoose, Oregon 97056
503-543-7172 FAX 543-7172

Q. IF COSTS PER POUND ARE SUBSTANTIALLY ABOVE PRICE PER POUND WHAT WILL THE IMPACT ON PRODUCTION BE?

A. As the Staff tells us:

> "The FEIS at page 5-3, states: The important point relevant to assessing the project's potential benefits to the local community is that the benefits depend on HRI's costs being lower than the future price of U_3O_8, which has been quite volatile. If the price of U_3O_8 is less than the cost of operation, then operations may be discontinued. **If this happens, there will be no economic benefits to the local community.**" Staff Exhibit 2 (May 11, 1999) Affidavit of Robert D. Carlson, page 2. (Emphasis added).

The Staff is correct in this. If the spread is negative, and likely to remain largely negative, there will be "no economic benefits to the local community."

Q. THE STAFF CONTINUES TO SUGGEST THAT LARGE ECONOMIC BENEFITS WILL ACCRUE, EVEN GIVEN ITS $9 TO $12 PRICE RANGE. WHAT'S YOUR OPINION OF THIS?

A. The Staff admits at the threshold of their analysis that they have no idea "of the minimum price that HRI would commence work on Section 8 or the rest of the mining project." Staff Exhibit 2 (May 11, 1999), Affidavit of Robert D. Carlson, page 2. Therefore the Staff's assumption of a $9 to $12 price range tells nothing about whether HRI will develop and produce at the CUP. If we accept HRI's <u>cost</u> per pound figure of $14.50, there will be no production at <u>prices</u> in the $9 to $12 range. Staff's analysis depends upon using a <u>cost</u> figure in the $9 to $12 range, much lower than that set forth by HRI. HRI Reply, p.19.

OSTERBERG & SHEEHAN
Public Utility Economists
33126 S.W. Callahan Road
Scappoose, Oregon 97056
503-543-7172 FAX 543-7172

Moreover, the Staff's cost figures are "direct production costs" and not the full cost per pound reflecting royalties, taxes, and restoration as shown at page 19 of the Company's May 11 filing. Since taxes, royalties, and restoration costs diminish margin, and margin matters, this a significant mistake.[4] Correcting for this Staff error we can see there will be no margin, no production, and no benefits.

Q. THE COMPANY ALSO IMPLIES THAT THERE WILL BE SUBSTANTIAL BENEFITS EVEN AT A COST PER POUND OF $14.50. HOW CAN THIS BE?

A. Whereas the Staff arrives at an assumption of full scale production by underestimating costs, the Company reaches the same result by starting with a reasonable cost figure ($14.50), and then comparing it to a price figure of $15.70 that has no relationship to reality. HRI's implication of benefits from the CUP amounts to pure fiction. HRI Response at 20.

Q. PUTTING ASIDE THE PARTICULAR PROBLEMS OF PRICE AND COST, ARE THERE OTHER ERRORS IN THE ESTIMATION OF BENEFITS BY THE STAFF?

A. The Staff's amended presentation of benefits in its May 11 filing still has many of the weaknesses I noted in my February testimony. I will briefly summarize

---

[4] It is also worth noting that the $14.50 per pound figure does not reflect corporate overhead costs. See the bottom two lines of p.19 of HR's May 11 filing. These may be ignored only in the short run, and the firm that cannot generate enough of a production margin to cover corporate overhead cannot survive in the long run.

OSTERBERG & SHEEHAN
Public Utility Economists
33126 S.W. Callahan Road
Scappoose, Oregon 97056
503-543-7172 FAX 543-7172

these:

Employment The analysis in Table 2 still assumes that there will about 100 jobs for local residents and that the jobs will pay approximately $24,000 per year. These assumptions are flawed for the following reasons:

1. The Company is laying off its fully trained production work force in Texas--why hire untrained local workers when fully trained Texas workers are available;

2. The $24,000 wage is substantially higher than the Company is paying to its Texas workers (about $16,500 for the same job it claims it will pay $24,000 for in New Mexico)--it is anomalous that the Company would pay untrained worked substantially more than the trained work force simultaneously laid off in Texas;

3. Given the high level of local unemployment in the project area, the company will probably be in a buyers' market and there will be no reason to pay premium wages.

Finally, even the Staff says that its numbers might be all wrong:

> "The number of jobs and average salary might be lower with U_3O_8 prices of $9 and $12 per pound (as compared to $15.70 per pound), if HRI decides to hire fewer workers and pay less salary. The Staff has no information from HR to make revised assumptions regarding these matters." Staff Exhibit 2 (May 11, 1999), Affidavit of Robert D. Carlson, page 3.

Royalties The royalty figures of $630,000 to $840,000 depend upon production of 1 million pounds per year. Yet there is no reason to suppose that production will remain at 1 million pounds at Unit 1 when the price is assumed lower by such a large amount ($15.70 down to either $9 or $12). Secondly, the out-of-pocket cost of bringing the Church Rock property into production is well over

OSTERBERG & SHEEHAN
Public Utility Economists
33126 S.W. Callahan Road
Scappoose, Oregon 97056
503-543-7172 FAX 543-7172

$13 million before a single pound of uranium is produced. RAI Q.92 Response: Church Rock 1-2. Royalties to local people will only be paid after Church Rock is producing; if Church Rock doesn't produce there will be no royalties at Unit 1. Given the financial condition of the Company, including its plan to sharply cut back expenditures on CUP, where is the $13 million up front money to come from? See below page 11.

Taxes The tax amounts set forth on Staff's Tables 2 and 3 are--as the Staff notes--entirely contingent on the outcome of the jurisdictional issue of whether the mine sites are within Navajo Indian County, and therefore subject to the taxing power of the Navajo Nation. In addition, as with Royalties and employment, there is no reason to assume that at sharply lower market prices ($9 versus $15.70), output will remain at the same high level of 1 and 2 million pounds annually.

Q. IF WE WERE TO ASSUME HYPOTHETICALLY THAT URANIUM PRICES ROSE TO $15.70 PER POUND AND HRI DECIDED TO BEGIN PRODUCTION AND SALE OF CUP URANIUM, WHAT IMPACT WOULD THESE EVENTS HAVE ON ENVIRONMENTAL RISK?

A. There are two issues here. The first is that the $15.70 figure is a "spot" market price. As we all agree, spot prices in this market vary a good deal over time. Since HRI is in poor financial condition[5], it needs net revenues from sales to continue to build and operate its operations safely. Anything that imperils this

[5] See, inter alia, my March 1999 testimony on financial assurance.

OSTERBERG & SHEEHAN
Public Utility Economists
33126 S.W. Callahan Road
Scappoose, Oregon 97056
503-543-7172 FAX 543-7172

cash flow increases environmental risk. A financially troubled company will hesitate to take the necessary measures to protect the environment if such a course would put the company in greater financial peril. The NRC has recognized this problem (as have all regulators of operations involving hazardous materials):

> "a licensee in financially straitened circumstances would be under more pressure to commit safety violations or take safety 'shortcuts' than one in good financial shape." *Gulf States Utilities Co.* (River Bend Station, Unit 1) 41 NRC 460, 473 (1995).

URI was in serious financial trouble in 1995 which led it into difficult financing arrangements and extended and ongoing litigation. URI's 1998 10-K (March 31, 1999) at 21-2. Moreover, URI reports that it is currently:

> "consolidating certain of its administrative locations and reducing its work force. These measures were initiated in the fourth quarter of 1998 and will continue in 1999. The Company projects that upon the successful implementation of these strategies it will be able to maintain a continued positive liquidity position at least through 1999. However, there can be no assurances that the Company will be able to fully implement these strategies. If certain of these strategies cannot be implemented and if alternatives are not available, the Company's operations and liquidity would be negatively impacted and the Company may be unable to continue as a going concern. Even if the market price of uranium increases and the demand for new production meets the industry's expectations, there can be no assurance that the Company can survive long enough to participate in meeting such demand or that it will have access to the capital necessary to bring new production on line." URI's 1998 10-K filed March 31, 1999 at 27.

The Company's sharp reductions in planned investment in New Mexico are an

OSTERBERG & SHEEHAN
Public Utility Economists
33126 S.W. Callahan Road
Scappoose, Oregon 97056
503-543-7172 FAX 543-7172

example of an inability to maintain consistent and responsible financing.

> "The Company is also implementing cost reduction initiatives to reduce expenditures below 1998 levels throughout the Company. These include a targeted 33% reduction in total corporate overhead. Expenditures in New Mexico are projected to be reduced by between 60% - 70% to those levels consistent with remaining permitting and land holding costs." URI 1998 10-K filed March 31, 1999 at 5.

Once the injection of lixiviant and the inception of other parts of the operation with substantial environmental consequences begins, the inability to maintain consistent financing will pose a significant threat to the environment.

In sum, were HRI to begin development and production based on a spot price of $15.70 if the price were to fall again, HRI would be caught in a situation where it its poor financial condition might well result in a substantial increase in environmental risk to the community.

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS.

A. It seems to me that a reasonable market price for yellowcake for use by the Staff in its cost-benefit analysis is the $10 to $11 range. I recognize that there will probably be price excursions that occasionally move outside that range over time. HRI's suggestion of a cost figure of $14.50 per pound, including royalties, taxes and restoration (but not including an allowance for corporate overhead), seems to me to be reasonable for Section 8 (with similar costs of $13.61 and $12.61 for Unit 1 and Crownpoint, respectively). At this cost level

OSTERBERG & SHEEHAN
Public Utility Economists
33126 S.W. Callahan Road
Scappoose, Oregon 97056
503-543-7172 FAX 543-7172

production will not begin, given our estimate of price in the $10 to $11 range or even in the $9 to $12 range sponsored by the Staff. Even if price were $9 to $12 and costs were in the $9 to $12 range, in my judgment production would still not begin, given the very substantial up front costs involved, the Company's financial condition, and the Company's own statements relating to reducing expenditures on CUP by 60 to 70 percent. Without production there are no benefits. For the reasons set forth above, and in more detail in my February testimony, I don't believe that the economics of the situation will permit production.

Finally, even putting aside these problems, the Staff analysis of benefits, assuming production could begin, still substantially over-estimates most benefits, as I have described above (as well as in more detail in my February 11th testimony).

Q. DOES THIS COMPLETE YOUR TESTIMONY?

A. Yes it does.

OSTERBERG & SHEEHAN
Public Utility Economists
33126 S.W. Callahan Road
Scappoose, Oregon 97056
503-543-7172 FAX 543-7172

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Law Judge Bloch

In the Matter of:	)	
	)	Docket No. 40-8968-ML
HYDRO RESOURCES, INC.	)	ASLBP No. 95-706-01-ML
2929 Coors Road, Suite 10	)	
Albuquerque, NM 87120	)	
	)	

STATE OF OREGON)
) ss:
County of Columbia)

AFFIDAVIT OF MICHAEL F. SHEEHAN

I, Michael F. Sheehan, being sworn, depose and say as follows:

The attached prefiled written testimony was prepared by me or under my direct supervision for submission in the above captioned proceeding. The statements contained in this testimony are true and correct to the best of my knowledge, information and belief.

FURTHER AFFIANT SAYETH NOT.

Michael F. Sheehan

Subscribed and sworn to before me May 21, 1999.

OFFICIAL SEAL
MADELYNNE SHEEHAN
NOTARY PUBLIC-OREGON
COMMISSION NO. 050062
MY COMMISSION EXPIRES JAN. 7, 2000

Notary Public for Oregon

The Ux Consulting Company, LLC & The Uranium Exchange Company

As published in *The Ux Weekly*.
This page is updated on Tuesday evenings.
Current prices are available in the Subscriber Services section.

Ux Weekly Prices as of 5/17/99	Change from previous (week)
U_3O_8	***$10.65*** (-0.10)
CIS U_3O_8	***$8.50*** ( )

Industry Spot Prices

	NuclearFuel Low	NuclearFuel High	Nukem Low	Nukem High	Trade Tech	Ux	IAP*
Weekly							
U_3O_8 ($/lb)	(5/17/99)				(5/14/99)	(5/17/99)	
Restricted	$10.30	$10.90	--	--	$10.60	**$10.65**	$10.62
Non-restr.	$8.40	$8.80	--	--	$8.50	**$8.50**	$8.53
Month-end for April							
U_3O_8 ($/lb)	(4/19/99)		(4/30/99)		(4/30/99)	(4/26/99)	
Restricted	$10.60	$11.20	$10.40	$10.85	$10.85	**$10.85**	$10.81
Non-restr.	$8.40	$8.80	$8.45	$9.00	$8.50	**$8.50**	$8.58
Conversion							
($/kgU as UF_6)	--	--	$3.50	$4.50	$3.75	**$3.65**	$3.80
UF_6 ($/kgU)							
Restricted	--	--	--	--	$32.00	**$32.00**	$32.00
Non-restr.	--	--	--	--	$26.00	**$25.86**	$25.93
SWU ($/SWU)							
Restricted	--	--	--	$86.00	$85.00	**$85.00**	$85.33
Non-restr.	--	--	$83.00	--	$84.00	**$84.00**	$83.67

***Note:** Definitions of these prices vary among companies. They are listed strictly for comparison purposes and are in U.S. dollars. Nukem's SWU price shows limits on its price range. **IAP:** The calculation of the Industry Average Price (IAP) uses the mid-point of those companies that report a price range.*

Updated: 5/17/99
Frequency: Delayed Posted on Tuesdays after 5 PM EST
Non-delayed prices are available only in the Subscriber Services section.

EXHIBIT
MFS-1

MAY 99

Ux Price Definitions

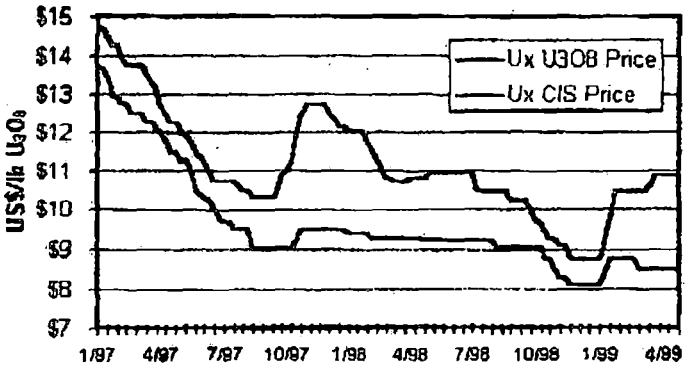
All prices are shown in US dollars. Units for U_3O_8 are in $/pound. Conversion and UF_6 are in $/kgU as UF_6 and SWU are in $/SWU.

The Ux Prices indicate, subject to the terms listed, the most competitive spot offers available for the respective product or service, of which Ux is aware. The **Ux U_3O_8** price includes conditions for quantity, delivery timeframe, origin and location considerations while the **Ux CIS U_3O_8** price is the most competitive price for deliveries up to six months forward without regard to specific quantity or location. Both U_3O_8 prices are published weekly. The **Ux Conversion** price considers spot offers for delivery up to twelve months forward. The **Ux UF_6** price represents the sum of the conversion and U_3O_8 components as discussed above and, therefore, does not necessarily represent the most competitive UF_6 offers available. The **Ux SWU** price considers spot offers for deliveries up to twelve months forward. The Conversion, UF_6 and SWU prices are published once a month on the last Monday of each month.

The Ux Prices represent neither an offer to sell nor a bid to buy the products or services listed.

37009

The Ux Consulting Company, LLC & The Uranium Exchange Company



Updated: 4/28/99
Frequency: Monthly

CS-79-98

RESOLUTION OF THE
NAVAJO NATION COUNCIL

Approving the Fiscal Year 1999 Navajo Nation
Operating Budget and Other Related Actions

WHEREAS:

1. Pursuant to 2 N.N.C. §102 (A), the Navajo Nation Council is the governing body of the Navajo Nation; and

2. By Resolution BFMY-45-98, the Budget and Finance Committee of the Navajo Nation Council accepted the Navajo Nation Controller's General Fund Revenue Projection of $104,400,000 for Fiscal Year 1999, established the Fiscal Year 1999 Budget Ceiling, and adopted the Budget Instructions Manual for the preparation of the Fiscal Year 1999 Navajo Nation Operating Budget. The Fiscal Year 1999 General Fund Revenue Projection submitted by the Navajo Nation Controller is attached hereto as **Exhibit "A"**; and

3. Pursuant to Navajo Nation Council Resolution CJY-53-85, twelve percent (12%) of all General Fund revenues shall be appropriated to the Navajo Nation Permanent Fund which is calculated at $12,528,000 using the revenue projection of $104,400,000 for Fiscal Year 1999 leaving a balance of $91,872,000; and

4. Pursuant to Navajo Nation Council Resolution CJY-54-94, two percent (2%) of all General Fund revenues shall be appropriated to the Navajo Nation Land Acquisition Trust Fund which is calculated at $2,088,000 using the revenue projection of $104,400,000 for Fiscal Year 1999 thereby leaving $89,784,000 net available for the Navajo Nation Fiscal Year 1999 Operating Budget appropriations; and

5. By Resolution CS-45-84, the Navajo Nation Council approved and established the Tribal Reserve Fund at $55 Million and directed that the Tribal Reserves be maintained at said amount; and

6. By Resolution CAP-31-94, the Navajo Nation Council adopted and approved the Fiscal Year 1995 Navajo Nation operating budget and other related actions and directed the Controller, the Budget and Finance Committee of the Navajo Nation Council and the Attorney General to study the feasibility of maintaining the $55 Million minimum fund balance for the Tribal Reserves; and

EXHIBIT
5

7. By memorandum dated August 26, 1998, the Controller of the Navajo Nation issued the second revision of the Fiscal Year 1998 General fund revenue projection in which the Controller stated that $10,973,000 is additional revenues in Fiscal Year 1998. After depositing 12% for the Permanent Fund and 2% for the Land Acquisition Trust Fund, $9,437,000 is available for deposit into the Navajo Nation Undesignated Reserves at the end of Fiscal Year 1998; and

8. By Resolution TAX-98-141, the Navajo Nation Tax Commission authorized the release of $2 Million from the Navajo Nation Tax Administration Suspense Fund for appropriation in Fiscal Year 1999 as an additional base to the Fiscal Year 1999 revenues. By Resolution GSCAU-51-98, the Government Services Committee of the Navajo Nation Council recommended the release of $2 Million from the Navajo Nation Tax Administration Suspense Fund to the General funds. $240,000 of the $2 Million Tax Administration Suspense Fund will be appropriated for deposit into the Navajo Nation Permanent Fund and $40,000 of the $2 Million Tax Administration Suspense Fund will be appropriated for deposit into the Navajo Nation Land Acquisition Trust Fund leaving $1,720,000 net available for Navajo Nation Fiscal Year 1999 Operating Budget appropriations; and

9. The Navajo Nation Council appropriated supplemental funds in Fiscal Year 1998 for various Navajo Nation programs and the Navajo Nation President informed the Budget and Finance Committee that substantial CIP funds will revert to the Navajo Nation General funds as year end balances at the end of Fiscal Year 1998. The Budget and Finance Committee determined that it is appropriate to carry over from Fiscal Year 1998 to Fiscal Year 1999 unexpended General funds for the Navajo Nation Solid Waste Management Program, Navajo Nation TANF and capital Improvement projects; and

10. Through regular budget deliberations, the Budget and Finance Committee of the Navajo Nation Council made a detailed review of the proposed Fiscal Year 1999 operating budgets presented by the three Branch Chiefs of the Navajo Nation and recommendations presented by the various standing committees of the Navajo Nation Council for divisions, departments and programs over which they have oversight responsibilities; and by Resolution BFAU-111-98, attached hereto as **Exhibit "H"**, the Budget and Finance Committee of the Navajo Nation Council recommended adoption of the three branch budgets for Fiscal Year 1999 and carryover various General funds from Fiscal Year 1998 to Fiscal Year 1999; and

11. Pursuant to Resolutions CS-64-96, Exhibit "E", and CMA-25-96, Exhibit "E" and Resolution CMA-35-96 Exhibit "E", #16: "a" through "h", programs and departments were requested to present reorganization, consolidation, or merger plans to implement cost savings. The Navajo Nation Council determines that it remains incumbent upon the Navajo Nation government divisions, departments and programs to complete reorganizing and restructuring their functions; eliminate duplicate functions and costs; and merge compatible programs that have similar goals, objectives, and missions; and

12. Historically, the Navajo Nation Council, in considering the resolution approving the annual operating budget, has created conditions precedent to expenditures and expressed concerns with regard to government operations through policy, directives, and cost containment measures. Pursuant to Resolution CAP-16-95, the method used by the Navajo Nation Council to express conditions precedent and concerns was defined either as a "Condition or Appropriation or Expenditure" or as a "Legislative Concern".

NOW THEREFORE BE IT RESOLVED THAT:

1. The Navajo Nation Council hereby adopts the Navajo Nation Controller's General Fund Revenue Projections of $104,400,000 for Fiscal Year 1999, attached hereto and incorporated herein as **Exhibit "A"**.

2. The Navajo Nation Council hereby appropriates the Fiscal Year 1999 General Fund Revenues for: $12,528,000 to the Navajo Nation Permanent Fund; $2,088,000 to the Navajo Nation Land Acquisition Trust Fund and the net available of $89,784,000 for the Navajo Nation Operating Budget.

3. The Navajo Nation Council hereby appropriates $6,372,751 from the Navajo Nation Undesignated Reserves, of which $5,772,751 is allocated for the Navajo Nation Executive Branch Operating Budget and $600,000 is allocated for the Legislative Branch.

4. The Navajo Nation Council hereby authorizes the release of $2 Million from the Navajo Nation Tax Administration Suspense Fund and appropriates $240,000 for deposit into the Navajo Nation Permanent Fund, $40,000 for deposit into the Navajo Nation Land Acquisition Trust Fund, and the net available of $1,720,000 for the Navajo Nation Operating Budget is allocated in the amount of $148,554 for the Legislative Branch, $254,725 for the Judicial Branch and $1,312,721 for the Executive Branch.

5. The Navajo Nation Council hereby appropriates the following for Navajo Nation Special Revenue Funds and Fiduciary Funds for the various designated programs and/or entities as provided in the attached Navajo Nation operating budgets:

a.	Scholarship Trust - Graduates	$ 1,300,000
b.	Scholarship Trust - Medical	$ 70,000
c.	1982 Claims Scholarship	$ 925,000
d.	1986 Vocational Education Trust	$ 302,900
e.	NECA Trust Funds	$ 61,020
f.	1986 Handicapped Trust	$ 600,000
g.	1982 & 1986 Claims - Chapter	$ 3,200,000
h.	1986 Senior Citizens Fund	$ 460,000
i.	Permanent Fund	$ 2,422,000
j.	Retirement Fund	$ 4,300,000
k.	Nihibeeso 401 (k) Savings Fund	$ 140,000
l.	Navajo Tourism Fund	$ 2,000,000
m.	Worker's Compensation	$ 1,000,000
	Total:	$16,780,920

6. The Navajo Nation Council hereby approves and adopts the Fiscal Year 1999 Operating Budget for the Navajo Nation in the total amount of $336,560,636, as set forth herein and referenced as **Exhibit "B"**, of which $97,876,751 is in General Funds; $13,000,000 is in Indirect Cost Credit; $21,610,654 is in Revolving Funds; $19,080,920 is in Other Tribal Funds; $178,009,499 is in federal funds; and $6,982,812 is in state/private funds for the Navajo Nation and the summaries among the three (3) Branches are as follows:

a. The Navajo Nation Council hereby approves and adopts the Fiscal Year 1999 Operating Budget for the Legislative Branch of the Navajo Nation in the total amount of $24,287,274 as set forth herein and referenced as **Exhibit "C"**, of which $19,676,360 is in General Funds and Other Tribal Funds $3,393,797; $1,195,235 is in Indirect Cost Credit and $21,882 is in state/private funds for the Navajo Nation Council, various standing committees, commissions, programs, offices, departments and activities within the Legislative Branch.

b. The Navajo Nation Council hereby approves and adopts the Fiscal Year 1999 Operating Budget for the Judicial Branch of the Navajo Nation in the total amount of $5,899,475 as set forth herein and referenced as **Exhibit "D"** of which $4,742,538 is in General Funds, $18,749 is Indirect Cost Credit and $1,138,188 is in federal funds for the various programs, offices, departments and activities within the Judicial Branch.

c. The Navajo Nation Council hereby approves and adopts the Fiscal Year 1999 Operating Budget for the Executive Branch of the Navajo Nation in the total amount of $306,373,887, as set forth herein and attached as **Exhibit "E"**, of which $73,457,853 is in General Funds; $11,786,016 is in Indirect Cost Credit; $21,610,654 is in Revolving Funds; $15,687,123 is in Other Tribal Funds; $176,871,311 is in federal funds; and $6,960,930 is in state/ private funds for the various Divisions/ Offices, departments, programs and activities within the Executive Branch.

7. The Navajo Nation Council adopts the following definition of "Condition of Appropriation or Expenditure" and adopts the Condition of Appropriation or Expenditure for the Fiscal Year 1999 Operating Budget attached hereto as **Exhibit "F"** for the purposes of the Navajo Nation Council budget resolution:

Condition of Appropriation or Expenditure: A specific legal condition precedent to the expenditure of funds placed upon an appropriation by majority vote of the votes cast by the Navajo Nation Council at the time the appropriation is finally adopted by passage of the main motion. Funds appropriated by the Navajo Nation Council may not be lawfully expended unless the condition of appropriation is met. It shall be the responsibility of the Controller of the Navajo Nation to ensure that funds are expended in accordance with the conditions placed on the appropriation.

8. The Navajo Nation Council adopts the following definition of "Legislative Concern" and adopts the Legislative Concerns for the Fiscal Year 1999 Operating Budget attached hereto as **Exhibit "G"** for the purposes of the Navajo Nation Council budget resolution:

Legislative Concerns: A comment, directive or recommendation made by the Navajo Nation Council, by virtue of its legislative oversight authority and pursuant to its authority as the governing body of the Navajo Nation, raising an issue of concern with respect to the internal functioning of the three Branches. Such concerns are advisory in nature, and do not create legal conditions precedent to the expenditure of appropriated funds. In order for a particular legislative concern to be appended to the Fiscal Year 1999 budget resolution, it must be voted upon and adopted by a majority of the Navajo Nation Council. Legislative Concerns which are not adopted will not be appended to the Fiscal Year 1999 budget resolution but will be referred to the appropriate Branch Chief in memorandum form by the Speaker of the Navajo Nation Council.

9. The Navajo Nation Council hereby authorizes and directs that, for the purposes of accounting for payroll (including fringe benefits) and making payments to employees only, Fiscal Year 1998 shall end on September 25, 1998, and Fiscal Year 1999 shall begin on September 28, 1998, and continue for twenty-six (26) pay periods. All Branch Personnel Offices are directed to ensure that all Reduction in Force (RIF's) required by the Fiscal Year 1999 Budget shall be effective September 25, 1998, to ensure proper advance notice to the affected employees.

10. The Navajo Nation Council hereby authorizes and approves the carryover of unexpended Fiscal Year 1998 General fund budgets into Fiscal Year 1999 for the Navajo Nation Solid Waste Management Program in the amount of $293,786, the Navajo Nation TANF Program in the amount of $1,280,498, Department of Agriculture in the amount of $64,366 and Capital Improvement Projects in the amount of $3,328,711; the Capital Improvement Projects remaining balances are attached hereto as **Exhibit "I"**.

11. The Navajo Nation Council further authorizes and approves the carryover of unexpended Fiscal Year 1998 General funds into Fiscal Year 1999 for the programs listed in **Exhibit "J"**, attached hereto and made apart hereto by reference.

12. The Navajo Nation Council hereby authorizes the Navajo Nation Chapters to manage and expend the funds appropriated by the Navajo Nation Council for the purposes set forth within this resolution. This resolution provides an independent grant of authority for such management and expenditure of Navajo Nation funds by the Chapters of the Navajo Nation, separate and apart from other codified and non-codified resolutions of the Navajo Nation Council which may provide a basis for this exercise of Chapter authority.

13. The Navajo Nation Council hereby waives Resolutions CS-45-84 and CMA-25-95 for the appropriations from the Navajo Nation Undesignated Reserves.

CERTIFICATION

I hereby certify that the foregoing resolution was duly considered by the Navajo Nation Council at a duly called meeting at Window Rock, Navajo Nation (Arizona), at which a quorum was present and that same was passed by a vote of 57 in favor, 2 opposed and 0 abstained, this 8th day of September 1998.

Kelsey A. Begaye, Speaker
Navajo Nation Council

9-9-98
Date Signed

Motion: Wallace Charley
Second: Lee B. Roy

CS-79-98

ACTION BY THE NAVAJO NATION PRESIDENT:

1. I hereby ~~give notice that I will not veto~~ sign into law the foregoing legislation, pursuant to 2 N.N.C. §1005 (C)(10), on this 18 day of Sept. 1998.

Milton Bluehouse, Sr., President
Navajo Nation

2. I hereby veto the foregoing legislation, pursuant to 2 N.N.C. §1005 (C)(10), this ___ day of _____, 1998 for the reason(s) expressed in the attached letter to the Speaker.

Milton Bluehouse, Sr., President
Navajo Nation

EXHIBIT "A"

THE NAVAJO NATION
P.O. BOX 3150 WINDOW ROCK, ARIZONA 86515 (520) 871-6310

THOMAS ATCITTY
President

MILTON BLUEHOUSE
Vice-President

March 10, 1998

MEMORANDUM

TO: Cordell Shortey, Executive Director
OFFICE OF MANAGEMENT & BUDGET

FROM: Bobby J. White
Bobby J. White, Controller
DIVISION OF FINANCE

SUBJECT: ***Revision - Fiscal Year 1999 General Fund Revenue Projection***

Ahktar Zaman has submitted a revision ($6.9 million decrease) to applicable portions of the Initial Fiscal Year 1999 General Fund Revenue Projection. As a result of this revision, I've attached a revised schedule on the Fiscal Year 1999 General Fund Revenue Projection.

Attachment

cc: Martin E. Ashley, "Acting" Assistant Controller, FSD
Pearl Lee, Accounting Manager, FSD
Ahktar Zaman, Director, Minerals Department/DNR
Steven Begay, Executive Director, ONTC
Mark Maryboy, Chairperson, B&F Committee
Thomas Atcitty, President, NN

THE NAVAJO NATION

GENERAL FUND REVENUES

($1 = $1,000)

Revenue Source	Actual				Initial Projection of Recurring Revenues			
	Year Ended 3/31/94	Year Ended 3/31/95	18 Mos. Ended 9/30/96	Year Ended 9/30/97	Year Ended 9/30/98	Year Ended 9/30/99	Year Ended 9/30/00	Year Ended 9/30/2001
Oil & Gas	$14,579	$16,304	$28,211	$20,964	$19,800	$17,000 (B)	$17,000	$17,000
Mining	$60,979	$53,012	$72,464	$54,170	$46,200	$49,300 (B)	$49,500	$49,500
Taxes	$38,059	$33,372	$44,807	$28,753	$24,549	$26,200	$26,200	$26,200
Investment Income	$6,829	$5,200	$10,673	$7,644	$5,500	$5,500	$5,500	$5,500
Land Rentals, ROW, Bus. Site	$6,487	$7,784	$20,900	$21,607 (A)	$5,500	$4,900	$5,300	$5,300
Court Fines & Fees	$930	$917	$1,655	$1,106	$1,000	$1,000	$1,000	$1,000
Other - Misc. Rev.	$1,231	$1,836	$3,657	$2,054	$500	$500	$500	$500
GROSS TOTAL:	$129,094	$118,425	$182,367	$136,298	$103,049	$104,400	$105,000	$105,000
Less 12 % Perm. Fund	($15,491)	($14,211)	($21,884)	($16,356)	($12,366)	($12,528)	($12,600)	($12,600)
Less 2% Land Aquis. Trust Fund			($3,647)	($2,726)	($2,061)	($2,088)	($2,100)	($2,100)
Net Revenue Available for Budget	$113,603	$104,214	$156,836	$117,216	$88,622	$89,784	$90,300	$90,300

(A) Includes the $14 million received from PNM Settlement.

(B) Revised pursuant to Minerals Department memo dated 3/4/98 supercedes previous schedule dated 1/26/98.

3/9/98

EXHIBIT "B"

THE NAVAJO NATION - FISCAL YEAR 1999
SUMMARY OF THE NAVAJO NATION OPERATING BUDGET

	DESCRIPTION	GENERAL FUNDS	INDIRECT COST FUNDS	REVOLVING FUNDS	OTHER TRIBAL FUNDS	FEDERAL FUNDS	STATE/PRIVATE FUNDS	TOTALS
1.	EXECUTIVE BRANCH	73,457,853	11,786,016	21,610,654	15,687,123	176,871,311	6,960,930	306,373,887
2.	LEGISLATIVE BRANCH	19,676,360	1,195,235	0	3,393,797	0	21,882	24,287,274
3.	JUDICIAL BRANCH	4,742,538	18,749	0	0	1,138,188	0	5,899,475
4.	**GRAND TOTAL:**	**97,876,751**	**13,000,000**	**21,610,654**	**19,080,920**	**178,009,499**	**6,982,812**	**336,560,636**

EXHIBIT "C"

THE NAVAJO NATION - FISCAL YEAR 1999
SUMMARY OF THE LEGISLATIVE BRANCH OPERATING BUDGET

	DESCRIPTION	GENERAL FUNDS	INDIRECT COST FUNDS	REVOLVING FUNDS	OTHER TRIBAL FUNDS	FEDERAL FUNDS	STATE/PRIVATE FUNDS	TOTALS
1.	Navajo Nation Council	2,605,288	534,500					3,139,788
2.	Government Services Committee	17,183	26,250					43,433
3.	Budget & Finance Committee	37,761	26,250					64,011
4.	Education Committee	20,808	26,250					47,058
5.	Public Safety Committee	13,458	26,250					39,708
6.	Resources Committee	19,771	26,250					46,021
7.	Ethics and Rules Committee	44,931						44,931
8.	Judiciary Committee	18,391	26,250					44,641
9.	Economic Development Committee	44,671						44,671
10.	Health & Social Services Committee	23,051	26,250					49,301
11.	Election Administration Office	770,927						770,927
12.	Ethics and Rules Office	271,225						271,225
13.	Office of Legislative Services	1,137,556	78,235					1,215,791
14.	Community Svcs Coord Prgm - Chinle	159,544						159,544
15.	Community Svcs Coord Prgm - Eastern	169,985						169,985
16.	Community Svcs Coord Prgm - Ft Defiance	162,295						162,295
17.	Community Svcs Coord Prgm - Shiprock	147,470						147,470
18.	Community Svcs Coord Prgm - Western	175,024						175,024
19.	Trans/Community Development Committe	24,776	26,250					51,026
20.	Navajo Nation Labor Commission	149,499						149,499
21.	Office of Miss Navajo Nation	109,540						109,540
22.	Black Mesa Review Board	42,675					21,882	64,557
23.	Office of Auditor General	719,328	20,000					739,328
24.	Intergovernmental Relations Committee	31,376	26,250					57,626
25.	Beclabito Chapter	91,122			14,471			105,593
26.	Office of the Speaker	895,753	150,000					1,045,753
27.	Office of Navajo Government Development	313,883						313,883
28.	Office of Legislative Counsel	513,877	150,000					663,877
29.	Human Services Committee	26,244	26,250					52,494
30.	Office of Legislative Personnel	199,277						199,277
31.	Community Svcs Coord Prgrm - Admin	157,330						157,330
32.	Agency Network Program	276,088						276,088
33.	Navajo Housing Authority	11,884						11,884
34.	Personnel Lapse Fund	(239,000)						(239,000)
35.	Navajo Utah Commission	145,407						145,407
36.	Navajo Hopi Land Commission	42,489						42,489
37.	Burnham Chapter	89,951			12,323			102,274
38.	Cudeli Chapter	90,920			15,276			106,196

THE NAVAJO NATION - FISCAL YEAR 1999
SUMMARY OF THE LEGISLATIVE BRANCH OPERATING BUDGET

	DESCRIPTION	GENERAL FUNDS	INDIRECT COST FUNDS	REVOLVING FUNDS	OTHER TRIBAL FUNDS	FEDERAL FUNDS	STATE/PRIVATE FUNDS	TOTALS
39.	Cove Chapter	90,033			14,068			104,101
40.	Hogback Chapter	96,678			25,700			122,378
41.	Mexican Water Chapter	92,683			18,556			111,239
42.	Nenahnezad Chapter	95,008			27,813			122,821
43.	Newcomb Chapter	91,812			17,377			109,189
44.	Red Mesa Chapter	94,762			27,162			121,924
45.	Red Valley Chapter	98,753			31,441			130,194
46.	San Juan Chapter	89,076			14,202			103,278
47.	Sanostee Chapter	102,240			45,851			148,091
48.	Sheepsprings Chapter	92,102			17,975			110,077
49.	Sweetwater Chapter	94,899			26,721			121,620
50.	Teesnospos Chapter	97,248			30,600			127,848
51.	Shiprock Chapter	131,337			140,885			272,222
52.	Two Grey Hills Chapter	95,453			25,001			120,454
53.	Upper Fruitland Chapter	98,092			42,365			140,457
54.	Birdsprings Chapter	90,851			17,752			108,603
55.	Bodaway-Gap Chapter	95,377			33,886			129,263
56.	Cameron Chapter	94,282			26,408			120,690
57.	Chilchinbeto Chapter	91,924			24,373			116,297
58.	Coalmine Mesa Chapter	90,807			15,409			106,216
59.	Coppermine Chapter	89,975			14,874			104,849
60.	Dennehotso Chapter	94,704			31,889			126,593
61.	Inscription House Chapter	92,521			23,828			116,349
62.	Kaibeto Chapter	96,817			35,420			132,237
63.	Kayenta Chapter	108,654			83,620			192,274
64.	LeChee Chapter	92,811			29,621			122,432
65.	Leupp Chapter	94,868			31,620			126,488
66.	Navajo Mountain Chapter	91,114			17,889			109,003
67.	Oljato Chapter	98,307			40,936			139,243
68.	Shonto Chapter	97,042			43,002			140,044
69.	Tolani Lake Chapter	89,997			17,290			107,287
70.	Tonalea Chapter	99,123			43,803			142,926
71.	Tuba City Chapter	122,129			126,918			249,047
72.	Naschitti Chapter	98,549			38,806			137,355
73.	Cornfields Chapter	92,123			20,149			112,272
74.	Coyote Canyon Chapter	95,783			31,602			127,385
75.	Crystal Chapter	92,893			23,089			115,982
76.	Dilkon Chapter	94,957			35,526			130,483

THE NAVAJO NATION - FISCAL YEAR 1999
SUMMARY OF THE LEGISLATIVE BRANCH OPERATING BUDGET

	DESCRIPTION	GENERAL FUNDS	INDIRECT COST FUNDS	REVOLVING FUNDS	OTHER TRIBAL FUNDS	FEDERAL FUNDS	STATE/PRIVATE FUNDS	TOTALS
77.	Fort Defiance Chapter	114,827			104,377			219,204
78.	Ganado Chapter	96,375			43,781			140,156
79.	Houck Chapter	95,669			32,859			128,528
80.	Indian Wells Chapter	91,455			24,622			116,077
81.	Jeddito Chapter	92,849			25,961			118,810
82.	Kinlichee Chapter	98,554			36,934			135,488
83.	Klagetoh Chapter	94,081			24,923			119,004
84.	Lower Greasewood Chapter	94,765			29,735			124,500
85.	Lupton Chapter	91,028			21,397			112,425
86.	Manuelito Chapter	89,911			17,668			107,579
87.	Whitecone Chapter	92,374			23,224			115,598
88.	Twin Lakes Chapter	96,046			38,566			134,612
89.	Mexican Springs Chapter	92,467			22,280			114,747
90.	Nahata Dzil Chapter	90,206			20,133			110,339
91.	Oak Springs Chapter	90,201			16,501			106,702
92.	Red Lake Chapter	88,049			29,237			117,286
93.	Rock Springs Chapter	91,887			26,359			118,246
94.	Sawmill Chapter	93,380			25,036			118,416
95.	St Michaels Chapter	105,858			83,644			189,502
96.	Steamboat Chapter	96,129			34,518			130,647
97.	Teesto Chapter	93,358			26,233			119,591
98.	Tohatchi Chapter	97,115			36,165			133,280
99.	Tsayatoh Chapter	91,170			25,260			116,430
100.	Wide Ruins Chapter	93,599			28,757			122,356
101.	Black Mesa Chapter	88,274			13,665			101,939
102.	Blue Gap Chapter	92,469			24,564			117,033
103.	Chinle Chapter	116,426			116,126			232,552
104.	Forest Lake Chapter	89,785			15,008			104,793
105.	Hardrock Chapter	93,348			27,427			120,775
106.	Low Mountain Chapter	91,466			19,269			110,735
107.	Lukachukai Chapter	97,427			40,842			138,269
108.	Many Farms Chapter	99,152			43,907			143,059
109.	Nazlini Chapter	92,644			24,847			117,491
110.	Pinon Chapter	100,237			45,806			146,043
111.	Rock Point Chapter	94,996			29,425			124,421
112.	Rough Rock Chapter	90,842			21,790			112,632
113.	Round Rock Chapter	92,655			22,311			114,966
114.	Tsaile/Wheatfields Chapter	97,203			34,966			132,169

THE NAVAJO NATION - FISCAL YEAR 1999
SUMMARY OF THE LEGISLATIVE BRANCH OPERATING BUDGET

	DESCRIPTION	GENERAL FUNDS	INDIRECT COST FUNDS	REVOLVING FUNDS	OTHER TRIBAL FUNDS	FEDERAL FUNDS	STATE/PRIVATE FUNDS	TOTALS
115.	Tselani/Cottonwood Chapter	98,807			37,460			136,267
116.	Whippoorwill Chapter	93,775			24,975			118,750
117.	Alamo Chapter	93,380			27,580			120,960
118.	Baca Chapter	96,747			27,284			124,031
119.	Becenti Chapter	88,854			13,397			102,251
120.	Breadsprings Chapter	90,573			23,074			113,647
121.	Canoncito Chapter	92,429			25,959			118,388
122.	Casamero Lake Chapter	88,186			15,008			103,194
123.	Chichiltah Chapter	96,862			34,694			131,556
124.	Churchrock Chapter	98,965			40,473			139,438
125.	Counselor Chapter	90,272			23,555			113,827
126.	Crownpoint Chapter	95,603			41,869			137,472
127.	Huerfano Chapter	100,042			47,524			147,566
128.	Iyanbito Chapter	89,751			19,975			109,726
129.	Lake Valley Chapter	87,682			12,726			100,408
130.	Littlewater Chapter	90,984			18,894			109,878
131.	Mariano Lake Chapter	90,995			19,714			110,709
132.	Nahodisgish Chapter	86,780			10,846			97,626
133.	Nageezi Chapter	96,249			29,599			125,848
134.	Ojo Encino Chapter	89,045			16,350			105,395
135.	Pinedale Chapter	92,358			20,739			113,097
136.	Pueblo Pintado Chapter	88,969			14,605			103,574
137.	Ramah Chapter	95,811			30,386			126,197
138.	Red Rock Chapter	96,052			29,687			125,739
139.	Smith Lake Chapter	89,894			16,082			105,976
140.	Standing Rock Chapter	89,484			13,397			102,881
141.	Thoreau Chapter	92,424			27,160			119,584
142.	Torreon Chapter	94,190			29,882			124,072
143.	Whitehorse Lake Chapter	88,941			15,947			104,888
144.	Whiterock Chapter	86,698			9,772			96,470
145.	Aneth Chapter	99,739			41,564			141,303
146.	**GRAND TOTAL:**	**19,676,360**	**1,195,235**	**0**	**3,393,797**	**0**	**21,882**	**24,287,274**

EXHIBIT "D"

THE NAVAJO NATION - FISCAL YEAR 1999
SUMMARY OF THE JUDICIAL BRANCH OPERATING BUDGET

	DESCRIPTION	GENERAL FUNDS	INDIRECT COST FUNDS	REVOLVING FUNDS	OTHER TRIBAL FUNDS	FEDERAL FUNDS	STATE/PRIVATE FUNDS	TOTALS
1.	Personnel Lapse Fund	(122,000)						(122,000)
2.	Administrative Office of Courts	704,356	2,302			1,138,188		1,844,846
3.	Chinle Judicial District Court	522,144	2,302					524,446
4.	Crownpoint/Ramah Judicial Distrist Courts	961,522	3,618					965,140
5.	Ft Defiance Judicial District Court	1,093,999	3,784					1,097,783
6.	Shiprock Judicial District Court	565,702	2,467					568,169
7.	Tuba City/Kayenta Judicial District Courts	1,016,815	4,276					1,021,091
8.	**GRAND TOTAL:**	**4,742,538**	**18,749**	**0**	**0**	**1,138,188**	**0**	**5,899,475**

EXHIBIT "E"

THE NAVAJO NATION - FISCAL YEAR 1999
SUMMARY OF THE EXECUTIVE BRANCH OPERATING BUDGET

	DESCRIPTION	GENERAL FUNDS	INDIRECT COST FUNDS	REVOLVING FUNDS	OTHER TRIBAL FUNDS	FEDERAL FUNDS	STATE/PRIVATE FUNDS	TOTALS
1.	Executive Offices	2,877,067	324,143					3,201,210
2.	Division of General Services	3,054,430	2,203,910	11,562,992	1,000,000	561,315		18,382,647
3.	Division of Finance	2,435,616	1,894,277	800,000	4,472,000			9,601,893
4.	Department of Justice	3,362,454	1,023,785			50,000		4,436,239
5.	Office of Management and Budget	777,182	534,621					1,311,803
6.	Office of Navajo Tax Commission	1,073,350						1,073,350
7.	Division of Economic Development	3,600,471	278,032	755,000	2,000,000			6,633,503
8.	Division of Community Development	7,292,986	411,805		515,203	8,855,633		17,075,627
9.	Division of Human Resources	3,193,449	527,773		4,690,000	19,980,433	142,444	28,534,099
10.	Division of Natural Resources	13,123,044	459,660	5,985,000	0	17,837,822		37,405,526
11.	Environmental Protection Agency	1,085,364	73,522			3,441,294		4,600,180
12.	Division of Public Safety	5,019,786	341,295	475,000		26,108,733	590,456	32,535,270
13.	Division of Health	8,321,476	142,700	10,000	460,000	38,477,063	3,156,583	50,567,822
14.	Division of Social Services	3,653,392	295,589	400,000		29,711,669	2,037,628	36,098,278
15.	Division of Dine Education	5,410,800	421,425	55,000	2,549,920	31,847,349	1,033,819	41,318,313
16.	Fixed Costs	8,249,730	2,853,479	1,567,662				12,670,871
17.	Fixed Cost Credit	(3,563,744)						(3,563,744)
18.	Tribal Grants	4,491,000						4,491,000
19.	**GRAND TOTAL:**	**73,457,853**	**11,786,016**	**21,610,654**	**15,687,123**	**176,871,311**	**6,960,930**	**306,373,887**

EXHIBIT "F"

Navajo Nation Fiscal Year 1999
Conditions of Appropriation or Expenditures

A. General Statement of Policy

It is the intent of the Navajo Nation Council that all Navajo Nation appropriated or allocated general funds, undesignated reserve funds, revolving funds, Federal funds, State funds, and other external funding sources be subject to the following Conditions of Appropriation or Expenditures. Primary responsibility for ensuring compliance with the conditions of appropriation shall rest with the Office of the Controller and coordinated with the Office of Management and Budget.

Further, the Budget and Finance Committee of the Navajo Nation Council in cooperation and coordination with the appropriate oversight committee shall exercise its statutory authority with respect to Branch, Division, Department and Program expenditures and financial performance through:

1. Quarterly review of expenditure patterns;
2. Quarterly review of revenue collection patterns;
3. Quarterly review of responses to and compliance with the Conditions of Appropriation or Expenditure;
4. Quarterly review of responses to and compliance with the Legislative Concerns.

B. Conditions of Appropriation or Expenditure

The following are the Fiscal Year 1999 operating budget conditions of appropriation or expenditure applicable to all expenditures made from October 1, 1998, to September 30, 1999:

1. To continue the development and use of performance based budgeting and management within the Navajo Nation government, all programs shall report the status of Fiscal Year 1999 stated goals and objectives to the Office of Management & Budget (OMB) on a quarterly basis. The status of a program's performance shall be considered during all legislative and administrative decisions pertaining to that particular program. Program performance information shall also continue to be a factor during the annual appropriation process. OMB shall be authorized to develop and implement a performance based management and budget methodology.

2. The Office of Contracts and Grants shall ensure that all programs funded by non-general funds shall include an indirect cost line item at the then current rate negotiated under the applicable provisions of federal OMB Circular A-87; unless the funding agreement is approved without sufficient indirect costs by the appropriate oversight committee and the Intergovernmental Relation Committee.

3. Th Office of Management and Budget shall on a quarterly basis review and identify all Programs and Departments without approved or current plans of operation and take appropriate steps to notify the program and the appropriate oversight committee of this deficiency so that an update of the plan of operation and enabling legislation for the affected Division or Program can be presented to the Navajo Nation Council and/or the appropriate standing committee of the Navajo Nation Council.

4. The Office of Management and Budget shall ensure that no enabling legislation and respective plan of operation for any Navajo Nation entity or program shall contain language requiring or approving an annual appropriation. All appropriations of funds shall occur through the annual Navajo Nation budget process or supplemental appropriations process.

5. The Office of Management & Budget shall ensure that Navajo Nation programs not utilize the Navajo Nation budgeting process to reorganize operations. All plans for reorganizations shall be made final by the end of the third quarter of the fiscal year in preparation for the upcoming fiscal year.

6. All revolving accounts for approved Navajo Nation Branches, Division, Departments and Programs shall operate pursuant to an official Fund Management Plan recommended by the appropriate oversight committee and approved by the Budget and Finance Committee of the Navajo Nation Council. The Office of the Controller shall identify all revolving accounts without Fund Management Plans and shall require the affected Branch, Division, Department or Program to present a Fund Management Plan for the affected revolving account to the appropriate oversight committee for recommendation to the Budget and Finance Committee for approval. Failure to comply with this condition will result in restriction of a program's access to revolving account funds.

7. The Office of the Controller shall review and approve all requests for transfer of funds between non-personnel line items within a program account. Due to estimated Budget Savings from personnel vacancies being included as credits within the budget (i.e. Personnel Lapse), transfer of funds (Current Year General Funds only) from personnel line items to non-personnel line items or between personnel line items, except for the Salary Adjustment Line Item, shall be prohibited.

8. The Office of the Controller and the Office of Management & Budget shall ensure that all requests for budget transfers within the same program and/or account which significantly affects or changes the original intent of the appropriation and/or budget be subject to approval by the program's respective oversight committee of the Navajo Nation Council pursuant to 2 NNC §185 (A).

9. All requests for additional funding or supplemental appropriations within the period of October 1, 1998 to September 30, 1999, shall be submitted to the appropriate Branch Chief and Branch budget officer prior to presentation to the appropriate oversight committee and the Budget and Finance Committee. Supplemental appropriations may be considered only if revenues beyond the Controller's original estimate of $104,400,000 are officially projected. The Controller shall inform all Branch Chiefs upon projection of additional revenues and each Branch Chief may seek additional appropriations from the Navajo Nation Council pursuant to recommendations from the Budget and Finance Committee. Each Branch Budget Office shall prepare a quarterly summary of supplemental request activities.

10. All oversight comm 'ttees of the Navajo Nation Council shall identify the source of funds to support recommendations for budget increases or additional appropriations.

11. All fairs and rodeos shall justify any funding requests by submitting proposals via the 2 NNC §164 process without exception, including the Navajo Nation Fair and July 4th Celebration/Rodeo.

12. Each Branch Personnel Office shall ensure the borrowing of vacant or occupied positions among Branches, Divisions, Departments, and Programs and Offices be prohibited. This prohibition shall not include the use of vacant positions for temporary employment of college interns or temporary usage of the vacant positions provided the usage is to fulfill the legislated purpose of the program under which the funds were authorized. All temporary, administrative and acting status assignments shall be done in accordance with the respective Branch personnel policies and procedures.

13. All lease/purchase or rental agreements for equipment, goods and vehicles shall be submitted to the Division of General Services and Division of Finance for review before execution of the contractual obligation so that expenditures for lease payments are properly processed.

14. Expenditures for the 7990 line item (Matching Funds) shall not be authorized and processed unless the final agreement for such match funding has been executed. If the external match funding is not obtained, the non-matched Navajo Nation general funds, including capital improvement match funds, shall revert to the undesignated reserve for appropriation by the Navajo Nation Council, upon recommendation to the appropriate oversight committee and the Budget and Finance Committee. The specific amount of match funding required for expenditures from the 7990 line item shall depend upon the specific agreement for match funding between the Navajo Nation and the external funding source. The Office to Contracts and Grants, in consultation with the Controller, shall report on a quarterly basis to the appropriate oversight committee and the Budget and Finance Committee informed as to the utilization and expenditure of funds within the 7990 line item.

15. All Navajo Nation government entities and organizations of the Navajo Nation seeking capital improvement funds from the Navajo Nation shall follow proper procedures as established by the Transportation and Community Development Committee of the Navajo Nation Council resolution TCDCMY-47-92 and funding of such capital improvement projects shall be made only upon the recommendation and approval of the Transportation and Community Development Committee of the Navajo Nation Council. The Capital Improvement Program, Division of Community Development, shall prepare a quarterly summary on CIP project activities.

16. The Office of Management and Budget shall be included in the 2 NNC 0164 review process regarding all budgetary and programmatic matters including budget reallocations and transfers, plans of operation and fund management plans.

17. The Personnel Lapse Credit accounts shall be monitored by the respective Branches, and the Controller will report the status of the Personnel Lapse Credit accounts to the Branch Chiefs appropriate oversight committee and Budget and Finance Committee on a quarterly basis.

18. The Office of the Controller, Office of Contracts & Grants and the Office of Management & Budget shall issue quarterly reports to the Branch Chiefs and legislative oversight committees on the status of all appropriations, including but not limited to current year

funds, continuing accounts, no-year fu ds, revolving funds, federal funds, state funds, indirect cost credits, and capital improvement project funds, under the respective jurisdiction of each oversight committee of the Navajo Nation Council.

19. The Office of Contracts and Grants shall provide quarterly expenditure reports and technical assistance to the Branch Chiefs and Divisions on external funds (non-general) to ensure that expenditures are made correctly and within established time-lines. Pursuant to applicable laws or regulations, oversight Committees may make appropriate fund reallocations.

20. The Agency Computer Network Program and the Computer Services Program of the Division of General Services shall coordinate information technology through the development and implementation of a technology plan so that all Navajo Nation government employees will utilize technology at their work stations.

21. In the period covering October 01, 1998 to September 30, 1999, when expending Fiscal Year 1999 operating funds all Navajo Nation government branches, programs, departments, divisions, entities, enterprises and authorities shall inform the Navajo Nation Chapters of the service delivery programs the chapters can implement at the local level through contracts, subcontracts or Navajo Nation Council appropriation. The development of the information to be disseminated to the Navajo Nation Chapters shall be accomplished in coordination and consultation with the branches, programs, departments, divisions and entities and the respective oversight committee(s) of the Navajo Nation Council.

22. When expending Fiscal Year 1999 operating funds, all Navajo Nation branches, departments, programs and offices shall recognize that the Office of Navajo Government Development is the lead Navajo Nation government agency to plan policy forums to implement the Local Governance Act.

23. All Navajo Nation, federal, state, and private funds appropriated by the Navajo Nation Council shall be expended for the purpose and intent for which said funds were granted to the Navajo Nation; programs other than the program receiving such funds are prohibited from expending such program funds.

24. Consistent with sound business practices, all Navajo Nation programs receiving external funds shall utilize the external funds in accordance with their contract provisions prior to expending the Navajo Nation general funds appropriated to them. The purpose and intent of this condition of appropriation is to ensure that all external funds provided to the Navajo Nation are fully expended and none of said funds will be carried over into succeeding fiscal years, unless such external funds are treated as available until expended by the funding sources.

25. When expending Fiscal Year 1999 funds, the Navajo Veterans Affairs Program will utilize consistent floor plans provided by the Navajo Housing Services, Division of Community Development, for Veterans Housing Assistance.

26. The Department of Youth/Community Services shall concentrate on involving parents in the youth activities and programs so that parents of the Navajo children that participate in such activities and programs become familiar with such activities and programs.

27. The Department of Youth/Community Services shal. network and coordinate all planning, development and implementation of youth activities and programs, including recreational equipment and facilities, with local resources and programs within the agencies, counties and region where services are provided. The local resources will include, but not be limited to, Navajo Nation chapters, NHA, IHS, Social Services, Ke' Project, Youth Detention, Police Department, and other Tribal/State entities.

28. The Diné College's appropriation of $2,000,000 shall be established as a Fixed Cost Account. Pursuant to 10 N.N.C. Section 125, the Diné College shall maintain its semi-independent status. The funds shall be solely subject to the spending authority of the Diné College Board of Regents, pursuant to 10 N.N.C. Section 2016(B). The Navajo Nation Council directs the Diné College Task Force to research and develop a funding strategy to stabilize funding for the Diné College. The Task Force shall develop and present a short and long range timeframe for achieving stable funding for approval by the Education Committee, Budget and Finance Committee and the Navajo Nation Council, which may include the creation of a trust fund or other fund into which a minimum annual appropriation of $2,000,000 can be made by the Navajo Nation Council. Further, the Diné College shall seek alternative funding resources and shall work with the Navajo Nation Tax Commission to develop a tax specifically for Diné College. The specific tax may include, but not limited to, gross receipts tax and mill levy.

29. The Navajo Nation Supply Center shall be utilized for all expenditures for the acquisition of office supplies. Other office supplies vendors may not be utilized unless satisfactory written justification is presented to the Controller of the Navajo Nation and approved by the Controller.

30. Fiscal Year 1999 Operating Budget for the Navajo Nation Office of the President and Vice President shall be apportioned and drawn down quarterly for the first six months of Fiscal Year 1999. The purpose and intent of this condition of appropriation is to ensure that sufficient Fiscal Year 1999 funds are available for the new administration.

31. The Navajo Hopi Land Commission Office shall equally assist Navajo families residing in the Navajo Partitioned Land and Hopi Partitioned Land when expending Fiscal Year 1999 operating funds.

32. The Navajo Election Administration shall utilize the Navajo Times printing press to print election ballots for all Navajo Nation elections.

33. Consistent with Navajo Nation law, the Navajo Nation Environmental Protection Agency must enter Joint Powers Agreement with San Juan County, Utah, to correct environmental and solid waste in the Aneth and Red Mesa areas.

34. The Navajo Nation Environmental Protection Agency must ensure that federal funds set aside for ground water protection be decentralized so that areas affected by the pollution will directly benefit instead of centralizing the funds at Window Rock, Navajo Nation (Arizona).

35. The Navajo Nation Environmental Protection Agency must ensure that appropriate information and identified eligible open dump sites are documented to ensure that the Navajo Nation is not placed in a position to be responsible for ineligible dumps.

36. The Navajo Nation Environmental Protection Agency shall continue to investigate the uranium contaminated material located in a building at Montezuma Creek, Utah, and take appropriate measures to address the situation including possible testing of nearby residents.

37. When expending Fiscal Year 1999 operating funds, the Chapter Government Development Department of the Division of Community Development shall coordinate and plan with the Community Services Program of the Legislative Branch to ensure that the Chapter Government Development Department merges with the Community Services Program in Fiscal Year 1999.

38. When expending Fiscal Year 1999 operating funds, the Office of Auditor General shall conduct a performance audit of the Office of Management and Budget, Evaluation Section, to determine the feasibility of program existence. The Office of Management and Budget was directed in Fiscal Year 1998 to conduct said study but did not comply with said directive. The study is necessary to determine program effectiveness and eliminate duplication.

39. When expending the Fiscal Year 1999 operating funds, the Budget and Finance Committee of the Navajo Nation Council shall seek $1 Million to be appropriated by the Navajo Nation Council as supplemental funds in Fiscal Year 1999 for the Office of Navajo Government Development for the implementation of the Local Governance Act.

40. The Judicial Branch shall cooperate fully with the attorneys representing the claimants in the San Juan County, Utah, in the lawsuit claiming that Navajos are excluded from jury selection in state court proceedings. The Judicial Branch shall provide the Navajo claimants attorneys the names of all Navajo Nation Judicial Branch employees and officials who have addressed this matter, as well as all requested documents and other information relative to the Navajo Nation Judicial Branch in working with the Utah authorities to address the exclusion of Navajos from the state jury selection lists.

41. Judges of the Navajo Nation shall be entitled to educational leave on the same basis as all other employees of the Navajo Nation; judges shall not receive educational leave benefits on terms which are greater than or more favorable than those available to all other employees of the Navajo Nation. The Chief Justice shall not grant educational leave benefits to judges if such leave interferes with the full-time performance of the judge and shall withdraw leave grants which are inconsistent with this policy. The Chief Justice shall ensure that all judges provide full time service to the Navajo Nation. The Chief Justice shall revise the Judicial Branch personnel policies in compliance with this condition of appropriation.

42. The Judiciary Committee and Public Safety Committee of the Navajo Nation Council shall consider and propose amendments to the fine provisions of Title 14 and 17 to bring those fines into line with the maximum fines currently allowed under the Indian Civil Rights Act, 25 USC Section 1321. Amendments shall be reported to the Navajo Nation Council at the 1999 Summer Session. A study shall also be conducted by the Division of Finance to establish a mechanism which ensures that retirement benefits of judges are fully funded and regularly receive appropriate cost of living adjustments.

43. When expending Fiscal Year 1999 operating budget, the Branch Chiefs of the Navajo Nation shall seek on priority basis federal funds to finance the construction of detention facilities on the Navajo Nation. Each Branch Chief shall coordinate their efforts to accomplish this condition of appropriation with the respective oversight committees of the Navajo Nation Council.

44. The Chief Justice and the Judiciary Committee of the Navajo Nation Council shall study and determine the feasibility of establishing a district court on the Utah portion of the Navajo Nation.

45. Consistent with the relevant provisions in the Navajo Preference in Employment Act, all branches, divisions, departments and programs of the Navajo Nation employing non-Navajo employees shall ensure that a training plan is in place to train Navajo Nation employees to perform the job duties of the non-Navajo employee.

46 The Controller of the Navajo Nation shall establish new accounts for the Ramah Judicial District in the amount of $323,454, Supreme Court of the Navajo Nation in the amount of $325,047, Peacemaker Division in the amount of $124,831 and Kayenta Judicial District in the amount of $419,178. The funds for the new accounts will be reallocated from the appropriated funds for Programs 9806, 9807, 9808, 9809, 9810 and 9811 of the Judicial Branch. The Judiciary Committee of the Navajo Nation Council will reallocate the appropriated general funds to ensure that the new account are budgeted for use in Fiscal Year 1999.

47. The Office of the President and Vice President of the Navajo Nation shall prepare a proposed application to the United States for designation of the Four Corners region as an Empowerment Zone (EZ) designed to establish a strategic vision for the future involving community-based partnerships fostering sustainable community and economic development. The Office of the President and Vice President shall ensure that in the development of the application Navajos will have a controlling majority on the EZ governing board, that compliance be required with all applicable Navajo Nation laws, that the background of all non-Navajos be properly scrutinized and that approval of the involved standing committees of the Navajo Nation Council be sought and obtained.

48. The Office of the President and Vice President of the Navajo Nation shall evaluate the entire Navajo Nation Law Enforcement Department, including the districts, to determine the possibility of reorganizing the department and amending its plan of operation. The findings and recommendations shall be reported to the Navajo Nation Council within the first six months of Fiscal Year 1999.

49. The Navajo Hopi Land Commission Office shall under the direction of the President of the Navajo Nation and Navajo Hopi Land Commission coordinate plans for the administration and utilization of the Navajo Rehabilitation Trust Fund.

50. All Navajo Nation government vehicles shall be utilized for official use only and program directors and supervisors shall strictly enforce this condition of appropriation. The vacant positions on the Motor Vehicle Review Board shall be filled immediately and the Board will assist in the enforcement of this condition of appropriation.

51. The Controller of the Navajo Nation shall reevaluate the existing process and procedures to determine the expenditure level for all Navajo Nation revolving accounts.

52. The Division of Economic Development shall seek supplemental funds in Fiscal Year 1999 in the amount of $2 Million for the Antelope Point infrastructure development (i.e. waterline, powerline, sanitation system and the construction of the fee station). The supplemental request shall be presented to the Navajo Nation Council at the 1998 Fall Session.

53. The Budget a d Finance Committee of the Navajo Nation Council shall seek supplemental appropriation in the amount of $500,000 in Fiscal Year 1999 for the Navajo Wool Marketing Program to pay for prior fiscal year deficit and program operating budget.

54. The Division of Economic Development shall seek a supplmental appropriation for the establishment of a salaried personnel position which shall be dedicated to seeking economic opportunities associated with the Year 2002 Winter Olympic Games in Salt Lake City, Utah, from February 8-24, 2002, for the Navajo Nation and Navajo craftsmen and businessmen. The economic opportunities sought by this position shall include, but not be limited to, tourism promotion, corporate recruiting, artisan/vendor relationships, cultural events, job opportunities associated with the Games and access to surplus property after the games. This position would also coordinate closely with the Utah Department of Community and Economic Development Director of Olympic and Business Relations and the Economic Development Committee of the Navajo Nation Council. The position, if funded, would be stationed at the Navajo Utah Commission Office at Aneth, Navajo Nation (Utah).

55. The Division of Economic Development shall develop a Navajo Nation crafts patent law and seek patents for the Navajo jewelry, rugs and crafts to preserve and ensure the authenticity of the Navajo jewelry, rugs and crafts.

56. The Division of Economic Development shall study the feasibility and seek external funds through the Transportation Equity Act and other legislation for toursim development on the Navajo Nation.

57. The Department of Justice and Office of Legislative Counsel, in consultation with the Division of Economic Development, shall develop legislation similar to the New Mexico Manufactured Housing Act (NMSA Section 60-14-1, et seq.) and the New Mexico Unfair Trade Practices Act (NMSA Section 57-21-1, et seq.) for presentation and adoption at the Fall 1998 Session of the Navajo Nation Council. These entities may also consult other similar consumer protection laws from other states, but shall ensure that the legislation which is presented is designed to suit local, Navajo Nation conditions.

58. The Navajo Housing Services Department Agency Offices shall determine the clients to be assisted with housing material and labor in burnout cases.

59. The Division of Community Development shall bring forth resolutions to the Transportation and Community Development Committee and Government Services Committee to amend the plan of operation for the Navajo Housing Services Program to ensure that funds allocated to the Navajo Nation Chapters are categorized as discretionary funds instead of entitlement funds.

60. The Division of Resources shall ensure that the Historic Preservation Department Roads Planning Section (Public Law 93-638) and the Project Review Office Right-of-Way Section (Public Law 93-638) are properly transferred, including the external funds of these programs, to the Division of Community Development in Fiscal Year 1999. The Division of Resources and Division of Community Development are directed to ensure that the existing Public Law 93-638 contracts for the Roads Planning Section and Right-of-Way Section are appropriately modified and/or amended to accomplish the intent and purpose of this condition of appropriation.

61. The Staff Development and Ti ining Program will develop a two (2) day LGA workshop in October 1998 for the current members of the Navajo Nation Council and a comprehensive three (3) day LGA workshop for the new and incoming Council delegates that will take the oath office in January 1999. The development of the workshop will be planned and coordinated with the Community Services Program, Office of Navajo Government Development (Legislative Branch), Office of the Controller (Division of Finance), Chapter Government Development (Division of Community Development) and the Public Employment Program, (Division of Human Resources).

62. The Navajo Department of Workforce Development shall exceed the established minimum requirement of expending 85% of allocated funds from the grantor. The Navajo Department of Workforce Department will expend 97% of the base budget of the new grant year external funds allocated for all youth and adult programs.

63. The Division of Natural Resources shall identify Fiscal Year 1999 appropriated general funds for the Historic Preservation Department and Division of Resources Administration to be reallocated by the Resources Committee of the Navajo Nation Council for a Ranger position under the Resources Enforcement Program. The Ranger position shall be assigned to protect on a full time basis the petrified wood in the southwestern area of the Navajo Nation.

64. The Budget and Finance Committee of the Navajo Nation Council shall seek Fiscal Year 1999 supplemental funds in the amount of $457,522 for the Navajo Nation Americorp Program.

65. The Executive Director of the Division of Natural Resources shall propose amendments to the plans of operation for the District Grazing Committee and Land Boards so that they are separated from the Department of Agriculture and become a department within the Division of Natural Resources. The respective plans of operation shall be amended by the Government Services Committee of the Navajo Nation Council by the 1998 Navajo Nation Council Fall Session.

66. The Navajo Nation Environmental Protection Agency ("EPA") shall address the health and safety concerns of Navajos in the Utah portion of the Navajo Nation relative to the transportation of nuclear materials through the Navajo Nation to and from the White Mesa Mill in Blanding, Utah. The Navajo Nation EPA shall further determine the extent that operation of the mill will or could have negative effects upon the health and safety of Navajo persons, their livestock and crops, as well as wildlife and vegetation within the Navajo Nation. The Navajo Nation EPA shall take all actions authorized under their plan of operation to prevent the unauthorized entry of persons onto Navajo Nation land with nuclear materials. The Navajo Nation EPA shall further take all authorized actions to protect Navajo persons, livestock, crops, wildlife and vegetation against negative effects resulting from the operation of the White Mesa Mill in Blanding, Utah. The Navajo Nation EPA shall report to the Resources Committee of the Navajo Nation Council on a quarterly basis relative to their progress and activities on this condition of appropriation.

67. When expending the Fiscal Year 1999 operating budget, the Emergency Management and Disaster Assistance Programs shall consider the preservation of human life as its first priority in the provision of services and expenditure of program funds.

68. The Division of Public Safety shall cooperate fully with the Lupton Chapter in regard to returning the lease of the former Public Safety Building located at Lupton, Navajo Nation (Arizona),to Lupton Chapter. In addition, the Division of Public Safety shall be

fully responsible for the clean-up of the environm .ıtal aspects of the building. The Budget and Finance Committee of the Navajo Nation Council shall seek supplement funds in Fiscal Year 1999 for the clean-up environmentally unsafe material in the Lupton Public Safety Building and other environmentally unsafe buildings of the Navajo Nation.

69. The Public Safety Committee of the Navajo Nation Council shall develop and submit a proposal seeking $150,000 supplemental funds in Fiscal Year 1999 to purchase a fire truck to provide services to the residents of the southwestern area of the Navajo Nation.

70. The Division of Health, Shiprock Agency Navajo Area on Aging Agency, shall ensure that $43,691 initially allocated for the Cove Chapter Senior Center shall be assigned to and expended for the Nenahnezad Chapter Senior Center; the $43,691 designated for the Nenahnezad Chapter shall be allocated as following: $27,240 in line item 2100; $300 in line item 2200; $300 in line item 2300; $3,300 in line item 4400; and $12,551 in line item 8100.

71. The Budget and Finance Committee of the Navajo Nation Council shall seek in Fiscal Year 1999 supplemental funds in the amount of $25,029.49 for the Iyanbito Chapter Senior Center Supervisor position.

72. The Office of the Navajo Nation President shall not remove the current Executive Director of the Division of Social Services, Leila Help-Tully, during the remainder of Fiscal Year 1998 and Fiscal Year 1999 through the end of the current Presidential term.

73. The Education Committee of the Navajo Nation Council shall review the feasibility of allowing grant schools within the Navajo Nation to receive and accept FI&R funds at the local level.

74. The Office of Navajo Nation Scholarship and Financial Assistance shall seek the scholarship funds contributed by Peabody Western Coal Company to the Council of Energy Resource Tribes ("CERT") and set aside said funds for the chapters directly impacted by the Peabody coal mine. The CERT scholarship funds shall be equally distributed to the affected chapters such as Kayenta Chapter, Chilchinbeto Chapter, Forest Lake Chapter and Shonto Chapter.

75. The Division of Diné Education shall seek supplement appropriations in Fiscal Year 1999 reestablish a Counselor position for the Eastern Agency Department of Youth/Community Services; Agency Program Director for the Western Agency Department of Youth/Community Services; and Agency Program Director for the Fort Defiance Agency Department of Youth/Community Service.

76. Programs that receive funding adjustments during the Fiscal Year 1999 Navajo Nation Council budget appropriations session shall coordinate with the Office of Management and Budget to revise the Fiscal Year 1999 program performance criteria (goals and objectives) to reflect the funding adjustments. Any revised program performance information shall be concurred by the appropriate oversight standing committee of the Navajo Nation Council.

77. The Department of Justice, the Office of Navajo Labor Relations, with the oversight of the Government Services Committee and the Human Services Committee shall propose amendments to the Navajo Preference in Employment Act to address the following concerns:

(a) The most cost effective and feasible method to adjudge complaints submitted to the Navajo Labor Commission;

(b) In conjunction with the Division of General Services and the Department of Personnel Management, the above noted entities shall research the possibility of purchasing personnel liability insurance for the Navajo Nation, as well as other alternatives, including, but not limited to, the creation of some form of "self-insured reserve" account. Such review and recommendation shall include a review of the NPEA, ONLR policies and procedures, the Navajo Nation's labor laws and the Navajo Nation Personnel Policies and Procedures; and

(c) In addition, DOJ and ONLR shall consider amendments to the Navajo Preference in Employment Act in a manner consistent with the Local Governance Act and the provisions of this Condition of Appropriation.

78. The Budget and Finance Committee of the Navajo Nation Council shall seek Fiscal Year 1999 supplemental appropriation in the amount $300,000 for the full implementation of the Diné Elder Protection Act of the Navajo Nation.

EXHIBIT "G"

Navajo Nation Fiscal Year 1999
Legislative Concerns

A. General Statement of Policy

It is the intent of the Navajo Nation Council that the appropriate Branch, Divisions, Departments and Programs carryout or address the following legislative concerns. Primary responsibility for ensuring compliance with legislative concerns shall rest with the appropriate Branch Chief, Program Managers, and coordinated with the Office of Management and Budget.

Further, the respective standing committees of the Navajo Nation Council in cooperation and coordination with the appropriate Branch Chief and Program Managers shall exercise its statutory authority in assuring the concerns are addressed:

B. Legislative Concerns

The following are the Fiscal Year 1999 operating budget legislative concerns:

1. The Office Navajo Government Development shall develop plans for the establishment of five (5) Agency Administration Buildings for the purpose of housing decentralized programs that will provide administrative/technical services to the Navajo Nation Chapters. The plans shall be presented to the affected Navajo Nation programs and their respective oversight committee(s) of the Navajo Nation Council for final adoption or recommendation to the Navajo Nation Council.

2. The Office of the Speaker, Chinle Agency Community Services Program, Eastern Agency Community Services Program, Fort Defiance Agency Community Services Program, Shiprock Agency Community Services Program, Western Agency Community Services Program, Office of Navajo Government Development and the Division of Financial Services shall jointly plan, develop and implement financial service offices at the Agency level for fiscal operations, check disbursements, and similar activities.

3. The Speaker of the Navajo Nation Council and the Chairpersons of the standing committees of the Navajo Nation Council shall authorize on priority basis the committee chairpersons, vice-chairpersons and/or sub-committees to conduct off-Navajo Nation travels due to limited standing committee travel funds.

4. The Division of Community Development Administration must develop a Fiscal Year 1999 supplemental budget to reestablish the Planner position.

5. The Construction Supervisor position located at the central office of the Housing Services program should be transferred to one of the Navajo Housing Services Agency Offices.

6. In the event that external funds are obtained to fund the remaining four (4) Agency staff of the Housing Services Program, the Division of Community Development and Navajo Housing Services (Central) shall develop a Navajo Nation supplemental budget to match fund the external funds.

7. The Comp ter Services Program of the Division of General Services and Agency Network Program of the Legislative Branch shall ensure that all Navajo Nation government computer support systems are upgraded to address the anticipated computer program problems anticipated in the year 2000.

8. Navajo Department of Work Force Development will ensure that services it provides are fully integrated into and support the Navajo Nation TANF Plan.

9. The Navajo Department of Work Force Development Program management, planning section and agency directors will ensure that the Fiscal Year 1999 Summer Youth Employment Training Program (SYETP) federal funds become available for expenditure expeditiously and implement two (2) cycles of Summer Youth Employment.

10. Navajo Department of Veterans Affairs will continue to seek and attain direct block grant funding to assist the Navajo Veterans with housing assistance under the provisions of the Native American Housing Assistance and Self-Determination Act (NAHASDA) of 1996 (P.L. 104-330). This effort will be coordinated with the Navajo Housing Services, Division of Community Development and the Navajo Housing Authority.

11. Navajo veterans, surviving spouses and Gold Star Mothers will be given the highest priority for housing assistance.

12. Department of Personnel Management will continue its efforts to fully analyze the organizational and managerial structure of the Navajo Nation Government, divisions and programs and recommend the process that will streamline and merge services to be more cost effective. This effort will be coordinated with the Office of Management and Budget (OMB), the affected divisions and programs and respective oversight committees of the Navajo Nation Council. The provisions and intent of the Local Governance Act will be incorporated into the final recommendations.

13. The Department of Personnel Management and the Office of Navajo Labor Relations will ensure that "Affirmative Action Plans" are developed by all divisions, departments and programs that presently employ non-Navajo program directors and supervisors. This effort will be coordinated with the Legislative and Judicial Branches of the Navajo Nation Government. A complete status report will be presented to the Human Services Committee of the Navajo Nation Council and other appropriate standing committees by March 31, 1999.

14. The Staff Development and Training Program will continue to provide training on prevalent issues associated with Human Resources and concentrate on providing the same training to the new and incoming Council Delegates that will take the oath of office in January, 1999.

15. Navajo Office of Safety and Health Administration (NOSHA) will ensure that the NOSHA Code of the Navajo Nation is fully developed and enacted by the Navajo Nation Council for use by the Navajo Nation Government. All NOSHA employees will wear badges as a form of identification.

16. Public Employment Program will revise its program plan of operation to be consistent and in line with the purpose and objectives of the Local Governance Act.

17. The Division of Diné Educ tion and Department of Personnel Management shall coordinate the delegation of the recruitment and selection process to the Division of Diné Education to ensure that all personnel vacancies are filled expeditiously so that programs can immediately expend their personnel funds. Delays in the recruitment and selection process have caused program dollars to revert back to the Navajo Nation General funds which negatively impacts the quality of educational services provided to the Navajo people.

18. In accordance with the Local Governance Act, Navajo Nation Chapters shall establish funds supporting youth activities and programs, including funding for personnel positions.

19. The Executive Budget Review Team must be knowledgeable and aware of Diné Education programs, priorities, laws, regulations, etc. to review, recommend approval of the Division of Diné Education' budget.

20. The Office of Navajo Nation Scholarship and Financial Assistance must comply with established and adopted procedures and policies when evaluating and awarding financial assistance and scholarship to applicants and continuing students.

21. The Office of Navajo Nation Scholarship and Financial Assistance must inform the Navajo Nation general public of the Navajo Nation scholarship and financial assistance programs available for Navajo students. The intent and purpose of this legislative concern is to ensure that scholarship and financial assistance funds are accessible by the Navajo students.

22. Elected officials of the Navajo Nation who are veterans of the armed forces and honorably discharged should be eligible and considered for receiving veterans benefits.

23. A comprehensive bond financing plan must be developed by the Controller of the Navajo Nation; capital projects that will be financed may include high school facilities, Diné College facilities, government buildings, Pinon Health Center, etc.

24. The President and Vice President of the Navajo Nation, Navajo Nation Washington Office, Archeology Department and Historic Preservation Department shall propose amendments to the Navajo Nation and federal laws that require environmental and archeological clearance prior to proceeding with capital projects. The amendments must ensure that capital improvement projects of the Navajo Nation are processed and completed expeditiously.

25. The Executive Director of the Division of Economic Development shall determine the feasibility of assigning a personnel position under the Business Regulatory Department to the Montezuma Creek, Red Mesa and Aneth areas.

26. The Division of Economic Development shall seek funds for business development within the Shiprock area to compensate livestock owners when taking away their customary use area and to pay for costs associated with archaeological clearances and environmental studies. The purpose and intent of this legislative concern is to ensure that Navajo lands will be readily available for future business developments in the Shiprock area.

27. The Office of Navajo Labor Relations and the Human Services Committee of the Navajo Nation Council shall immediately assist complainants by minimizing referral of the complainants to other offices and simplifying the complaint form. The Office of Navajo Labor Relations shall monitor entities such as Indian Health Services and other private organizations that employ Navajos on the Navajo Nation regarding their compliance with the Navajo Preference in Employment Act and enforce the same Act.

28. The Transportation and Community Development Committee of the Navajo Nation Council shall reallocate funds of those chapters whose capital improvement projects in the Exhibit "I" list are 100% completed or whose capital improvement project funds in Exhibit "I" are less than $1000 if such chapters do not submit additional capital improvement projects proposals by the end of January 1999. The funds subject to reallocation shall be reallocated for house wiring and other special projects.

29. The District Grazing Committee Office of the Division of Natural Resources shall periodically inform the District Grazing Committee Members and the Land Board Members of the balances in their Fiscal Year 1999 operating budgets, status of their respective plan of operation, and other developments relating to their duties and responsibilities.

30. The Public Safety Committee of the Navajo Nation Council, in consultation with the Department of Justice, shall ensure that the Resource Enforcement Program Rangers are properly certified to carry fire arms, mace and batons and determine if the Resources Enforcement Program Rangers should issue traffic citations or recommend the Program to be redirected so that the Rangers' primary duties and responsibilities are to enforce the Navajo Nation rules, regulations, policies and laws pertaining to livestock management and grazing.

31. The Executive Director of the Division of Natural Resources and the Director of the Department of Agriculture shall meet with Mr. David Tsosie to reach an agreement on a payment in the amount of $4,735 to Mr. David Tsosie for services provided by Mr. Tsosie under a previous contract.

32. The Division of Natural Resources and the Resources Committee of the Navajo Nation Council shall review the overall feasibility of allowing Navajo livestock growers to graze their livestock on the Boquillas Ranch and other ranches owned by the Navajo Nation.

33. The Public Safety Committee of the Navajo Nation Council, Division of Public Safety Administration, Department of Highway Safety of the Division of Public Safety and the Transportation and Community Development Committee of the Navajo Nation Council shall determine the feasibility of establishing a Navajo Nation Highway Patrol Program. The source of funds for the new program should include the State of Arizona, New Mexico and Utah gasoline tax paid by the people living on the Navajo Nation.

34. The Health and Social Services Committee of the Navajo Nation Council shall seek match funds from the Navajo Nation schools that have Navajo students that receive Navajo Nation student clothing program funds to match the Navajo Nation student clothing funds.

EXHIBIT "H"

BFAU-111-98

**RESOLUTION OF THE
BUDGET AND FINANCE COMMITTEE
OF THE NAVAJO NATION COUNCIL**

Approving and Recommending that the Navajo Nation Council Adopt the Fiscal Year 1999 Navajo Nation Operating Budget and Other Related Actions

WHEREAS:

1. Pursuant to 2 N.N.C. §§371 and 374 (B)(1), the Budget and Finance Committee is established and continued as a standing committee of the Navajo Nation Council with the authority to recommend to the Navajo Nation Council the budgeting, appropriation, investment and management of all funds; and

2. Pursuant to 2 N.N.C. §§372 (B)(3) and (4), the purpose of the Budget and Finance Committee of the Navajo Nation Council is to recommend the adoption of legislation designed to strengthen the fiscal and financial position of the Navajo Nation, to promote the efficient use of the fiscal and financial resources of the Navajo Nation, to protect the interests of the Navajo people through prudent management of financial reserves of the Navajo Nation and the efficient use of funds available for expenditure by the Navajo Nation; and

3. By Resolution BFMY-45-98, the Budget and Finance Committee of the Navajo Nation Council accepted the Navajo Nation Controller's General Fund Revenue Projection of $104,400,000 for Fiscal Year 1999, established the Fiscal Year 1999 Budget Ceiling, and adopted the Budget Instructions Manual for the preparation of the Fiscal Year 1999 Navajo Nation Operating Budget; and

4. Pursuant to Navajo Nation Council Resolution CJY-53-85, twelve percent (12%) of all General Fund revenues shall be appropriated to the Navajo Nation Permanent Fund which is calculated at $12,528,000 using the revenue projection of $104,400,000 for Fiscal Year 1999 leaving a balance of $91,872,000; and

5. Pursuant to Navajo Nation Council Resolution CJY-54-94, two percent (2%) of all General Fund revenues shall be appropriated to the Navajo Nation Land Acquisition Trust Fund which is calculated at $2,088,000 using the revenue projection of $104,400,000 for Fiscal Year 1999 thereby leaving $89,784,000 net available for the Navajo Nation Fiscal Year 1999 Operating Budget appropriations; and

6. By Resolution CS-45-84, the Navajo Nation Council approved and established the Tribal Reserve Fund at $55 Million and directed that the Tribal Reserve be maintained at said amount; and

7. By Resolution CAP-31-94, the Navajo Nation Council adopted and approved the Fiscal Year 1995 Navajo Nation operating budget and other related actions and directed the Controller, the Budget and Finance Committee of the Navajo Nation Council and Attorney General to study the feasibility of maintaining $55 Million minimum fund balance for the Tribal Reserves; and

8. By memorandum dated August 26, 1998, the Controller of the Navajo Nation issued the second revision of the Fiscal Year 1998 General Fund Revenue Projection at which the Controller stated that $10,973,000 is an additional revenue. After depositing 12% for the Permanent Trust Fund and 2% for the Land Acquisition Trust Fund, $9,437,000 is available for deposit into the Navajo Nation Undesignated Reserve at the end of Fiscal Year 1998; and

9. By Resolution TAX-98-141, the Navajo Nation Tax Commission authorized release of $2 Million from the Navajo Nation Tax Administration Suspense Fund for appropriation in Fiscal Year 1999 as an additional base to the Fiscal Year 1999 revenues. By Resolution GSCAU-51-98, the Government Services Committee of the Navajo Nation Council recommended the release of $2 Million from the Navajo Nation Tax Administration Suspense Fund to the General Funds. $240,000 of the $2 Million Tax Administration Suspense Fund will be appropriated for deposit into the Navajo Nation Permanent Trust Fund and $40,000 of the $2 Million Tax Administration Suspense Fund will be appropriated for deposit into the Navajo Nation Land Acquisition Trust Fund leaving $1,720,000 net available for Navajo Nation Fiscal Year 1999 Operating Budget appropriation; and

10. Through regular budget deliberations, the Budget and Finance Committee of the Navajo Nation Council made a detailed review of the proposed Fiscal Year 1999 operating budgets presented by the three Branch Chiefs of the Navajo Nation and recommendations presented by the various standing committees of the Navajo Nation Council for divisions, departments and programs over which they have oversight responsibilities; and

11. Pursuant to Resolution CS-64-96, Exhibit "E", and CMA-25-96, Exhibit "E" and Resolution CMA-35-96 Exhibit "E", #16: "a" through "h", programs and departments were requested to present reorganization, consolidation, or merger plans to implement cost savings. The Budget and Finance Committee of the Navajo Nation Council determines that it remains incumbent upon the Navajo Nation government divisions, departments and programs to complete reorganizing and restructuring their functions; eliminate duplicate functions and costs; and merge compatible programs that have similar goals, objectives, and missions; and

12. Historically, the Navajo Nation Council, in considering the resolution approving the annual operating budget, has created conditions precedent to expenditures and expressed concerns with regard to government operations through policy, directives, and cost containment measures. Pursuant to Resolution CAP-16-95, the method used by the Navajo Nation Council to express conditions precedent and concerns was defined either as a "Condition or Appropriation or Expenditure" or as a "Legislative Concern"; and

13. The Navajo Nation Council appropriated supplemental funds in Fiscal Year 1998 for Navajo Nation programs and the Navajo Nation President informed the Budget and Finance Committee that substantial CIP funds will revert to the Navajo Nation General Funds as year end balances. The Budget and Finance Committee determines that it is appropriate to carryover from Fiscal Year 1998 to Fiscal Year 1999 unexpended general funds for the Solid Waste Management Program, Navajo Nation TANF and Capital Improvement Projects; and

14. The Budget and Finance Committee of the Navajo Nation Council finds that the budget appropriation as recommended herein is in the best interests of the Navajo Nation.

NOW THEREFORE BE IT RESOLVED THAT:

1. The Budget and Finance Committee of the Navajo Nation Council hereby accepts the Navajo Nation Controller's General Fund Revenue Projections of $104,400,000 for Fiscal Year 1999, attached hereto and incorporated herein as Attachment "A".

2. The Budget and Finance Committee of the Navajo Nation Council hereby adopts and recommends that the Navajo Nation Council appropriate the Fiscal Year 1999 General Fund revenues for $12,528,000 to the Navajo Nation Permanent Fund; $2,088,000 to the Navajo Nation Land Acquisition Trust Fund and the net available of $89,784,000 for the Navajo Nation Operating Budget.

3. The Budget and Finance Committee of the Navajo Nation Council hereby adopts and recommends that the Navajo Nation Council appropriate $3,585,907 from the Navajo Nation Undesignated Reserves for the Navajo Nation Operating Budget.

4. The Budget and Finance Committee of the Navajo Nation Council hereby adopts and recommends that the Navajo Nation Council authorize the release of $2 Million from the Navajo Nation Tax Administration Suspense Fund and appropriate $240,000 for deposit into the Navajo Nation Permanent Trust Fund, $40,000 for deposit into the Navajo Nation Land Acquisition Trust Fund and $1,720,000 for the Navajo Nation Operating Budget.

5. The Budget and Finance Committee of the Navajo Nation Council hereby recommends that the Navajo Nation Council appropriate the following for Navajo Nation Special Revenue Funds and Fiduciary Funds for the various designated programs and/or entities as provided in the attached Navajo Nation operating budgets:

a.	Scholarship Trust - Graduates	$ 1,300,000
b.	Scholarship Trust - Medical	$ 70,000
c.	1982 Claims Scholarship	$ 925,000
d.	1986 Vocational Education Trust	$ 302,900
e.	NECA Trust Funds	$ 61,020
f.	1986 Handicapped Trust	$ 600,000
g.	1982 & 1986 Claims - Chapter	$ 3,200,000
h.	1986 Senior Citizens Fund	$ 460,000
i.	Permanent Fund	$ 2,422,000
j.	Retirement Fund	$ 4,300,000
k.	Nihibeeso 401 (k) Savings Fund	$ 140,000
l.	Navajo Tourism Fund	$ 2,000,000
m.	Worker's Compensation	$ 1,000,000
	Total:	$16,780,920

6. The Budget and Finance Committee of the Navajo Nation Council hereby adopts and recommends to the Navajo Nation Council the approval of the Fiscal Year 1999 Operating Budget for the Navajo Nation in the total amount of $333,773,792 as set forth herein and referenced as Attachment "B", of which $89,784,000 is in General Funds; $13,000,000 is in Indirect Cost Credit; $21,610,654 is in Revolving Funds; $19,080,920 is in Other Tribal Funds; $1,720,000 released from the Tax Administration Suspend Fund, $3,585,907 in Undesignated Reserve Fund, and $183,217,867 is in Federal/State/Private Funds for the Navajo Nation and the summaries among the three (3) Branches are as follows:

a. The Budget and Finance Committee of the Navajo Nation Council hereby adopts and recommends to the Navajo Nation Council the approval of the Fiscal Year 1999 Operating Budget for the Legislative Branch of the Navajo Nation in the total amount of $17,671,343 as set forth herein and referenced as Attachment "C", of which $16,305,672 is in General Funds; $1,195,235 is in Indirect Cost Credit; $148,554 release from Tax Administration Suspense Fund; and $21,882 is in Federal/State/Private Funds for the Navajo Nation Council, various standing committees, commissions, programs, offices, departments and activities within the Legislative Branch.

b. The Budget and Finance Committee of the Navajo Nation Council hereby adopts and recommends to the Navajo Nation Council the approval of the Fiscal Year 1999 Operating Budget for the Judicial Branch of the Navajo Nation in the total amount of $4,742,538 as set forth herein and referenced as Attachment "D" of which $4,483,813 is in General Funds; $18,749 is Indirect Cost Credit; and $258,725 released from the Tax Administration Suspense Fund for the various programs, offices, departments and activities within the Judicial Branch.

c. The Budget and Finance Committee of the Navajo Nation Council hereby adopts and recommends to the Navajo Nation Council the approval of the Fiscal Year 1999 Operating Budget for the Executive Branch of the Navajo Nation in the total amount of $310,202,974 as set forth herein and attached as Attachment "E", of which $68,994,515 is in General Funds; $11,786,016 is in Indirect Cost Credit; $1,312,721 released from the Tax Administration Suspense Fund; $3,585,907 in Undesignated Reserve Fund; $21,610,654 is in Revolving Funds; $19,080,920 is in Other Tribal Funds and $183,832,241 is in Federal/State/ Private Funds for the various Divisions/Offices, departments, programs and activities within the Executive Branch.

7. The Budget and Finance Committee of the Navajo Nation Council further recommends that the Navajo Nation Council adopt the following definition of "Condition of Appropriation or Expenditure" and adopt the Condition of Appropriation or Expenditure for the Fiscal Year 1999 Operating Budget attached hereto as Attachment "F" for the purposes of the Navajo Nation Council budget resolution:

Condition of Appropriation or Expenditure: A specific legal condition precedent to the expenditure of funds placed upon an appropriation by majority vote of the votes cast by the Navajo Nation Council at the time the appropriation is finally adopted by passage of the main motion. Funds appropriated by the Navajo Nation Council may not be lawfully expended unless the condition of appropriation is met. It shall be the responsibility of the Controller of the Navajo Nation to ensure that funds are expended in accordance with the conditions placed on the appropriation.

8. The Budget and Finance Committee of the Navajo Nation Council further recommends that the Navajo Nation Council adopt the following definition of "Legislative Concern" and adopt the Legislative Concerns for the Fiscal Year 1999 Operating Budget attached hereto as Attachment "G" for the purposes of the Navajo Nation Council budget resolution:

> Legislative Concerns: A comment, directive or recommendation made by the Navajo Nation Council, by virtue of its legislative oversight authority and pursuant to its authority as the governing body of the Navajo Nation, raising an issue of concern with respect to the internal functioning of the three Branches. Such concerns are advisory in nature, and do not create legal conditions precedent to the expenditure of appropriated funds. In order for a particular legislative concern to be appended to the Fiscal Year 1999 budget resolution, it must be voted upon and adopted by a majority of the Navajo Nation Council. Legislative Concerns which are not adopted will not be appended to the Fiscal Year 1999 budget resolution, but will be referred to the appropriate Branch Chief in memorandum form by the Speaker of the Navajo Nation Council.

9. The Budget and Finance Committee of the Navajo Nation Council hereby adopts and recommends that the Navajo Nation Council carryover unexpended Fiscal Year 1999 General Fund budgets into Fiscal Year 1999 for the Navajo Nation Solid Waste Management Program in the amount of $440,797, the Navajo Nation TANF Program in the amount of $1,280,498 and Capital Improvement Projects in the amount of $3,328,711; the Capital Improvement Projects remaining balances are attached hereto as Exhibit "H".

10. The Budget and Finance Committee of the Navajo Nation Council further recommends that for purposes of accounting for payroll and making payments to employees only Fiscal Year 1998 will end on September 25, 1998 and Fiscal Year 1999 will begin on September 28, 1998 and continue for 26 pay periods. All Branch Personnel Offices are directed to ensure that all RIF's required b the Fiscal Year 1999 Budget shall be effective September 25, 1998 and notices be issued consistent with the September 25, 1998 date to ensure proper advance notice to the effected employees.

11. The Budget and Finance Committee of the Navajo Nation Council further recommends that the Navajo Nation Council waive Resolutions CS-45-84 and CMA-25-95 for the appropriations from the Navajo Nation Undesignated Reserves.

12. The Budget and Finance Committee of the Navajo Nation Council further recommends that the Navajo Nation Council direct that the adoption of the Navajo Nation Fiscal Year 1999 Operating Budget not waive any applicable Navajo Nation or other laws, other than specified in this Resolution.

CERTIFICATION

I hereby certify that the foregoing resolution was duly considered by the Budget and Finance Committee of the Navajo Nation Council at a duly called meeting at Window Rock, Navajo Nation (Arizona), at which a quorum was present and that same was passed by a vote of 5 in favor, 0 opposed and 0 abstained, this 28th day of August 1998.

Chairperson
Budget and Finance Committee

Motion: Victor Joe, Jr.
Second: Kelly Wood Harvey

CAPITAL IMPROVEMENT PROJECTS

AGENCY SUMMARY SHEET

AGENCY		TOTAL APPROP.	FUND EXPENDED	ENCUMBER	BALANCE
CHINLE		$3,550,234	$2,544,032	$282,708	$723,494
EASTERN		3,284,006	2,763,822	46,046	474,138
FORT DEFIANCE		5,259,775	3,835,273	291,785	1,132,717
SHIPROCK		3,712,541	3,055,686	385,318	271,537
WESTERN		3,273,067	2,657,286	27,698	588,083
NAV. NATION		1,189,012	998,521	51,749	138,742
	GRAND TOTAL:	**$20,268,635**	**$15,854,620**	**$1,085,304**	**$3,328,711**

CAPITAL IMPROVEMENT PROJECTS

SUMMARY SHEET

CHINLE AGENCY CHAPTERS

CHAPTER	TOTAL APPROP.	FUND EXPENDED	ENCUMBER	BALANCE
Black Mesa	$832,000	$602,557	$0	$229,443
Burntcorn	160,000	155,753	0	$4,247
Chinle	60,333	42,068	17,529	$736
Forest Lake	51,892	26,593	0	$25,299
Hardrock	46,141	45,991	0	$150
Lukachuaki	361,588	255,897	52	$105,639
Many Farms	284,825	283,725	405	$695
Nazlini	255,342	250,820	882	$3,640
Pinon	2,682	0	0	$2,682
Rough Rock	399,583	50,250	233,333	$116,000
Round Rock	543,214	316,345	0	$226,869
Tachee/Blue Gap	176,667	175,969	0	$698
Tsaile	27,614	21,828	0	$5,786
Tselani/Cottonwood	126,353	111,286	14,320	$747
Whippoorwill	222,000	204,950	16,187	$863
CHINLE TOTAL:	$3,550,234	$2,544,032	$282,708	$723,494

EASTERN AGENCY CHAPTERS

CHAPTER	TOTAL APPROP.	FUND EXPENDED	ENCUMBER	BALANCE
Becenti	$27,233	$3,527	$9,013	$14,693
Breadsprings	33,500	29,176	0	$4,324
Canoncito	125,000	124,932	0	$68
Chichiltah	20,000	13,000	7,000	$0
Church Rock	88,476	86,636	0	$1,840
Counselor	356,252	355,641	0	$611
Crownpoint	168,994	100,596	0	$68,398
Huerfano	125,205	114,538	6,630	$4,037
Iyanbito	175,855	0	0	$175,855
Littlewater	102,165	83,944	12,000	$6,221
Manuelito	20,000	2,482	0	$17,518
Nageezi	25,000	23,881	0	$1,119
Nahodishgish	50,000	48,607	0	$1,393
Ojo Encino	370,000	367,896	0	$2,104
Pinedale	473,039	345,797	47	$127,195
Ramah	163,840	158,869	0	$4,971
Red Rock	185,000	169,572	0	$15,428
Rock Springs	184,000	194,980	2,632	($13,612)
Smith Lake	204,664	170,197	2,724	$31,743
Standing Rock	52,250	51,869	0	$381
Thoreau	135,200	134,394	0	$806
Torreon	6,000	0	6,000	$0
Tsayatoh	30,000	29,852	0	$148
White Rock	17,000	13,471	0	$3,529
Whitehorse Lake	145,333	139,965	0	$5,368
EASTERN TOTAL:	$3,284,006	$2,763,822	$46,046	$474,138

SUMMARY SHEET

FT. DEFIANCE AGENCY CHAPTERS

CHAPTER	TOTAL APPROP.	FUND EXPENDED	ENCUMBER	BALANCE
Cornfield	$230,000	$156,583	$0	$73,417
Coyote Canyon	517,673	292,145	3,006	$222,522
Crystal	100,000	99,565	0	$435
Dilcon	408,598	312,359	26,002	$70,237
District 7	37,000	25,553	0	$11,447
Ft. Defiance	1,032,447	764,911	0	$267,536
Ganado	171,000	128,099	3,581	$39,320
Indian Wells	56,829	1,211	40,000	$15,618
Jeddito	7,019	0	0	$7,019
Kinlichee	103,848	103,848	0	$0
Klagetoh	98,000	83,521	0	$14,479
Low Mountain	305,680	290,041	11,978	$3,661
Lower Greasewood	207,728	194,227	277	$13,224
Lupton	151,992	151,053	0	$939
Mexican Springs	267,178	263,196	0	$3,982
Nahatadzil	43,333	0	0	$43,333
Naschitti	167,649	137,169	0	$30,480
Oak Springs	460,415	375,549	0	$84,866
Rock Point	100,500	99,613	0	$887
Steamboat	198,333	174,827	257	$23,249
Teesto	85,667	17,212	65,165	$3,290
Tohatchi	300,000	121,107	141,167	$37,726
Whitecone	158,886	43,484	352	$115,050
Wide Ruins	50,000	0	0	$50,000
FT. DEFIANCE TOTAL:	$5,259,775	$3,835,273	$291,785	$1,132,717

SHIPROCK AGENCY CHAPTERS

CHAPTER	TOTAL APPROP.	FUND EXPENDED	ENCUMBER	BALANCE
Aneth	$86,212	$64,305	$0	$21,907
Blue Mesa	30,000	12,450	0	$17,550
Burnham	70,000	69,650	0	$350
Cove	155,676	112,129	0	$43,547
Hogback	525,150	520,478	1,045	$3,627
Kayenta	56,000	29,024	26,976	$0
Mexican Water	157,200	151,395	0	$5,805
Nenahnezad	235,979	208,894	27,085	$0
Newcomb	182,000	181,421	0	$579
Red Mesa	58,000	54,127	0	$3,873
Red Valley	475,500	462,755	643	$12,102
Rock Point	48,000	46,945	0	$1,055
San Juan	52,885	22,332	0	$30,553
Sheepsprings	215,000	203,271	0	$6,540
Shiprock	346,729	63,310	265,781	$17,638
Sweetwater	300,000	291,005	0	$8,995
TeecNosPos	106,239	80,619	0	$25,620
Two Grey Hills	406,509	277,511	58,599	$70,399
Upper Fruitland	205,462	204,065	0	$1,397
SHIPROCK TOTAL:	$3,712,541	$3,055,686	$380,129	$271,537

CAPITAL IMPROVEMENT PROJECTS

SUMMARY SHEET

WESTERN AGENCY CHAPTERS

CHAPTER	TOTAL APPROP.	FUND EXPEND( )	ENCUMBER	BALANCE
Birdsprings	$20,333	$3,680	$4,653	$12,000
Bittersprings	14,000	13,696	0	$304
Cameron	510,000	469,000	0	$41,000
Coppermine	129,333	128,043	0	$1,290
Dennehotso	58,000	55,186	502	$2,312
Kaibeto	223,534	153,176	501	$69,857
Kayenta	748,377	662,460	13,400	$72,517
Leupp	70,833	60,401	0	$10,432
Navajo Mountain.	108,000	80,386	7,700	$19,914
Oljato	84,500	81,252	1,250	$1,998
Red Lake #1	90,000	89,924	0	$76
Shonto	53,443	49,972	0	$3,471
Tolani Lake	29,110	15,096	0	$14,014
Tonalea	152,000	90,984	194	$60,822
Tuba City	1,039,604	759,216	0	$280,388
WESTERN TOTAL:	$3,331,067	$2,712,472	$28,200	$590,395

NAVAJO NATION

CHAPTER	TOTAL APPROP.	FUND EXPENDED	ENCUMBER	BALANCE
CIP Pool Acct	$96,340	$0	$0	$96,340
CIP/CDBG Pool Acct	533	0	0	$533
Navajo Nation	747,139	631,841	9,104	$5,088
Tribal Peaks Ranch	345,000	265,574	42,645	$36,781
NAVAJO NATION TOTAL:	$1,189,012	$897,415	$51,749	$138,742

EXHIBIT "J"

Navajo Nation Fiscal Year 1999
General Funds Carried Over from Fiscal Year 1998
to Fiscal Year 1999

The Navajo Nation Council authorized and approved the carry over of unexpended Fiscal Year 1998 General Fund budgets into Fiscal Year 1999 for the Navajo Nation Programs listed below so that their Fiscal Year 1998 General Funds shall not lapse on September 30, 1998.

1. Chapter Scholarship funds and placed the carryover funds into the individual chapter accounts in the Legislative Branch.
2. Chapter Claims funds and placed the carryover funds into the individual chapter accounts in the Legislative Branch.
3. Public Employment Program of the Division of Human Resources.
4. Navajo Housing Services Burnout Program of the Division of Community Development.
5. Government Services Committee of the Navajo Nation Council.
6. Budget and Finance Committee of the Navajo Nation Council.
7. Education Committee of the Navajo Nation Council.
8. Public Safety Committee of the Navajo Nation Council.
9. Resources Committee of the Navajo Nation Council.
10. Ethics and Rules Committee of the Navajo Nation Council.
11. Judiciary Committee of the Navajo Nation Council.
12. Economic Development Committee of the Navajo Nation Council.
13. Health and Social Services Committee of the Navajo Nation Council.
14. Human Services Committee of the Navajo Nation Council.
15. Transportation and Community Development Committee of the Navajo Nation Council.
16. Intergovernmental Relations Committee of the Navajo Nation Council.
17. The Navajo Nation Council.
18. Agency Councils of the Legislative Branch.
19. The Office of the Speaker of the Legislative Branch.
20. Navajo Election Administration of the Legislative Branch.
21. Office of Legislative Services of the Legislative Branch.

DOCKETED
May 25, 1999

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD

'99 MAY 27 P4:26

OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

In the Matter of	)	
	)	
HYDRO RESOURCES, INC.	)	Docket No. 40-8968-ML
(2929 Coors Road, Suite 101	)	ASLBP No. 95-706-01-ML
Albuquerque, NM 87120)	)	
	)	

CERTIFICATE OF SERVICE

I hereby certify that on May 25, 1999 I caused to be served copies of:

INTERVENORS' JOINT RESPONSE TO HRI'S AND THE NRC STAFF'S RESPONSES TO THE PRESIDING OFFICER'S APRIL 21, 1999 MEMORANDUM AND ORDER (QUESTIONS)

upon the following persons by U.S. mail, first class, and in accordance with the requirements of 10 C.F.R. §2.712. Service was also made by electronic mail to the parties marked below by an asterisk. The envelopes for first class mail service were addressed as follows:

Office of the Secretary
U.S. Nuclear Regulatory Commission*
Washington, D.C. 20555-0001
Attn: Rulemakings and Adjudications Staff

Peter B. Bloch*
Administrative Judge
Atomic Safety and Licensing Board
Mail Stop - T-3 F23
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Mitzi Young*
John T. Hull*
Office of General Counsel
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Office of Commission Appellate Adjudication
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Robin Brett
Administrative Judge
Special Assistant
U.S. Geological Survey
917 National Center
Reston, VA 20192

Thomas Murphy*
Administrative Judge
Special Assistant
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Diane Curran*
HARMON, CURRAN, SPIELBERG & EISENBERG, LLP
Suite 430
1726 "M" Street, N.W.
Washington, DC 20009

Jep Hill, Esq.
Jep Hill & Associates
P.O. Box 2254
Austin, TX 78768

Mitchell Capitan
ENDAUM
P.O. Box 471
Crownpoint, N.M. 77313

Roderick Ventura
Samuel D. Gollis
DNA - People's Legal Services, Inc.*
P.O. Box 306
Window Rock, AZ 86515

Anthony J. Thompson
Frederick Phillips
David Lashway
SHAW, PITTMAN, POTTS & TROWBRIDGE*
2300 "N" Street, N.W.
Washington, D.C. 20037-1128

William Paul Robinson
Chris Shuey
Southwest Research and Information Center*
P.O. Box 4524
Albuquerque, N.M. 87106

Levon Henry, Attorney General
Steven J. Bloxham, Esq.
Navajo Nation Department of Justice
P.O. Box 1020
Window Rock, AZ 86515

Dated at Santa Fe, New Mexico
May 25, 1999.

Douglas Meiklejohn